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The Effects of KB-mapping Method to Avoid Sentence-by-Sentence Comprehension Style in EFL Reading

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Abstract: Previous researches on supporting EFL (English as a Foreign Language) reading showed that Kit Build concept mapping (KB-mapping) method has better efficiency than Scratch Build concept mapping (SB-mapping) method in recalling the comprehended information two weeks later. In this research, we set out to investigate the following research question "Why KB-mapping method has better efficiency than SB-mapping method in recalling the comprehended information two weeks later?". One of the common comprehension styles in the EFL reading comprehension tasks is the sentence-by-sentence, where learners understand the text by closely following each sentence in the text. Learners will be able to sentence-by-sentence answer the Comprehension Test (CT) just after the reading, but many investigations indicated that, this understanding could not be kept for a longer time as is the case in the Delayed CT (DCT). We have a hypothesis that "KB-mapping method promotes a learner to read not sentence-by-sentence, although SB-mapping method does not promote same as KB-mapping method". In order to proof this hypothesis, we conducted an experiment to compare the learner's comprehension with KB-mapping and SB-mapping methods. During this experiment, we have monitored the performance of learners in terms of the size and the progress of building learner's map. In doing so, we added new functions to our system to record the building process of every learner. The outcome of the experiment confirms our previous results regarding the efficiency of KB-mapping. Moreover, the analysis of the progress of map building gives a proof that KB-mapping method helps the learners to avoid the sentence-by-sentence comprehension style. But the SB-mapping method could not help the learners to escape from this style of comprehension. Based on these results, we will design adaptive support for reading comprehension in our future work.

Keywords: Reading comprehension, building progress, sentence-by-sentence comprehension style.

1. Introduction

In language learning contexts, reading comprehension is an important learning activity that requires a special ability from the learner to reap its benefits. Reading comprehension poses many challenges as learners may experience one of these challenges: slow reading, insufficient vocabulary comprehension and poor recalling (Pearson & Johnson, 1978; Spiro & Brewer, 1980). Researchers have always tried to support this learning activity by proposing various methods and strategies. The main goal is to boost comprehension skills in the target subject area. When these methods or strategies are deployed in a language course, the main objective is to improve student reading comprehension of the text in addition to contributing to the acquisition of the Target Language (Graves & Graves, 1998; Kalhor & Shakibaei2012; Manoli & Papadopoulou, 2012).

Reading comprehension in EFL context is a special case because it is a complex, dynamic, multi-componential and multi-dimensional task in the learning process (Phakiti, 2006). It is a continuous process of multiple interactions between the readers' background knowledge in their

Mother Language (ML) and the knowledge exposed to in the Target Language (here English) (Coady & Huckin, 1997). Broadly speaking, the reading comprehension of EFL is the same as the ML reading comprehension but is slower and less successful than ML reading. This can be explained by the fact that the reading process is dependent on many factors such as the level of the readers' language proficiency, the subject matter of the text, text difficulty and task demands (Anderson & Cheng, 1999).

In our previous research (Alkhateeb & Hirashima 2015), we found that the KB-mapping method (Hirashima 2015) has the same efficiency of SB-mapping method for the comprehended information in the Comprehension Test (CT) just after the use of the method. On the other hand, KB-mapping has a better efficiency for recalling the comprehended information in the Delayed Comprehension Test (DCT) two weeks later. The research question "Why KB-mapping is better than SB-mapping in recalling information two weeks later?" is the main question of this research. To answer this question, we have added a new function to KB-system in order to monitor the progress of map building for the KB-map building and the SB-map building. Then, we analyzed this data to investigate the cause of this phenomenon.

1.1 EFL Reading Comprehension

'Comprehension' as a concept is defined as "the ability to understand something" in the Oxford Dictionary. The definition in the Cambridge Dictionary is "the ability to understand completely and be familiar with a situation, facts, etc.". For the purpose of this research, 'reading comprehension' will be defined as "a learner's ability to understand completely and memorize the important information that is included in the text he/she is reading". The definition necessarily includes the level of understanding of a text/message. Such an understanding comes from the interaction between the written words and how the learners trigger knowledge outside the text/message.

One of the most common styles of comprehension in the EFL reading comprehension learning activity is the sentence-by-sentence style (Gernsbacher 1996). Most of learners in EFL reading comprehension are tied to sentence-by-sentence comprehension (Grabe & Stoller 1997), this comprehension style is effective for comprehending the EFL text from the short time point of view as in the CT, but it is not so effective for recalling the comprehended information after a while as in the DCT (McKoon & Ratcliff, 1980; Block, 1986; Snowling & Frith, 1986). In our previous research, we found that the KB-mapping and SB-mapping methods have the same efficiency for comprehending the EFL text just after the method use, but KB-mapping method has a better efficiency for recalling the comprehended information later, So we are going to compare the KB-mapping and SB-mapping methods to support the learners of EFL reading comprehension task to avoid the sentence-by-sentence style of comprehension. And for this reason, we conducted an experiment to investigate the effects of building the two methods in the style of comprehension, by monitoring their building performance during the building process.

1.2 Scratch Build Concept Mapping Method

Scratch Build concept mapping Method, SB-mapping, is one of the newest strategies used to support the reading comprehension learning task, and it gives good effects on reading comprehension of EFL learners (Manoli & Papadopoulou 2012, Salehi & Khodabandehlou, 2013). SB-maps are visual representations of the knowledge which can be employed as a learning strategy by the learners to find the relationship between current knowledge and new information (Phantharakphong & Pothitha 2014). Researches have confirmed that EFL learners who used concept mapping gained high understanding in reading comprehension. Also, many studies proved that the concept mapping or semantic mapping technique could improve the learners' reading comprehension because they could understand the text more easily through the concept map.

SB-mapping provides learners with opportunities to become actively involved in their learning while linking knowledge to the long-term memory. Through the use of concept maps, learners have opportunities to organize their thoughts in a concrete and/or graphic/visual format, while connecting concepts and linking prior knowledge to new knowledge (Manoli & Papadopoulou 2012). Accordingly, related concepts become connected rather than being fragmented. Concept

maps also provide learners with opportunities to reconsider their own thinking, as they reflect on their conceptual understandings. The process of map drawing has a positive impact on learners' awareness of the reading process and learners can have more control over reading comprehension in English by visually representing what is conveyed in the texts they read.

In the practical use of SB-mapping method in our previous experiments, we noticed that the low reading ability learners were parsing the text sentence-by-sentence to extract the concepts and the relation in order to add them to the learner's map. This style of building is similar to the sentence-by-sentence comprehension style. Also the results of our previous researches indicate that the learners with SB-mapping method had the similar tendency as sentence-by-sentence comprehension understanding, so in this research, we investigated the effects of SB-mapping method during the building process in avoiding the sentence-by-sentence comprehension.

In general, using the SB-mapping method has many advantages in the reading comprehension process, such as it helps learners brainstorm and generate new ideas. Moreover, it encourages learners to discover new concepts and the propositions that connect them, allows learners to connect ideas, thoughts and information more clearly, and enables learners to gain enhanced knowledge of any topic and evaluate the information. All of these advantages improve the learners' comprehension of the text and allow them to recall the comprehended information after a while.

1.3 Kit-Build Concept Mapping Method

KB-map is "a framework to realize automatic diagnosis of concept maps built by learners and to give feedback to their errors in the maps" (Sugihara & Hirashima 2012). KB-map is a special kind of concept map. The creation of concept map consists of two steps: the extraction of the concepts and the relations from the text and the selection of the responsible relation that connects two concepts together. In KB-mapping, the supervisor makes the first step by creating the goal map from text and after that he can generate the kit from the goal map by dividing the goal map to concepts and relations, providing learners with this kit. After that, learners are tasked to build the concept map (called learner's map) by using the concepts and the relations that provided in the kit.

While the SB-mapping and KB-mapping allow learners to organize ideas and determine the relations between them, KB-mapping does it with more controlling and redirecting of the learners; it helps evoking prior knowledge through KB-map creation. This method can be used in any discipline to help learners to make connections between ideas, but the provided kit (all the important concepts and relations) always controls the process.

Reading comprehension refers to the ability to understand information presented in a written form. KB-mapping method, as its applications, helps the learners to understand the information presented in a written form, by converting the written information into a graphical form. Such a graphical form is easily recognized and is easier to be scanned for a specific word or general idea. Moreover, it allows for a more holistic understanding of the text, but at the same time controls the process of building the learners' map by the provided kit.

The main goal of the reading task is to distinguish the important information in the text and to comprehend it. The KB-mapping method has almost the same features as the SB-mapping method but the main difference is providing the kit, which contains the important words in the text. The kit is just a list of words that supports learners to distinguish the important information from the text. In other words, giving these words with the text to the learners will not be supported, rather the supported method is to use these words to find out the important information in the text, and this kind of activity can be implemented by using these words in building the learner's KB-map.

Finding the important information means not only to find the words, but, more importantly, means to find the relations and integrate them together to get the whole structure of the text that contains the important information (important information contains more than two important words). As it contains recognition of the relations among the words to complete the whole structure of the text, the important information cannot be found completely without thinking about the structure of the text. KB-mapping method reduces the learners' load in the selection process and lets the learners focus on the structuring process.

We have already developed a system called the "KB-map System" (Yamasaki & Funaoi 2010), the new version of the Learner Map Builder has functions to add concepts and relations to the learners' map and, the mark and click. By using these functions the learners can build the SB-map

easily as we explain in our previous research (Alkhateeb & Hirashima 2014). Also, it is proved that, using the KB-mapping method to support EFL reading comprehension was useful to help the learners to comprehend the text deeply, and to recall it after a while (Alkhateeb & hirashima 2015).

2. The Relation Between Map Building and Comprehension Style

Both SB-map and KB-map are useful tools to promote learners to describe their knowledge or understandings by themselves (Novak & Gowin, 1984; Yamasaki & Funaoi 2010). From the viewpoint of teaching, the Maps built by learners are promising products to examine the students' understandings (Barenholz & Tamir, 1992; Ozgemir 2005; Hirashima & Funaoi 2015). These researches indicated that the resulted map from the building process is a useful tool to evaluate the learner's understanding. In addition to that, we think that the building progress of a map is also a good indicator to show the learner's way of understanding. Accordingly, we propose the monitoring of progress of map building as a new method to describe the kind of learner's understanding, as the comprehension style in the EFL reading comprehension learning task in this research. In the next section, we are presenting the proposed method to monitor the map building progress during the building process, with an example applied in our experiment.

2.1 The Monitoring Method

Generally, the map consists of many propositions, which in turn consists of two nodes and a link. During the map building process, the learners are going to build the map by adding new propositions to the map. If we can check the way of map building, we can confirm the method or the style of learner's reading. One of the most common styles in EFL reading comprehension is the sentence-by-sentence reading. In this style, the learner tries to understand the text as individual sentences. To check if the learners are following this style of reading, we suggested to compare the map building sequence with the text following sequence. In doing so, for the KB-group learners, we gave values for all the propositions of the goal map, according to their appearance in the text. After that, we used these values to record the building progress as the order of adding propositions to the learner's map. Also for the SB-group learners, we gave values for all the propositions of every learner's map, and recorded the building progress as the order of adding to the learner's map.

2.2 Example of Map Building Progress Monitoring

To be able to monitor the progress of map building, the system was modified to automatically upload the learner's map to a server every one minute. At the end of each session, we will have a sequence of map versions (depend on session's length) for each learner. Then, we assign a value for each proposition in the final map representing its appearance order in the text. By comparing these values with the learner's building sequence, we could tell whether the learner follows the sentence by sentence style, i.e., his comprehending style is sentence by sentence comprehension.

Computer data storage

Computer data storage, often called storage or memory, is a technology consisting of computer components and recording media used to retain digital data. It is a core function and fundamental component of computers.

In contemporary usage of the words "memory" and "storage", "memory" is usually semiconductor storage read-write random-access memory, typically DRAM (Dynamic-RAM) or other forms of fast but temporary storage. "Storage" consists of storage devices and their media not directly accessible by the CPU, typically hard disk drives, optical disc drives, and other devices slower than RAM but they are non-volatile. Historically, memory has been called core, main memory, real storage or internal memory while storage devices have been referred to as secondary storage, external memory or auxiliary/peripheral storage.

Figure 1. Sample of the text used in this experiment.

For example, Figure 1 shows a part of a simple text used in our research talking about computer data storage. Then, computer data storage called storage will be assigned value 1.

As all learners following the KB-mapping method will build their maps using same kit (generated from the goal map), their maps will have the same propositions. Thus, we could use the goal map for assigning values for all the propositions of all learners' maps. Figure 2 shows the order of the propositions following the text sentence sequence and considering the text in Figure1.

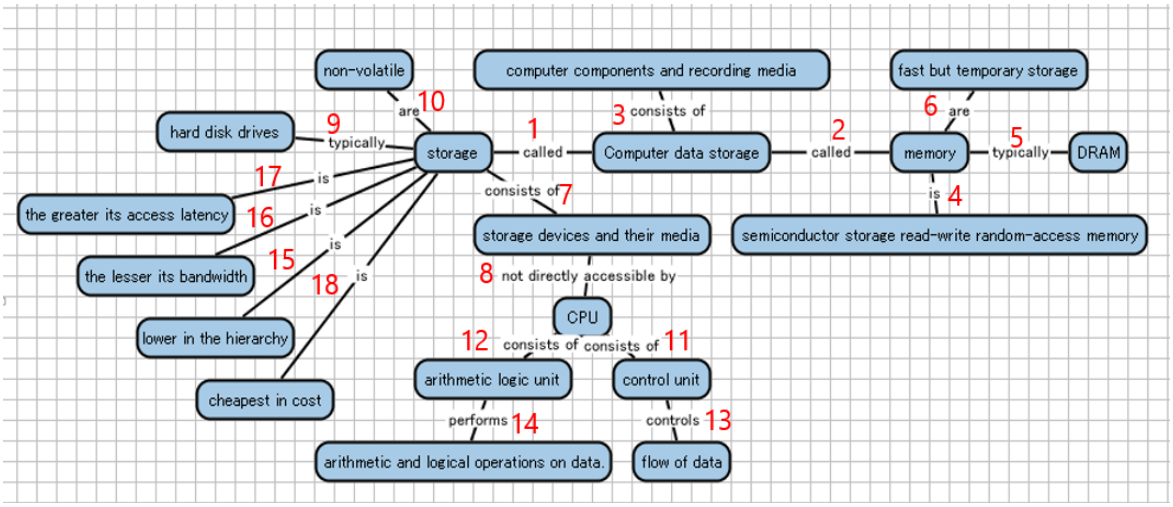

Figure 2. Sample of goal map of in this experiment with the values (order) of the Propositions.

On the other hand, learners of SB-mapping will have different propositions in their map as every learner is free to select the important nodes and links. Hence, we had to use the final learner's map for assigning values for all the propositions of every learner's map.

By doing so, we had the order of the propositions in the situation of following the text sentence sequence, which means that if a learner has the same building sequence, he will be building the map sentence-by-sentence, in other words, his comprehending style is sentence-by-sentence comprehension. For every learner, we had recorded the building sequence of the learner's map by recording the sequence of propositions value during the process of building.

After we got the building records for all the learners, we calculate the average anagram distance from the text following sequence. Anagram distance is calculate by the absolute value of the differences between the Text following Sequence and the learner's map building sequence, AD = ABS (TF – LS). Where the TF is the order of proposition appearance in the text, and the LS is the order of adding propositions to the learner's map. Table 1 shows examples of the records of building of two learners, one following the KB-mapping (LS1), and the other following the SB-mapping (LS2). The first row of the table is the order of Text Flowing sequence (T.F), and the others rows are the building sequences and the anagram distances of two learners. The last column is the average anagram distances for every learner's building sequence from the text following sequence.

Table 1: Samples of the building records of learner's map in this experiment.

T.F	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	A.A.D
LS1	1	2	3	4	5	7	15	8	9	11	12	13	16	17	18	6	10	14	
AD1	0	0	0	0	0	1	8	0	0	1	1	1	3	3	3	10	7	4	2.3
LS2	1	2	3	4	5	6	12	7	8	9	10	11	13	15	16	17	14	18	
AD2	0	0	0	0	0	0	5	1	1	1	1	1	0	1	1	1	3	0	0.89

(T.F: Text Following sequence; A.A.D: Average Anagram Distance; LS1, LS2: Learners' building Sequences; AD1, AD2: Anagram Distances of the two learners)

3. Experiment Methodology

We conducted an experiment trying to investigate why using the KB-mapping method, as a supportive tool for the reading comprehension task, is more effective in recalling information than using the SB-mapping method. To obtain that, we add a new function to our system to monitor the building progress of the both methods. This function is simply to upload the learner's map to the server every minute.

For this experiment, the method of investigation is very complicated and the requirements, of every session, are not easily applied for a big number of participants, so we planned to do this experiment with a small number of participants in several sessions.

3.1 The Participants

The participants were 11 Japanese students in the 3rd year of the information engineering course. Their TOEIC exam scores ranged from 375 to 570, so they had different reading abilities. By using their TOEIC scores and TOEIC reading scores, we grouped them into two groups, A and B, which had almost the same average scores of TOEIC, and reading part.

3.2 Procedure of the Experiment

The experiment was done in 6 sessions of the reading comprehension task for six different English texts. In the first session, we introduced the methodology of this learning process, the procedure of every session and the KB-map system. After that the participants start the learning activity of the session as shown in Table 2. For the other five sessions, we started with the Delayed Comprehension Test (DCT) of the previous session. In advance, we had a complementary session to conduct the DCT of the sixth session along with a questionnaire. During the experiment, each group underwent Kit Build conditions (KB-conditions) 3 times and Scratch Concept map conditions (SB-conditions) 3 times too. The conditions were alternated, where the KB-conditions group was considered to be the experimental group and the SB-conditions group was considered to be the control group.

We designed the learning activity to be done in a limited period of time to avoid the effects of other supporting strategies. The process of one session, as shown in Table 2, consisted of four steps. In the first 10 minutes, both groups were requested to read the whole text by skimming it (translating the difficult words in the text using a dictionary was allowed). Then, in the next 20 min, the KB-conditions group was required to build the learner's KB-map of the text by using the Learner Map Builder, and at the same time, the SB-conditions group was required to build the SB-map of the text by using Learner Map Builder too. Within the building time, the learners can read the text to check their comprehension. After that, both groups did the comprehension test (CT) within 5 min to measure their comprehension of the text. Finally, after 2 weeks, both groups did the same CT again as a DCT to measure their recallable information.

Table 2: The procedure of one session.

Time	KB-conditions	SB-conditions
10 min	Reading the text (using a dictionary was allowed)	
20 min	Making the KB-map by using KB-editor	Making the SB-map by using KB-editor
5 min	Comprehension Test (CT)	
5 min	Delayed Comprehension Test (DCT) (2 weeks later)	

3.3 Experimental Materials

The materials that were used in this experiment are 6 intermediate level texts in the information engineering field. The texts were of the same size (word count), and taken from Wikipedia; we checked them for grammatical and semantical errors. After that, we created the corresponding KB-map (goal map) for every text, by using the Goal Map Editor. The goal map covered the main concepts and relations; also all of the goal maps had almost the same size and structure. We prepared the CTs, which were multiple choice tests with 10 questions of the same level of complexity. Around 80% of the comprehension questions could be answered by the goal map and the others could not. Again we checked all of the materials to be sure they do not contain any errors. Finally, we noted if

the answers to questions of the CT were covered by the goal map and we marked the questions that were not covered; these were used for a detailed analysis as it was explained in our previous research (Alkhateeb &Hirashima 2015).

4. Results

We performed our experiment with 11 students in six sessions. In three sessions we had six participants as the KB-conditions group (Group A) and five as the SB-conditions group (Group B). In next session, the participants were shifted to the alternate conditions groups, where we had five participants as the KB-conditions group and six as the SB-conditions group. So, we had six sessions with different six texts, goal maps and tests, but for all the sessions there were balanced participants. For every session, we compared the CT average scores, the DCT average scores and the differences (DCT-CT) for the two conditions groups.

We got a new kind of data from this experiment which is the records of building learner's map of all learners as SB-conditions and KB-conditions. We analyzed this data in two ways to check what differences are between the two methods.

4.1 Retaining Comprehension

By comparing the average scores of the CT and the DCT for the two conditions groups in every session, we found that the experimental conditions group (KB-group) retained more information in comparison with the control condition group (SB-group). This experiment had shown that for every session the average difference between DCT score and CT score of the KB-group was smaller than the average difference of the SB-group.

For every session, we had different texts, goal maps and tests, but for all the sessions, we had the same conditions. So, we proposed to use the differences (DCT -CT) to evaluate the recalled information for the both methods. We gathered these differences for all the six sessions together to have a sufficient number of results for a valid statistical analysis. To confirm this approach is valid, we applied some non-parametric statistical analytical methods to check if we could use all of them together in one analysis. For the differences between the DCT and the CT scores (DCT-CT) in KB-group, we found by Bonferrion's method that there was no difference between any pair of means of all session differences; and for ALPHA= 0.05, the ANOVA Test gave P(value) =0.546. Also, with ALPHA= 0.05, the Friedman test gave P(value) = 0.373, and the Kruskal-Wallis test gave P(value) =0.57. We found that all the differences had similar distributions for p (chi-square distribution). Also for the SB-group differences (DCT-CT), by using the same statistical analysis methods, we found, that there was no difference between any pair of means of all session differences and all the differences had similar distributions for p (chi-square distribution).

We analyzed all the differences together by using the statistical two factors ANOVA with replications. In a simple comparison of the score means, for the KB-group, the average difference between the DCT and the CT was -4.55. On the other hand, for the SB-group, the average difference between the DCT and the CT was -14.42. The differences of the KB-group were lower than the differences of the SB-group for all the sessions. The value of the ANOVA Test P(value) =0.0005< 0.05 indicated that there were differences in the recalled information of the two groups. So we could say that the KB-mapping method helped the learners to retain their understanding for a longer time. Table 3 shows the details of the statistical analysis.

Table 3: The average difference (DCT-CT) for two conditions groups.

DCT-CT	KB-conditions group	SB-conditions group
Mean	-4.55	-14.42
SD	10.23	9.43
P(value)	0.0005	

4.2 Following Text Sequence

The records of building of the two methods contain the building sequence during the building time so we analyzed the sequence of map building during the building time. For every session, for the KB-mapping method, we gave an order for all the proposition of the goal map, according to their appearance in the text, and recorded the building sequence as the order of adding propositions to the learner's map. For the SB-mapping method, we gave an order for all the proposition of the learner's map, according to their appearance in the text, and recorded the building sequence as the order of adding propositions to the learner's map.

We calculate the absolute distance of every building sequence from the text following sequence and we found that the KB-group average distance of every session is higher than the SB-group one, as shown in Figure 3.

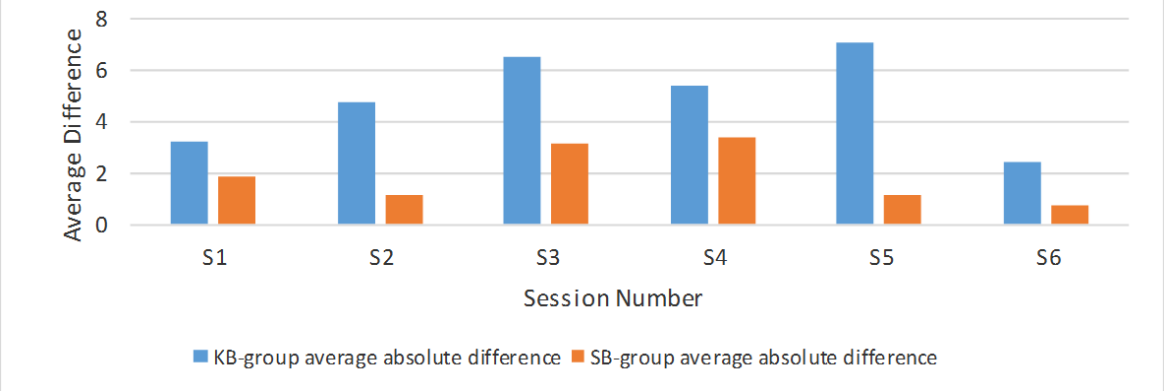

Figure 3. The average absolute differences for the two groups in all the sessions.

Also, we calculate the average Pearson product-moment correlation coefficient between the text following sequence and the building sequence of every learner in every session. We found that the SB-group building sequence has more strong correlation than the KB-group building sequence, so we can say that the SB-group, during the building process, followed the sequence of appearance in text.

To check the effects of following text sequence, we calculated the average Pearson product-moment correlation coefficient between the text following sequence and the scores of the learners in the comprehension test and the delayed one for the two conditions group. We found as shown in Table 4, that there is a coefficient correlation between the scores of the SB-group and the building sequence and there is no correlation between the scores of KB-group and the building sequence.

Table 4: The Average correlations between the learners' average absolute difference and scores.

	Session 1	Session 2	Session 3	Session 4	Session 5	Session 6
SB-CT	0.915	0.927	0.825	0.562	0.808	0.988
SB-DCT	0.472	0.766	0.796	0.496	0.576	0.853
KB-CT	0.219	0.168	0.130	-0.314	-0.059	0.104
KB-DCT	-0.155	0.273	-0.134	-0.332	0.232	-0.236

From these results, we could confirm that the learners of SB-mapping method had follow the sequence of sentences in the text, but the KB-mapping ones had not.

Also, the records of building of the two methods contain the building progress during the building time, so we can analyze the progress of map size during the building time. We found that both methods had almost the same map size progress during the building time, and the average final map size was almost the same for both methods. So, we can confirm that the map size has no effect on the reading comprehension process. But, from these results, we could confirm that the provided kit to KB-group learners, has no hidden support to learners in comparison with the SB-mapping learners who were not provided.

4.3 Considerations

As a results of this experiment, we confirmed again the results of our previous research (Alkhateeb & Hirashima 2015), that using the KB-mapping method has almost the same efficiency as using the SB-mapping method for comprehending English text just after the method use (the CT), so the two conditions groups could understand the text. But, the KB-mapping method has a better efficiency for recalling the comprehended information after some time had passed (the DCT). Another result, we could confirm that the provided kit, for the KB-mapping learners, does not give any underlined information or extra support for the building process in comparison with the learners of SB-mapping method who had to build all the map nodes and links by themselves because of the same evaluation of map size during the building process.

The main result of this research is the relation between the building sequence and the text following sequence, we could confirm that the learners of SB-mapping method were following the sequence of the text. In other words, they are parsing the text sentence-by-sentence to generate the concepts and the relations from the text during the building of the learner's map. The reader should notice, as we mentioned before, that this style of reading is not so effective for comprehending the text. That is because this style of reading does not help the learners to understand the text in a structural form, which means that the learners could comprehend the text as separated sentences or paragraphs. That will not help learners to keep their understanding for a long time. Subsequently, they could answer the comprehension test, but not the delayed test DCT.

In the other side, the learners of KB-mapping method were not following the sequence of the text, i.e., they are not parsing the text as the SB-mapping learners do, but they could answer the comprehension test as good as SB-mapping ones. Yet, they could answer the delayed comprehension test in a better way than SB-mapping ones do. So, we can confirm that the KB-mapping method helps the learners to understand the text in a more structural form and this understanding helps the learners in recalling the comprehended information later.

5. Conclusion and Future Works

In this paper, we described the effects of using KB-Mapping method as a supportive tool for the reading comprehension of English texts as EFL reading. Overall, from this research, we can conclude that using of KB-map as learning supportive tool for reading comprehension is as good as SB-mapping in the short term, but it so better for the long term. This can be explained by the building process of the two methods, where the building sequence of the two methods indicated that the SB-mapping method learners had followed the sentences sequence of the text, but the KB-mapping method learners did not. As we mentioned, the SB-group learners had comprehended the text as individual parts, so their comprehension was good in the CT but they could not recall in the DCT. In the other side, the KB-group learners had comprehended the text as a whole in a more structural form, so their comprehension was good in the CT and they could recall more in the DCT.

The experiment shows that the map size has no effect on the reading comprehension process, i.e., the provided kit to KB-mapping method learners, has no hidden support to learners. That is to have a fair comparison with the SB-mapping learners who were not provided.

Our next step is to investigate the effects of learning methods for the learners who have different levels of reading abilities, and how to improve our method to support all kinds of reading and all levels of learners. Also, we are going to design adaptive support environment for reading comprehension based on the considerations of this research and implementation of the monitoring function.

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