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Concept Mapping for Improving Reading Comprehension in Second Language Education: A Systematic Review

Na Ta*
Universiti Putra Malaysia (UPM), Malaysia

Abu Bakar Razali
Universiti Putra Malaysia (UPM), Malaysia

Abstract. Reading is an essential learning tool for students to achieve academic and career success, and the ability to read also has a significant impact on students' lifelong learning. In the field of ESL/EFL reading teaching, concept mapping has attracted considerable attention as a technique that can be used. To enable researchers and teachers to understand the research focus and application trends of concept mapping in the teaching of ESL/EFL reading, this article provides a literature review of 33 studies published in peer-reviewed journals from 2012 to 2022 on the use of concept mapping in teaching reading comprehension for learners in diverse ESL/EFL contexts. It was found that concept mapping was primarily used and studied among ESL/EFL students at the undergraduate level, serving as an advanced organizer in the pre-reading stage, an instructional medium in the while-reading stage, and a summarizing and evaluation tool in the after-reading stage. It was also found that the application of Kit-Build concept mapping, either in a technology-supported learning environment or with a source connection function, seems to have a promising impact on reading comprehension. Based on these findings, suggestions are provided to ESL/EFL teachers and researchers for better implementation and future research of concept mapping.

Keywords: reading comprehension; concept mapping; Kit-Build concept mapping; technology-enhanced learning; hand-drawn concept mapping

1. Introduction

Reading plays a crucial role in students' personal and professional accomplishments and greatly influences their lifelong learning (Macaro, 2003). It has long been a significant focus of researchers and teaching practitioners to

* Corresponding author: *Abu Bakar Razali, abmr_bakar@upm.edu.my*

enhance the teaching of reading skills in the English as a Second Language (ESL) and English as a Foreign Language (EFL) teaching field. In this regard, concept mapping has attracted considerable interest as a technique to be used for teaching ESL/EFL reading.

Concept mapping involves the construction of graphical diagrams to organize textual information and represent meaningful connections among concepts within a text. It is important to distinguish concept maps from mind maps, because they have fundamental differences in terms of structure, focus, and application. A concept map consists of nodes or boxes representing concepts, connected by lines with arrows to indicate relationships and directions between concepts (Machado & Carvalho, 2020). In contrast, a mind map is made up of a central word or image connected to secondary concepts that radiate from the central idea as branches (Casco, 2009). Concept maps are formal and structured (Davies, 2011), and are typically used to display relationships among concepts, while mind maps are less formal and structured, and are often adopted by students for brainstorming or vocabulary learning.

Concept mapping was first developed at Cornell University by Novak in 1972 and has since been applied in science education for several decades to present the complex relationships between different scientific concepts. Over time, its application expanded to many other education areas, including social studies, language arts, and mathematics. In the field of teaching reading, it was firstly used in the teaching of first language (L1) reading comprehension (e.g., Chang et al., 2002; Liu & Lee, 2013; Oliver, 2009) and later for second language (L2) reading comprehension (e.g., Liu et al., 2010; Tajeddin & Tabatabaei, 2016). When it is used in reading instruction, it is intended to help students visualize their thinking processes and present their understanding of reading materials. In the ESL/EFL context, in particular, visually organizing and connecting ideas through concept maps help students grasp main concepts, identify relationships between ideas, and understand the overall structure and flow of a text (Pinandito et al., 2021). However, despite its evident benefits, concept mapping is not without challenges. Practical implementation brings forth issues such as identifying concepts and connections, time constraints, students' resistance to change, and software difficulties (Machado & Carvalho, 2020).

While studies have addressed the benefits and challenges of using concept mapping for reading instruction, few researchers have undertaken a systematic review and comprehensive synthesis of its true potential and implications. As a result, a significant gap persists in our understanding of the capabilities and consequences of employing concept mapping in reading pedagogy. This study sought to bridge this gap by presenting an inclusive literature review that examines studies published in peer-reviewed journals between 2012 and 2022, and delving into the multifaceted use of concept mapping for teaching reading comprehension to learners across diverse ESL/EFL contexts. The study aims to offer researchers and educators comprehensive insight into the research focus and application trends concerning concept maps in the realm of ESL/EFL reading instruction. Additionally, this article extends its contribution by providing

practical suggestions for ESL/EFL teachers to enhance the implementation of this technique in their teaching practice and by offering recommendations for researchers to conduct future research in this area.

2. Methods for Review of Literature

The author undertook a systematic literature review, which entailed identifying, selecting, analyzing, and synthesizing existing research studies to address the focal topic. In particular, an extensive exploration of pertinent literature was conducted across prominent academic databases, including Springer, ResearchGate, ScienceDirect, ERIC, Taylor & Francis, and Google Scholar, covering the time period from 2012 to 2022. The search was strategically performed using primary keywords ("Concept Mapping" OR "Concept Maps") AND ("Reading" OR "Reading Comprehension").

After removing duplicate articles, a total of 51 articles were obtained. To select relevant articles for the review, the inclusion criteria focused on (1) the use of concept mapping in teaching reading comprehension, and (2) the application of concept mapping in ESL/EFL contexts. Irrelevant articles were eliminated based on the following exclusion criteria: (1) concept maps used in L1 reading comprehension, (2) participants being native English speakers, (3) articles not distinguishing between concept maps and mind maps, (4) articles not written in English, (5) articles lacking specification of research method, research data, or research results, and (6) articles not focused on reading. As a result, 18 articles were removed, leaving 33 articles for analysis.

3. Results

Results of the review will be presented according to research focus in terms of participants, research designs, application of concept maps at different stages of ESL/EFL reading, as well as the effects of using concept maps for ESL/EFL reading comprehension.

3.1 Participants

As is shown in Table 1, the reviewed literature demonstrates a predominant focus on undergraduate students, with 14 studies conducted at this level. Subsequently, six studies concentrated on participants at the intermediate level, while five studies targeted senior high school students. Furthermore, three studies investigated participants at the primary level, two studies centered on those at the pre-intermediate level, and individual studies delved into the graduate level and adult participants in private language institutions. There was also one case that did not specify the participants' level.

Table 1: Participant Levels in Reviewed Studies

Participant Level	References
Undergraduate students	Alkhateeb et al, 2016a, 2016b; Andoko et al., 2019; Andoko et al., 2020; Asri & Andoko, 2019; Jaya & Latief, 2013; Lechuga et al., 2015; Liu, 2014; Lumontad et al., 2020; Nguyen & Pham, 2018; Phantharakphong & Pothitha, 2014; Rasyidah & Mardiansyah, 2015; Syafrizal, 2018; Trang, 2017

Intermediate learners	Alkhateeb et al., 2015; Davaribina & Asl, 2017; Khajavi & Ketabi, 2012; Rassaei, 2019; Riahi & Pourdana, 2017; Soleimani & Nabizadeh, 2012
Senior high school students	Hamedi et al., 2020；Kalhor & Shakibaei, 2012; Liu et al., 2019; Tajeddin & Tabatabaei, 2016; Usman et al., 2017
Primary school students	Chiang et al., 2016; Morfidi et al., 2018; Wilson & Kim, 2016
Pre-intermediate learners	Alibabaee et al., 2014; Tabatabaei & Khalili, 2014
Graduate students	Pinandito et al., 2021
Adult learners	Yousofi & Seidi, 2015
Not specified	Beydarani, 2015

As depicted in Table 2, these participants were from several EFL/ESL countries. Notably, 12 studies involved participants from Iran. Six studies involved participants from Indonesia, while five studies encompassed participants from Japan. Other studies involved participants from South Korea, Vietnam, Greece, Spain, the Philippines, Thailand, and mainland and Taiwan of China.

Table 2: Countries of Participants in Reviewed Studies

Countries	References
Iran	Alibabaee et al., 2014; Beydarani, 2015; Davaribina & Asl, 2017；Hamedi et al., 2020; Kalhor & Shakibaei, 2012; Khajavi & Ketabi, 2012; Rassaei, 2019; Riahi & Pourdana, 2017; Soleimani & Nabizadeh, 2012; Tabatabaei & Khalili, 2014; Tajeddin & Tabatabaei, 2016; Yousofi & Seidi, 2015
Indonesia	Andoko et al., 2020; Asri & Andoko, 2019; Jaya & Latief, 2013; Rasyidah & Mardiansyah, 2015; Syafrizal, 2018; Usman et al., 2017
Japan	Alkhateeb et al., 2015; Alkhateeb et al. 2016a, 2016b; Andoko et al., 2019; Pinandito et al., 2021
South Korea	Wilson & Kim, 2016
Vietnam	Nguyen & Pham, 2018; Trang, 2017
Greece	Morfidi et al., 2018
Spain	Lechuga et al., 2015
The Philippines	Lumontad et al., 2020
Thailand	Phantharakphong & Pothitha, 2014
Mainland and Taiwan of China	Chiang et al., 2016; Liu, 2014; Liu et al., 2019

3.2 Research Designs

In reviewing these articles, the authors observed the prevalent use of quantitative research designs, as indicated in Table 3. Of the studies included, 29 employed a true experimental or quasi-experimental research design. Among these, 21 studies adopted a control-group pretest-posttest design. Notably, no studies were identified that exclusively employed a pure qualitative design. Alternatively, two studies integrated interviews alongside experiments, creating a mixed-methods design. Certain studies embraced the action research method as their approach.

Table 3: Research Designs in Reviewed Studies

Research Designs	References
True Experimental/Quasi-Experimental Design	Alibabaee et al., 2014; Alkhateeb et al., 2015; Alkhateeb et al., 2016a, 2016b; Andoko et al., 2019; Andoko et al., 2020; Beydarani, 2015; Chiang et al., 2016; Davaribina & Asl, 2017; Hamedi et al., 2020; Kalhor & Shakibaei, 2012; Khajavi & Ketabi, 2012; Lechuga et al., 2015; Liu, 2014; Lumontad et al., 2020; Morfidi et al., 2018; Nguyen & Pham, 2018; Pinandito et al., 2021; Rassaei, 2019; Rasyidah & Mardiansyah, 2015; Riahi & Pourdana, 2017; Soleimani & Nabizadeh, 2012; Syafrizal, 2018; Tabatabaei & Khalili, 2014; Tajeddin & Tabatabaei, 2016; Trang, 2017; Usman et al., 2017; Wilson & Kim, 2016; Yousofi & Seidi, 2015
Pure Qualitative Design	None
Mixed-Methods Design	Liu et al., 2019; Phantharakphong & Pothitha, 2014
Action Research	Asri & Andoko, 2019; Jaya & Latief, 2013

3.3 Application of Concept Maps in Different Stages of ESL/EFL Reading

The application of the concept mapping technique can take various forms. As is shown in Table 4, in some studies, students were asked to draw a concept map using traditional pencil and paper. In contrast, other studies required students to employ software in a technology-supported environment to construct concept maps, especially with the use of Kit-Build concept mapping (refer to Alkhateeb et al., 2015; Alkhateeb et al., 2016a, 2016b; Chiang et al., 2016; Liu et al., 2019). In some cases, students were not required to draw concept maps on their own. Instead, expert-generated concept maps were used, in either the pre-reading stage (e.g., Hamedi et al., 2020; Tajeddin & Tabatabaei, 2016), the while-reading stage (e.g., Liu, 2014; Morfidi et al., 2018; Jaya & Latief, 2013), or the after-reading stage (e.g., Rassaei, 2019) of the reading process. Using concept mapping in different stages of reading meant it played distinct roles. In the pre-reading stage, concept maps functioned as advanced organizers. In the while-reading stage, concept maps could be seen as instructional tools and information media. When used in the after-reading stage, concept maps served the purpose of assessing students' reading comprehension of the texts or evaluating their understanding.

Table 4: Types of Concept Maps Employed in Reviewed Studies

Types of Concept Maps	References
Students drew concept maps by hand	Beydarani, 2015; Khajavi & Ketabi, 2012; Lechuga et al., 2015; Lumontad et al., 2020; Mardiansyah, 2015; Phantharakphong & Pothitha, 2014; Rasyidah & Mardiansyah, 2015; Riahi & Pourdana, 2017; Syafrizal, 2018; Tabatabaei & Khalili, 2014; Trang, 2017; Usman et al., 2017; Wilson & Kim, 2016; Yousofi & Seidi, 2015
Students generated concept maps with the aid of computers	Alkhateeb et al., 2015; Alkhateeb et al., 2016a, 2016b; Andoko et al., 2019; Andoko et al., 2020; Asri & Andoko, 2019; Chiang et al., 2016; Liu et

	al., 2019; Nguyen & Pham, 2018; Pinandito et al., 2021
Expert-generated concept maps were used	Hamedi et al., 2020; Jaya & Latief, 2013; Liu, 2014; Morfidi et al., 2018; Rassaei, 2019; Tajeddin & Tabatabaei, 2016
Both expert-generated and student-constructed concept maps were used	Alibabaee et al., 2014; Kalhor & Shakibaei, 2012; Soleimani & Nabizadeh, 2012

Some studies involved both teachers and students in concept map construction activities; for example, Soleimani and Nabizadeh (2012) not only asked students to create hand-drawn concept maps, but also required teachers to produce expert-generated concept maps for comparison. Alibabaee et al. (2014) compared teacher-constructed concept maps with a cooperative concept map learning strategy to assess their impact on EFL learners' reading comprehension and autonomy. Furthermore, some studies used concept maps in multiple stages of reading comprehension, as demonstrated by Kalhor and Shakibaei (2012). They not only used expert-generated concept maps during the while-reading and after-reading stages, but also asked students to draw their own concept maps after class. In this case, concept maps played multiple roles: as an instructional tool, teaching students how to specify the relationship between concepts and the main idea during the while-reading process; as a summarizing and reviewing tool during the after-reading stage; and, furthermore, as an evaluation tool for teachers to assess students' understanding of the reading texts after the reading process.

3.4 Effects of Concept Maps in ESL/EFL Reading Comprehension

According to the findings reported in these studies, the vast majority – 23 studies –demonstrated the immediate positive effects of concept mapping on reading comprehension (refer to Table 5). All these studies found that using concept maps contributed to various aspects of students' improvements in the reading process. Specifically, using concept mapping could help students activate and energize their prior linguistic and world knowledge (Kalhor & Shakibaei, 2012; Riahi & Pourdana, 2017), prompt students to link new information to previous knowledge, and gain a deeper understanding of the text (Khajavi & Ketabi, 2012; Lumontad et al., 2020; Tajeddin & Tabatabaei, 2016; Trang, 2017; Yousofi & Seidi, 2015), encourage students' active engagement and facilitate meaningful learning (Khajavi & Ketabi, 2012; Lumontad et al., 2020; Nguyen & Pham, 2018; Tabatabaei & Khalili, 2014; Trang, 2017; Soleimani & Nabizadeh, 2012), direct attention to critical information in the text and guide students in building internal connections among ideas (Riahi & Pourdana, 2017; Tajeddin & Tabatabaei, 2016), as well as promote the use of various reading strategies (Kalhor & Shakibaei, 2012; Rassaei, 2019; Trang, 2017; Usman et al., 2017) during the reading process.

Table 5: Impact of Concept Mapping on Reading Comprehension in Reviewed Studies

Findings	References
Positive effects of concept mapping	Alibabaee et al., 2014; Beydarani, 2015; Chiang et al., 2016; Davaribina & Asl, 2017; Hamedi et al., 2020; Jaya & Latief, 2013; Kalhor & Shakibaei, 2012; Khajavi & Ketabi, 2012; Liu et

	al., 2019; Lumontad et al., 2020; Morfidi et al., 2018; Nguyen & Pham, 2018; Phantharakphong & Pothitha, 2014; Rassaei, 2019; Rasyidah & Mardiansyah, 2015; Riahi & Pourdana, 2017; Soleimani & Nabizadeh, 2012; Syafrizal, 2018; Tabatabaei & Khalili, 2014; Tajeddin & Tabatabaei, 2016; Trang, 2017; Usman et al., 2017; Yousofi & Seidi, 2015
No or negative effects of concept mapping	Asri & Andoko, 2019; Lechuga et al., 2015; Wilson & Kim, 2016

Some other studies, however, had contrasting results. For example, Lechuga et al. (2015) found that the concept mapping technique was not as effective as retrieval practice in a learning test. Asri and Andoko (2019) found that concept mapping was not entirely successful for improving students' reading skills. Additionally, Wilson and Kim (2016) found that concept mapping did not significantly increase reading comprehension achievement.

Comparing the construction of a concept map under the two conditions of collaborative construction versus individual drawing, Alibabaee et al. (2014) found the collaborative concept mapping to be superior to individual concept mapping for improving reading comprehension, whereas Riahi and Pourdana (2017) claim there are no differences between the individual and collaborative conditions.

Meanwhile, among the studies that used Kit-Build concept mapping, or more popularly known as KB mapping, both Alkhateeb et al. (2105) and Alkhateeb et al. (2016a) demonstrated its effectiveness in delayed reading comprehension, though not in immediate reading comprehension, thereby highlighting the function of KB mapping in recalling and remembering information. To explain these results, Alkhateeb et al. (2016b) and Andoko et al. (2019) examined students' map construction processes to compare their mapping styles.

More recently, Andoko et al. (2020) improved KB mapping by adding a source connection function, and Pinandito et al. (2021) adopted an online collaborative learning environment, both allowing KB mapping to maximize its function in promoting reading comprehension in both delayed and immediate effects.

In addition to the effectiveness of concept mapping in different forms and conditions, researchers were interested in the influence of concept maps on other aspects of reading comprehension learning. For example, Riahi and Pourdana (2017) and Rassaei (2019) found that concept mapping was beneficial for students' use of reading strategies, especially the use of metacognitive reading strategies (Rassaei, 2019). Phantharakphong and Pothitha (2014), Tabatabaei and Khalili (2014), Trang (2017), Nguyen and Pham (2018), and Asri and Andoko (2019) focused on students' attitudes towards concept mapping, which were generally positive. The study of Liu (2014) examined the process of using the concept-mapping technique by analyzing students' eye movements during the reading process.

4. Discussion

The discussion is based on the results provided, and will consider participants, research design, research trends, and research findings, and will focus, in particular, on the effectiveness of concept mapping for ESL/EFL reading comprehension.

4.1 Participants and Research Design

Considering the reviewed literature, it is evident that concept mapping finds its most prominent application among undergraduate students, with a substantial 14 studies devoted to their exploration. Following this, intermediate-level and senior high school-level students come into focus, primarily in ESL/EFL countries such as Iran, Japan, and Indonesia. This underlines the potential viability of concept mapping as an educational tool spanning various tiers of instruction on a global spectrum. In contrast, investigations delving into other participant groups, such as those at the primary level, pre-intermediate level, and graduate level, were found to be infrequent. Notably, studies involving participants at junior high school level were not found in the reviewed literature. Consequently, future studies could concentrate on participants at different levels, particularly the junior high school level, in diverse ESL/EFL contexts.

Regarding research design, the studies reviewed overwhelmingly adopted a control-group pretest-posttest design, where one experimental group used concept mapping and one control group used conventional teaching methods for comparison. However, other studies included two experimental groups. These studies comprised one experimental group using concept mapping and another group using an alternative, other teaching method that was aimed to replace or enhance the use of concept mapping. For example, Morfidi et al. (2018) designed a study with two experimental groups, where one group was taught using digital text-based concept maps, while the other group used multimedia concept maps. Although no significant differences in learning outcomes were found between the two experimental groups in terms of effectiveness, it provides novel ideas for EFL/ESL teachers to incorporate the concept-mapping technique in different formats in the classroom. Similarly, Rassaei (2019) designed two experimental groups in his study to investigate the effects of guided concept mapping and concept map correction on ESL reading comprehension. The results indicate that both concept mapping techniques were effective in promoting participants' reading comprehension skills. Moreover, the experimental group, using a map correction strategy, demonstrated better performance than the experimental group that used guided concept mapping for enhancing reading comprehension. Another example is Soleimani and Nabizadeh's (2012) study, which used concept mapping under the two conditions, of learners either constructing concept maps or filling in the maps. The results showed that the group that filled in the maps outperformed the other experimental group and control group in terms of reading comprehension. Thus, both Rassaei (2019) and Soleimani and Nabizadeh (2012) provide teachers and researchers with more effective ways to incorporate concept maps in EFL/ESL reading instruction.

The design of a quantitative quasi-experiment or true experiment has the advantage of allowing teachers and researchers to observe the effectiveness of the concept mapping technique compared to regular teaching methods, and providing direct answers to different outcomes when applying concept mapping in various ways. However, the detailed process of implementing concept mapping, and the opinions and perspectives of the teachers and students involved in this process have not been fully discussed and emphasized, except for two studies that incorporated interview results to gain insights into student attitudes during the learning process. This indicates the need for more studies that employ qualitative or mixed methods, to go beyond focusing solely on the effectiveness of the results, and to unveil the process of using concept maps comprehensively. Gaining a comprehensive understanding of teachers' and students' experiences and attitudes, identifying the challenges and frustrations they face, and collecting their ideas and suggestions, are crucial for informing future implementation of concept mapping.

4.2 Research Trends and Effectiveness of Concept Mapping

The original approach to using concept mapping in the teaching of EFL/ESL reading comprehension is to ask students to draw concept maps using pencil and paper. However, the process of hand-drawn concept maps is often challenging and frustrating for students, due to the complexity of searching for and linking concepts, as well as designing the layout (Machado & Carvalho, 2020). In response to this challenge, researchers have explored the use of concept mapping in technology-supported learning environments, with the aid of computers and software.

For example, some studies attempted to improve the limitations of hand-drawn concept maps by developing Kit-Build concept mapping, also known as KB mapping. KB mapping is a specialized form of concept map developed by researchers to reduce students' cognitive load when they select concepts during the map construction process. This approach is in contrast with the original construction of concept maps from scratch, either hand-drawn or computer-assisted, which is also referred to as Scratch-Build concept mapping (SB mapping). In essence, the key distinction between KB mapping and SB mapping lies in the level of support provided to students during the concept mapping process. KB mapping provides students with all the pre-existing components with which to build concept maps, while SB mapping requires students to independently create nodes and links from scratch.

In many studies that compared the effectiveness of KB mapping with SB mapping for improving ESL/EFL reading comprehension, such as the study conducted by Alkhateeb et al. (2015), however, did not find KB mapping to be superior to SB mapping for improving participants' understanding of texts. However, these studies did reveal an interesting effect of KB mapping on recalling and remembering text information after a certain period of time, such as two weeks. These findings align with another study by Alkhateeb et al. (2016a), which compared the KB mapping method with the original SB mapping method and found no differences in immediate comprehension test results, but significant

differences in delayed comprehension test results, indicating that the KB mapping method can facilitate knowledge retention and is more effective for recalling information. Consequently, it can be concluded that KB mapping did not produce significant differences in test results immediately after the reading activity. However, it demonstrated better efficacy than the SB mapping method when evaluated through a delayed comprehension test, which also had a profound impact on students' learning of reading comprehension in the long run.

To explore further why the KB mapping method demonstrated greater effectiveness than the SB mapping method in recalling comprehended information after a certain retention period, Alkhateeb et al. (2016b) compared learners' map-building styles in an experiment that used both methods. They not only monitored learners' performance in terms of map size and progress, but also added new functions to the system to record the building process of each learner. They found that KB-mapping learners tended to focus more on key structures and information in the text, and they constructed their concept maps in a holistic manner. In contrast, SB mapping learners were inclined to construct concept maps in a sentence-by-sentence style, and provided very detailed information on the texts. The study of Alkhateeb et al. (2016b) provides teachers and researchers with profound insights into the concept map construction process using KB-mapping and SB-mapping methods. It also encourages researchers to examine how concept mapping works in the reading learning process from the insightful perspective of learners' map-building styles. In a similar vein, Andoko et al. (2019) analyzed learners' concept mapping styles from the viewpoint of paragraph structure in the text. It was revealed that learners who used KB mapping tended to organize the meaning of the text independently of the sentence order. In contrast to SB-mapping learners, who constructed their maps in a random manner or sentence-by-sentence style, KB-mapping learners created concept maps based on their reflection on the paragraph structure of the text.

In conclusion, these two studies examined the detailed concept map-building process of learners using KB mapping and SB mapping, and provide an explanation for the superior efficiency of KB mapping for recalling information. In terms of the building sequence of the two methods, in the SB-mapping condition, learners typically followed the sentence sequence of the text and comprehended the text as individual parts. As a result, although they performed well in immediate comprehension tests, they failed to recall information in delayed comprehension tests. However, in the KB-mapping condition, learners did not adhere to the sentence sequence of the text and, instead, tended to comprehend the text as a whole in a more structural form. Consequently, they did as well in delayed comprehension tests as they did in immediate comprehension tests.

As a matter of fact, some researchers expected the use of KB mapping to not only yield prominent delayed effects on reading comprehension, but also produce significant immediate effects. This expectation prompted recent studies to dedicate considerable effort to applying KB mapping in different teaching and learning environments or refining the use of the KB-mapping technique. For

example, Pinandito et al. (2021) attempted to use KB mapping in an online collaborative environment, as an alternative to the traditional open-ended concept mapping approach. They investigated the learning effects and analyzed students' conversations during collaboration using the proposed online KB-mapping system. The results indicate that collaborative learning with KB mapping in an online environment yielded better outcomes and more meaningful discussions than traditional open-ended concept mapping, as measured by both immediate and delayed reading comprehension tests.

With the same motivation of optimizing the use of KB mapping in teaching reading comprehension, Andoko et al. (2020) improved the KB-mapping technique by incorporating a source connection function in their study. The findings reveal that the use of KB mapping with source connections had a significant impact on both immediate and delayed tests, thereby demonstrating that KB mapping with source connections was a more effective approach to improving reading comprehension and knowledge retention.

The application of the concept mapping technique in the domain of reading instruction has notably centered on the implementation of KB mapping in online collaborative environments, or the incorporation of a source connection function. This approach has demonstrated remarkable promise due to its pronounced efficacy in elevating both immediate and delayed reading comprehension outcomes. A substantial advantage arises from the mitigation of students' struggles in constructing concept maps, attributed to the provision of supplementary kits containing pivotal concepts and connections. It is crucial, however, to acknowledge the presence of limitations accompanying these approaches. According to Asri and Andoko's (2019) study, the implementation of KB mapping was not fully successful in improving students' reading skills, despite questionnaire and interview results indicating increased student interest and motivation to read. It is worth noting that KB mapping requires students to have a good command of software and computer skills, and schools need to provide sufficient equipment, which may not be practical for all classrooms in various regions where teaching for ESL/EFL reading takes place. Therefore, while future studies could continue the research trend to explore ways to enhance and refine KB mapping in reading teaching, it is still highly worthwhile to investigate how to improve the use of hand-drawn concept mapping.

5. Conclusion

This article provided a literature review of 33 studies conducted between 2012 and 2022 on the use of concept mapping in teaching reading comprehension to learners in diverse ESL/EFL contexts. The purpose was to provide researchers and teachers with a comprehensive understanding of the research focus and application trends of concept mapping in ESL/EFL reading teaching. It was revealed that concept mapping was predominantly used and studied among undergraduate-level students, with the majority of studies employing quantitative quasi-experiment or true experiment designs. The most recent application of concept mapping in reading teaching is the use of KB mapping, either in a technology-supported learning environment or with a source

connection function, which demonstrates a promising impact on reading comprehension in terms of both immediate and delayed effects.

Based on these findings, the authors provide suggestions to ESL/EFL teachers for improving implementation of concept mapping in practical teaching, which include offering a clear guideline and demonstration on map construction, allowing sufficient time for students to master the technique, and combining different forms of concept maps in different stages of reading to fully utilize the benefits of concept mapping. Furthermore, recommendations are given to researchers regarding highlighting the need to pay attention to understudied participants, such as junior high school students. The authors also suggest conducting studies from a qualitative perspective and examining the influence of concept mapping on students' use of reading strategies, attitudes, and motivations, which also play crucial roles in students' overall learning of reading comprehension.

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