The Use of Electronic Mind Maps to Develop EFL Students' Vocabulary

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https://doi.org/10.54855/paic.24610

Received: 15/09/2024 Revision: 06/11/2024 Accepted: 07/11/2024 Online: 08/11/2024

ABSTRACT

These days, the advancement of technology allows mind map creation on mobile apps or online platforms, which saves time and creates enjoyment for users. Literature indicates that electronic mind maps positively affect second language learning in different aspects. With the use of Coggle – an online mind map creator, this study aimed to explore the influence of electronic mind maps on the English vocabulary of EFL students. Thirty-six students of non-English majors participated in this one-group pretest-post-test design pre-experimental research, which lasted ten weeks. The data collected from pre-test, post-test, and questionnaire were analyzed quantitatively by SPSS. The results revealed that electronic mind maps significantly increased the students' vocabulary and developed their autonomous learning. It is suggested that electronic mind maps should be used more in the future to help EFL learners develop their language skills.

Keywords: mind map, vocabulary, vocabulary knowledge scale, autonomous learning

Introduction

Because of vocabulary shortages, language learners can face numerous difficulties communicating in target languages. Very little information can be conveyed with no grammar, but no information can be conveyed with no vocabulary. The traditional methods of learning vocabulary, such as remembering long lines of new words, were revealed to be ineffective and boring. Therefore, new approaches to teaching and learning vocabulary are introduced to increase the effectiveness of vocabulary acquisition. One of the methods that is gaining attention is mind mapping, which helps develop the brain's memory through text and graphics (Wu & Zheng, 2023). When learning English, it is essential to have a solid vocabulary knowledge of the meanings and the use of words in different contexts. Studies indicate that using mind maps helps increase English learners' vocabulary knowledge and recommend using mind maps more in both in and out-of-class activities (Al Shdaifat et al.,2019; Kord et al.,2022).

Thai Nguyen University of Education is a northern part of Vietnam university responsible for educating pre-service teachers in all subjects. English is considered one of the indispensable skills of 21st-century teachers and has received a wealth of attention from the University's

CITATION | Tran, T. N. P., Ngo, T. B. N., & Nguyen, T. H. P. (2024). The Use of Electronic Mind Maps to Develop EFL Students' Vocabulary. *Proceedings of the AsiaCALL International Conference*, 6, 133-143. ISSN: 2833-6836, ISBN: 979-8-9870112-6-3. DOI: https://doi.org/10.54855/paic.24610

lecturers and managers. However, the level of English proficiency of students is relatively low. One of the reasons for students' low English level is that they possess very little vocabulary. Regular vocabulary tasks, additional e-learning instructions from lecturers, and frequent formative assessments are not effective enough to help students gain much of the required vocabulary. Finding a learning method to help students increase their knowledge of English vocabulary is crucial. It is the foundation for developing other English skills and helps students reach the required English level of 21st-century teachers.

The advancement of technology allows free access to mind map creators, which have proven to be easy to use and help save much time (Alba, 2020). Studies also indicate that using mind maps and electronic mind maps helps increase vocabulary recall and retention (Al Shdaifat et al., 2019; Kord, 2022; Duyen, 2020). It can be seen from the literature that little research investigates the effects of electronic mind maps on different aspects of vocabulary, which is not only the meaning of words. In addition, Alba (2022) concluded that electronic mind maps helped improve students' autonomy; he suggested more studies should be conducted to examine the influence of electronic mind maps on students' autonomy at different levels.

This study aims to determine if using Electronic mind maps helps increase the vocabulary knowledge of students at Thai Nguyen University of Education and examine the influence of using electronic mind maps on students' autonomous learning.

The study's findings could contribute to the existing research gaps and suggest an effective method of teaching vocabulary to English lecturers and students at Thai Nguyen University of Education and other English teachers and learners.

Literature review

Vocabulary

The most popular vocabulary knowledge includes productive and receptive; productive refers to the vocabulary used in speaking and writing, and receptive refers to understanding the meaning and form of words in reading and listening (Al Shdaifat, 2019). The research of receptive and productive knowledge must be in conjunction with other dimensions of vocabulary to fully evaluate the learner's comprehension of target words. Henriksen (1999) introduced three dimensions of vocabulary knowledge: partial-precise, depth of knowledge, and receptive-productive, which is accepted to match with different dimensions developed by other scholars (Zhong, 2011). The partial-precise dimension is the ability to translate a word into an individual's mother tongue; word cognition tasks can test this dimension; in this dimension, the learner might or may not know the word's meaning. The depth of knowledge is the inferential meanings and the relations to other words of a lexical item, including synonyms, antonyms, hyponymy, and collocations. The third dimension is receptive-productive, which is the "ability to use words in comprehension and production" (Henriksen, 1999, p.307).

In order to assess the vocabulary knowledge of learners, some tools have been developed to cover all the dimensions of words. The Vocabulary Recognition Task is developed to evaluate content areas that combine self-reported and performed knowledge; this assessment can test the knowledge of related words and the ability to read and divide words into topics. Vocabulary Assessment Magazine specializes in measuring students' understanding of science texts; this assessment has two main aims. The first one, with open-ended questions, tests students' ability to summarise, make questions, and use the text to illustrate knowledge, and the second one tests the science knowledge ranges. The Vocabulary Knowledge Scale is a self-report assessment

with formatted answers indicating the learners' knowledge of each word. The scoring is designed into five categories, including the learner has seen the word or not, the learner has seen the word but does not know the meaning, the learner has seen the word but is not sure about the meaning, the learner knows the word, and the last level is the learner can use the word in sentences (Dougherty Stahl, 2010). The Vocabulary Knowledge Scale aims to record the knowledge of new words from reading texts in a short time through 5-scale indicators, which are large enough to present the vocabulary acquisition but small enough to show the changes in the knowledge during the limited time of instruction (Anthony, 2009).

Regarding the ability to evaluate the three dimensions of the scale, it could be seen that the Vocabulary Knowledge Scale is more suitable to test the dimensions, specifically the partial-precise is evaluated by the recognition of a word (having seen the word before), and the recognition of a word without knowing the meaning (having seen the word before but not knowing the meaning). The translation and synonyms of the word test the depth of knowledge. The receptive-productive knowledge is examined by the ability to use words in sentences. However, the sense of depth in the three dimensions of vocabulary is larger than the indicators of the scale (Henriksen, 1999). Therefore, in this study, in addition to the translation and vocabulary, the depth is also examined by antonyms, hyponymy, and collocations of words.

Mind maps

The mind map was first introduced in the 1970s and was a combination of words, images, and colors presented in a graphic manner (Luangkrajang, 2022). In latter definitions, the description and function of mind maps are more precise defined as they are the diagrams that present the connection of ideas or information (presented as branches) to a topic or keyword (in the center) by connecting lines; different pictures, colors, and shapes are used to highlight the main thoughts and facts (Luangkrajang, 2022; Al Shdaifat et al., 2019; Meirbekov, 2022).

Mind maps can be used in education for different purposes, such as organizing information, planning thoughts, brainstorming ideas, and reviewing the whole content of a topic (Luangkrajang, 2022). Mind maps promote students' prior knowledge and organize vocabulary in foreign language instruction. Before introducing new words, it is essential to repeat the learned words because a large amount of information received every day may cause the forgetting of learned words (Meirbekov, 2022). Mind maps can link the learners' previous and new vocabulary. Mind maps' visual, organizational, and radial traits enable them to function as memory tools for vocabulary learning. In addition, the visuality of mind maps can balance the brain's work and facilitate the link between old and new information, maximizing vocabulary memory (Duyen, 2020). Besides the facilitation of memory, mind maps can meet the requirements of all types of learners. Three types of learners are determined as the target audience in every classroom. Learners learn in their best way when they see materials, learners who learn when they listen, and learners who learn by moving or using their hands. Mind maps match visual and kinetic learners when they can convert texts to visual depictions by drawing and writing.

Several studies on using mind maps in vocabulary learning (Sari et al., 2023) concluded that mind mapping is a powerful tool to motivate English vocabulary learning. Mind maps have also proved to be effective in developing the vocabulary recall and retention of English as a second language students in a study conducted by (Feng et al., 2023). Meirbekov's (2022) paper confirmed the effectiveness of mind maps in developing students' English vocabulary and increasing their creativity and motivation.

Different structures and types of mind maps can be used for specific purposes. Wu & Zheng

(2023) introduced three types of mind maps for vocabulary learning: situational maps, synonyms/antonyms maps, and roots and affix maps. Situational maps allow the creation of an overview of words related to a specific context or topic. Synonyms/antonyms maps can compare and distinguish words. Root and affix maps help to see the components and origins of words. He concluded that combining three types of maps promotes long-term and short-term memory.

Electronic mind maps

Mind maps are paper-based, and using pens and colors creates a connection between ideas. Recently, the advancement of technology allowed the introduction of mind-mapping software and websites, which can transform the classroom into a cheerful learning environment and save much time (Feng et al., 2023; Al Shdaifat, 2019). Electronic mind maps have proven to be effective in improving the learning outcomes of learners in the process of learning vocabulary and surpassing hand-written mind maps in certain aspects. Al Shdaifat (2019) had a study investigating the influence of electronic mind maps on students' English vocabulary and found that the use of electronic mind maps is easier, faster, and more attractive to students; in addition, students revealed to improve vocabulary in four sub-skills which are, generalization (the ability to define words), application (the ability to select a suitable use of words), breadth (the knowledge of multiple meanings and synonyms of words), and precision (the ability to use a word correctly in contexts). Kord et al. (2022) confirmed electronic mind maps' effectiveness in activating students' ability to define words.

In modern education, teachers must adapt software that meets their teaching objectives and select the suitable tool to bring students interest and motivation (Al Shdaifat, 2019; Tu, 2022; Vu, 2022). Although studies indicated the effectiveness of using electronic mind maps in vocabulary learning, little research suggested specific electronic mindmap-creating tools for vocabulary education. This study examines the use of Coggle, an online platform specializing in creating mind maps, to evaluate its effectiveness in vocabulary acquisition.

Coggle is one of the first websites to allow graphic communication through mind maps (Premchandran & Chalamayya, 2024). With its ease of use, this website can promote easy and free access for users regardless of time and location; users can create their mind maps or use the available mind maps in the gallery (Arulchelvan, 2019). Users can easily add branches of the core concept by clicking on the 'add' symbol. The users can choose the map colour and add links, images, and icons to make the maps of their style. The website allows users to share maps with other users by sending invitations through email; therefore, many users can work on the same map simultaneously. The website allows the use and presentation of files online or by downloading them as files. Besides the convenience and ease of use, Coggle has improved the critical reading and thinking of learners who study English for specific purposes (Khatib & Zaidoune, 2024).

Autonomous learning

In a study on mind map software and learning vocabulary, Alba (2022) suggested that applying mind mapping software can build up autonomy for learners in making their mind maps. Sa'adah and Wahyuningsih (2024) also confirmed that mind maps can promote autonomous learning. Autonomous learning can be divided into three aspects, including cognitive which is achieved by the process of reading, note-taking, and remembering; metacognitive can be mastered through the collection of data, self-supervision, planning the learning, evaluation of the learning process, arranging learning materials; social mediation is demonstrated through relaxed behavior in learning, forming rules in group work, cooperating with other students,

communicating effectively, and helping other students to evaluate their work. Students who learn autonomously do not ignore the role of classroom learning; they consider the classroom and lecturers to be supportive sources of their autonomous learning (Zulaihah & Harida, 2017).

Research Questions

In order to fulfill the purposes of the study, the research questions are listed as follows:

1. To what extent does using electronic mind maps influence students' vocabulary knowledge at Thai Nguyen University of Education?

2. How does using electronic mind maps affect students' autonomous learning at Thai Nguyen University of Education?

From the research questions, the hypotheses of the study are as follows:

H1: Electronic mind maps significantly increase Thai Nguyen University of Education students' vocabulary knowledge.

H2: Students had a high level of autonomous learning when using mind maps to learn English vocabulary.

Methods

Pedagogical Setting & Participants

The participants were 36 students from different Thai Nguyen University of Education majors, including 24 females and 12 males. They were joining the English 3 course, which is one of three compulsory English courses at the University. Their performance in the English 2 course (the pre-course of English 2) was low; all had a final score below 4.0.

Design of the Study

The mind maps were used in the course's reading section because vocabulary relates to reading (Al Shdaifat, 2019). The course book was Life A2-B1; in this course, students studied from units 9 to 12, which covered the topics of holidays, products, history, and nature. Before the reading lessons, the students were asked to draw their mind maps using Coggle at home. In this study, the mind maps for the vocabulary of Wu & Zheng (2023) were adapted to develop the maps for each topic; however, the participants were all non-English majors, so the roots and affix map is not used in this study because this type of map requiring a certain level of word knowledge to develop which is challenging for the participants of this study. Each week, students were asked to develop two mind maps. The first was a situational map, designed individually in Coggle; before the reading class, the teacher assigned the topic to students and encouraged them to link it with all the words they knew to create the mind map. The second one was a synonym/antonym map, a group work on Coggle; in addition to the synonyms and antonyms of words, the collocations and hyponymy were encouraged to be included in the maps. The synonym/antonym map was assigned as the homework, and students submitted it on Google Drive. The students were familiar with the types of mind maps they were required to develop and were instructed on how to use Coggle to draw maps in the first week of the study. Students were randomly chosen to present their situational mind maps in class as a pre-reading activity. Other students were asked to comment and advise on developing more branches for the presented maps. For the synonym/antonym mind maps, students were asked to visit the Google Drive folder and comment on other groups' work on FDP mind maps files. The total time of the study was ten weeks; before the time of the study, the allowance and acceptance

were asked from the University and students.

Data collection & analysis

In order to answer the first research question, the self-evaluated test was developed to measure the students' vocabulary. The test adapted the form of the Vocabulary Knowledge Scale to test three dimensions of vocabulary (Henriksen, 1999). The Vocabulary Knowledge Scale could not cover all the knowledge of depth that is proposed by (Anthony, 2009); therefore, at the fourth level of scale, rather than testing only the semantic aspects of words, the other aspects of depth defined by Henriksen (1999) including synonyms, antonyms, and collocations were added to fulfil the shortcoming of the Vocabulary Knowledge Scale. The test includes 50 target words and 10 distractors. The target words were selected from the reading texts that appeared in the coursebook of students during the intervention time. For each target word, there were five options to choose from, including I have not seen this word before (1 point), I have seen this word before but do not know the meaning (2 points), I have seen this word before and know its meaning (3 points), I know this word and know its meaning and its synonyms/antonyms/collocations (4 points), I know the word's meaning and its synonyms/antonyms/collocations and I can make sentence with this word (5 points). For the distractors, no points were given to any option. Therefore, the minimum score of the test was 50, and the test's maximum was 250. The test was used as the pre-test and the post-test of the study; in the post-test, the order of the words was changed.

In order to answer the second research question, the questionnaire was designed based on three aspects of autonomy learning, namely cognitive, metacognitive, and social mediation. The cognitive level had three items indicating the ability to identify and set the learning goals and perform activities to create mind maps on Coggle. The metacognitive level had three items, which explored the ability to plan, evaluate, and organize vocabulary learning and materials when using Coggle to create mind maps. The social mediation level included three items, indicating that the interaction with other students and evaluating others' work on Coggle were covered. The questionnaire was sent to 10 random students who were not majoring in English to ensure the items were easy to understand. After some revisions, the questionnaire was delivered to the participants at the end of the intervention to collect data for analysis. The 5-point Likert Scale is used for the questionnaire items with 1-never, 2-occasionally, 3-sometimes, 4-often, and 5-always. The mean value is interpreted based on the work of Alkharusi (2022), namely 1-1.80 refers to the very low level, 1.81-2.61 refers to the level, 3.43-4.23 refers to the moderate level, and 4.24-5.04 refers to the very high level. The questionnaire was converted into Google form and sent to the students at the end of the study. The Cronbach's Alpha was .089, indicating a high level for the questionnaire; therefore, further analysis was used for the collected data.

Results/Findings and discussion

The data collected from the tests and the questionnaire were analyzed using SPSS.

This study aims to investigate the hypothesis that using electronic mind maps significantly increases the vocabulary knowledge of the Thai Nguyen University of Education students. The mean and deviation of the pre-test and post-test were calculated. Besides, the paired sample test was used to estimate the difference between the scores of students in two tests. The results are presented in Table 1. Students' vocabulary knowledge increased after applying Coggle to build mind maps for learning English vocabulary. In the pre-test, the total score had Mean=82.97 (SD=11.73); this number grew up to 189.39 (SD=9.09) in the post-test; p=.000 <.05 and effect

size = 7.01, which indicated that the increase in the vocabulary knowledge of students was significant and the use of electronic mind maps had a large effect on students' vocabulary knowledge.

Table 1.

The statistical results of the tests

Paired Samples Statistics				Paired Samples Test	Paired Samples Effect Sizes
		Mean	Std. Deviation	Sig. (2-tailed)	Point Estimate Cohen's d
Vocabulary	Pre-test	82.97	11.73	.000	-7.01
	Post-test	189.39	9.09		
Scale 1	Pre-test	22.56	7.84	.000	2.88
	Post-test	.00	.00		
Scale 2	Pre-test	46.78	13.45	.000	3.10
	Post-test	5.39	2.23		
Scale 3	Pre-test	9.08	7.50	.000	-1.11
	Post-test	34.33	22.02		
Scale 4	Pre-test	2.33	3.22	.000	-4.46
	Post-test	118.56	26.59		
Scale 5	Pre-test	2. 22	4.70	.000	-1.76
	Post-test	31. 11	15.68		

In order to examine the influence of electronic mind maps on vocabulary dimensions, the same analysis was applied with five scales of the tests. In scale 1 and 2, the score of students significantly decreased from Mean=22.56 (SD=7.84) to 0.00 (SD=0), $p<.05$, d=2.88 and Mean=22.56 (SD=7.84) to 5.39 (SD=2.23), $p<.05$, d= 3.10; scale 2 and 3 revealed a different trend with a significant increase from Mean=9.08 (SD=7.50) to Mean=34.33 (SD=22.02),$p<.05$, d=1.11. These results implied that the number of words that students cannot recognize and cannot remember the meanings significantly decreased, and the number of words that students can recognize and remember the meaning significantly increased, which meant that the dimension of partial-precise had positive growth. On scale 4, there was a significant increase from mean=2.33 (4.46) to Mean=118.56 (SD=26.59), $p<.05$, d=4.46, which implied that the number of words that students know the meanings and related words (the depth of knowledge dimension) significantly increased. On a scale of 5, the score grew from Mean=2.22 (SD=4.70) to Mean =31.11 (SD=15.68), $p<.05$, d=1.74, which indicated that the number of words that students knew the meanings, related words, and could make sentences with had a significant increase (receptive-productive dimension).

The results from the test supported the hypothesis that the use of electronic mind maps significantly increased the vocabulary knowledge of the students. It is worth mentioning that the use of the mapping technique affected three dimensions of vocabulary knowledge, including partial-precise, depth of knowledge, and receptive-productive. This finding is in line with the conclusion of (Sari et al.,2023; Al Shdaifat et al., 2019; Kord et al., 2022; Alba, 2022) that the use of mind maps had positive effects on the vocabulary knowledge of students. This result could be explained by the fact that students had to read the text and detect the related vocabulary to build a mind map. They must link the words by different themes, which creates opportunities for students to see and think about the words many times, promoting the work of brains to remember the words better; therefore, the partial-precise scale is developed. In addition,

synonym/antonym maps required students to expand their work on one specific word to find the connection of the words with other related words, which insults the improvement in the dimension of depth knowledge. Knowing the meanings of words allows students to develop the ability to use words in sentences, which promotes the receptive-productive dimension.

The second hypothesis is that students had a high level of autonomous learning when using electronic mind maps to learn English vocabulary. The data from the questionnaire was analyzed using the mean and standard deviation and compared with the interpretation scale (Table 2). At the cognitive level, all the investigated items had means at a very high level, the overall Mean=4.50 (SD=.51), which indicated that the autonomous learning of students at this level is very high. Regarding the metacognitive level, Mean=4.40 (SD=.54) meant that students had a very high level. The only item that fell below the very high range was that students downloaded the files from the web and saved them in themes. At the social median level, the students had a very high level with Mean=4.50 (SD=.49). The overall autonomous learning of the students had Mean=4.47 (SD=.47), which supported the hypothesis. This finding is consistent with the conclusion of (Alba, 2022; Sa'adah & Wahyuningsih, 2024) that using mind-mapping techniques can give students autonomy in learning. These results can be explained by the fact that to draw a mind map, students have to follow specific steps involved in autonomous learning. At the cognitive level, students had to read the texts and look up related words to complete their theme-based maps. At the metacognitive level, which had a lower mean than the two other levels, the indicators were much more related to the self-control activities and less related to the requirement of the study setting; therefore, to some degree, it was not as high as other levels. The setting of the social mediation level, which asked students to draw mind maps in groups, is the reason for the high level of autonomous learning performance; to find agreement among members, students had to discuss and plan for group work. In addition, creating mind maps in this study is a home-based task that promotes students' autonomous learning.

Table 2.

The statistical results of the questionnaire

Cognitive	Mean	Std. Deviation
I read the texts to find words and related words to make mind maps on Coggle.	4.58	.50
I looked up the meanings of words and their related words to make mind maps on Coggle.	4.67	.48
I took notes of words and their related words to make mind maps on Coggle.	4.25	.81
Mean	4.50	.51
Metacognitive		
I planned time for vocabulary learning and made vocabulary mind maps with Coggle.	4.39	.73
I revisited Coggle to read my mind maps and make changes if necessary before class.	4.61	.60
I downloaded mind maps from Coggle and save them according to themes.	4.19	.82
Mean	4.40	.54
Social mediation		
I made comments and gave feedback on my group's mind maps created on Coggle.	4.69	.47
My group and I discussed finding the best links between words.	4.56	.56
My group and I had rules to work on Coggle to create vocabulary mind maps.	4.25	.77
Mean	4.50	.49
Overall	4.47	.47

In short, the findings of the study could be a reference for English teachers and students at Thai Nguyen University of Education and other educational institutions as an effective way of fostering students' vocabulary in three different dimensions, including partial-precise, depth of knowledge, and receptive-productive according to the definition of (Henriksen, 1999) and Anthony (2009) and motivate students' autonomous learning. In addition, researchers can refer to the study as concrete evidence of the positive influence of electronic mind maps on students' development of English vocabulary in different dimensions and the promotion of students' autonomous learning.

Conclusion

The study aims to investigate the influence of electronic mind maps on the vocabulary knowledge of the students and the level of autonomous learning of them when using mind maps to learn English vocabulary. The findings indicated that using mind maps helps develop students' vocabulary knowledge in all three invested dimensions, including partial precision, depth of knowledge, and receptive-productive. In addition, when using mind maps to learn vocabulary, students perform a high level of autonomous learning. However, the metacognitive level was lower than the cognitive and social mediation, but it was still at a very high level.

While the study's two hypotheses were supported, certain limitations were identified. The self-

reported nature of the tests and questionnaire could potentially introduce bias, leading to inaccurate evaluations. Furthermore, the items used to gauge students' autonomous learning may not encompass all relevant aspects. Therefore, future research should focus on developing more comprehensive tests with clear criteria and a broader range of indicators for autonomous learning.

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