

CONCEPT MAPPING OF SCIENTIFIC PROPOSITIONS WITH ADVERBIAL PHRASES OR CLAUSES

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Abstract. The traditional concept mapping method developed for English causes problems in other languages. These problems are mostly caused by the limitation of the traditional concept mapping method in representing the complete meaning of the proposition compared with the natural language. This study investigates an alternative method to construct a concept map of a proposition that contains adverbial phrases or clauses that are difficult to make sense of with the traditional method. The study results in an alternative concept mapping method for the propositions which is easier to construct and has a clearer meaning than the traditional one. We also developed an online concept mapping program which can construct a concept map using the newly derived method. We applied the new concept mapping method and program to seniors at the university. The result was that 73% of the participants preferred the newly developed method for presenting adverbial phrases or clauses, and in reading, 79% of the participants preferred the new method to the old one.

1 Introduction

Since the late 1980s when the concept map was introduced in Korea, it has been used for several purposes including organizing and representing knowledge, determining a learner's alternative conceptions, and examining changes in the cognitive structure. In science education, especially in biology, a lot of research on the concept map is being accomplished. Through the continuing research, it has been revealed that the concept map is an effective learning tool for Korean students (Kim & Oh, 1995). Also, most middle school science textbooks contain concept maps to encourage concept mapping by students (Cho, So, & Kim, 2005). In order to encourage an effective and easy application of the concept map as a teaching and learning tool, an online concept mapping program and concept map evaluation program was developed (Ahn, So, & Kim, 2006; So & Kim, 2005).

However, with all these efforts, students are still experiencing difficulty with concept mapping: The four major difficult processes of concept mapping are: making hierarchy, finding relation between concepts, writing linker, and finding concepts (Lee & Kim, 2006). Thus we explored an alternative approach to 'finding relation between concepts' and 'writing linker.' Finally, we thought that the traditional method of representing an adverbial phrase or clause (AdvP/C) in the concept map was responsible for the problems.

2 Problem: Concept Map and Language

Though the concept map was invented in America for people who use English as their first language, people in other countries where English is not their first language are trying to use the concept map and it seems that they are using it with few difficulties in their language systems (Kilic, 2003).

On the other hand, syntactic difference makes it difficult to construct the concept map in Korean and Japanese (Lee, 1999), and it has been reported that the modification should be placed on the established English method of concept mapping when doing it in Turkish, which belongs to the Altaic languages along with Korean and Japanese (Kilic, 2003). Not only the difference between Altaic languages and English but also an error in the traditional method of constructing an English concept map for the proposition that contains an AdvP/C may cause difficulty when using the concept map.

2.1 Proposition of Scientific Knowledge that Contains Adverbial Phrase or Clause

Before we consider the error in the method of constructing a concept map for the proposition that contains an AdvP/C, let's think about the role and the meaning of the AdvP/C in the expression of scientific knowledge. Scientific concepts or phenomena are frequently explained or understood with many other conditions which limit them. So when we explain the scientific knowledge in a language, we use sentences and propositions that contain the AdvP/C, e.g., time, method, cause & effect, place, and degree, to limit and specify the meaning.

2.2 Problem of Concept Mapping a Proposition which Contains Adverbial Phrase or Clause

First of all, let's look at the linguistic difference between English and Korean. Table 1 shows that the word order is different. The English sentence is S(subject) + V(erb) + O(bject), whereas the Korean is S(subject) + O(bject) +

V(erb). This difference causes a difference in the construction and the interpretation of the concept map. Since Korean is an agglutinative language that has developed the postpositional word, it is relatively free from word order in forming the meanings compared with English. Therefore, it is simple to construct a concept map for the basic sentence ((a) of Table 1), and the linguistic difference can be easily overcome (Figure 1).

Table 1. Sentence of biological knowledge that contains adverbial phrase.

English	(a) Green plants make carbohydrates S V O	녹색 식물 = Green plants 탄수화물 = carbohydrates 엽록체 = chloroplast 만든다 = make ~은 : postposition for subject ~을 : postposition for object ~에서 = in
	(b) Green plants make carbohydrates in chloroplast S V O AdvP	
Korean	(a) 녹색 식물은 탄수화물을 만든다. S O V	
	(b) 녹색 식물은 엽록체에서 탄수화물을 만든다. S AdvP O V	

But if the proposition to construct contains an adverbial phrase that qualifies the predicate verb, the situation becomes more complicated. In English, the AdvP is added to the back of the VP (verb phrase) of the main sentence. But in Korean, it is inserted into the main sentence in front of the VP. The different positions cause a problem in constructing and interpreting the concept map.

Let's represent Sentence (b) of Table 1 as a concept map. Traditionally we construct a concept map like Figure 1 and then add the new concept 'chloroplast' to the second concept 'carbohydrates' simply by using the preposition 'in' (Figure 2).

Since this way of concept mapping for the AdvP - 'carbohydrates in chloroplast' - which contains the important concepts cannot form a meaningful proposition independently, the basic rule that every link between the two concepts should form a meaningful proposition is violated (Novak & Gowin, 1984; Wandersee, 2000). With all these violations, this expression has been connived and used because it is possible to form the original proposition - 'Green plants make carbohydrates in chloroplast' - when reading the concepts and connectives from top to bottom. But this way causes difficulty in representing the meanings because of the difference in the word order and the forming process of the meanings in Korean and some other languages.

To avoid this problem, we can break the sentence which includes AdvP into several simple propositions and then construct a concept map from them. But this process of breaking sentence is too difficult for the students who faced a new scientific knowledge just now. It makes most students to feel difficulties in concept mapping. Also the concept map which constructed from broken propositions can't represent the full meaning of the original sentence.

Thus the traditional way of concept mapping needs to be improved so that students do not have any difficulties and can represent the proposition with full meaning.

3 Alternative Concept Mapping Method to Represent Adverbial Phrase or Clause

The traditional concept map organizes a meaningful proposition by linking two or more concepts with a linker. The linker was allowed only on the relation of concepts and this linker represents the relation between them. But as we have already seen, there are difficulties when expressing the AdvP meaningfully, which qualify the entire

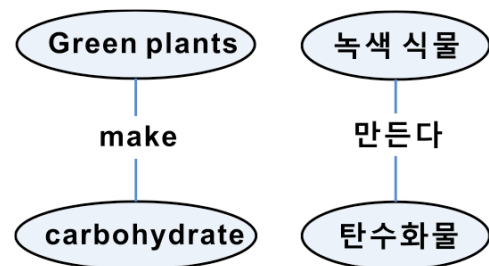


Figure 1. Concept map for a basic sentence ((a) of Table 1) that is easy to compose and makes sense in both languages.

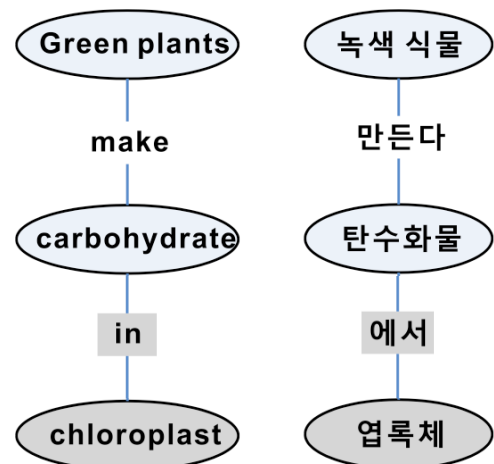


Figure 2. Traditional concept map of a sentence ((b) of Table 1) that contains an AdvP. In English, it matches the English word order. But in Korean, it is not a meaningful concept map. Also, in both languages, it is not possible to derive separated, meaningful propositions for each linker.

verbal phrase containing an important concept. To solve this problem, we have developed a concept map constructing method that allows the sublinker which links the main linker and concept (Table 2). By using this method, the proposition which contains an AdvP can be expressed meaningfully in Korean as well as in English (Figure 3).

Table 2. Alternative Concept Mapping Steps.

1. Identify scientific propositions (principles and laws).
2. Identify concepts and linking words in the propositions.
3. Arrange the concepts hierarchically.
 - From general at the top to specific at the bottom
4. Draw connecting lines among the arranged concepts to represent the relationship.
 - Each connection should be labeled with a linking word (linker) to represent the proposition.
 - If proposition contains adverbial phrase or clause which modifies the primary predication, link the phrase to the main linker and not the concept.
5. Find and draw cross-links to represent meaningful knowledge integration.
6. Add examples for the concepts.
 - Use "e.g." as a linker.
 - To distinguish examples from concepts, do not enclose them in circles.
7. Rearrange and revise the map to avoid being too complicated and let it be visually balanced.

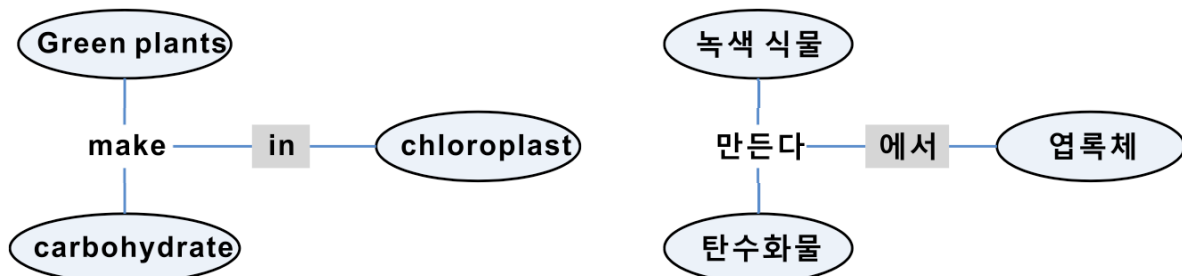


Figure 3. Concept map using alternative method for an AdvP. This is meaningful in Korean as well as in English, and it is easy to compose.

4 Online Concept Mapping Program to Construct Scientific Knowledge

By modifying the already developed online concept mapping program (So & Kim, 2005), we developed an expanded concept mapping program which supports an alternative concept mapping method that allows using sublinker to the main linker. Using this program, it is possible to construct a concept map not only in the traditional way but also with the new alternative way (Figure 4).

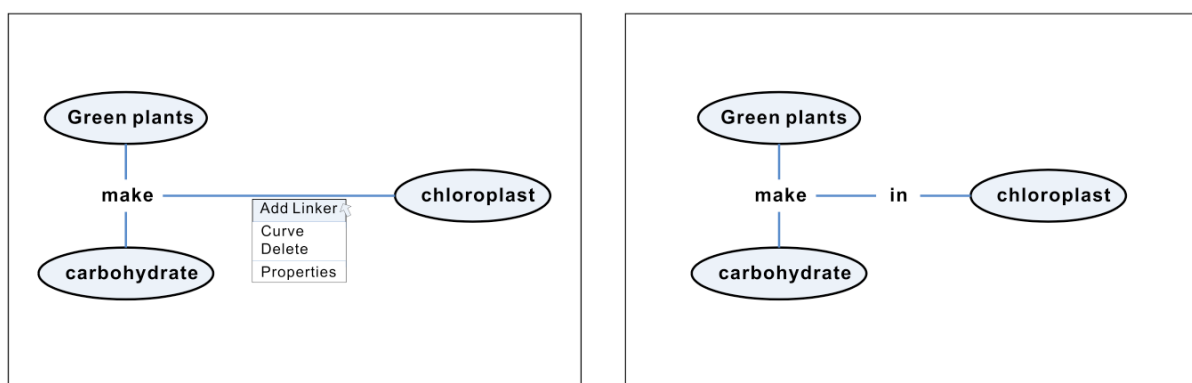


Figure 4. Expanded online concept mapping program (<http://bioedu.snu.ac.kr/conceptmap/online>). New functions are added for the alternative concept mapping method on the popup menu (left). It is easy to construct a meaningful concept map (right).

5 Application and Result

To make sure that the alternative concept mapping method is really helpful to construct and interpret the concept map containing an adverbial phrase or clause, we applied the new concept mapping method and program to senior students majoring in biology education at university.

First, to examine which method was preferred, we asked them to construct a concept map for a proposition containing an AdvP. Twenty-two of the thirty participants, or 73%, constructed it as the expanded form by using the alternative method.

Next, we showed them a proposition containing an AdvP and two concept maps of the proposition which were constructed with the traditional method and the newly developed method respectively. We then asked them which one represented the proposition more clearly. Twenty-three of the twenty-nine participants, or 79%, answered that the concept map constructed with the newly developed method was a clearer representation of the proposition.

6 Conclusion

To solve learners' difficulties with concept mapping of scientific knowledge that contain adverbial phrases or clauses, we pointed out the problem of the traditional concept mapping method in this study. Through the investigation, we derived an alternative concept mapping method for the propositions which contain an AdvP/C; If proposition contains adverbial phrase or clause which modifies the primary predication, link the phrase to the main linker and not the concept. It is easier to compose and clearer in its meaning than the traditional one.

We also developed an online concept mapping program which composes a concept map using the newly derived method. By using this program, verification of the newly derived concept mapping method was carried out even though it has limitations. It is necessary to verify the newly derived concept mapping method with a more systematic study. It also needs to be applied and verified whether the new method is effective for the people whose first language has the SVO word order. Furthermore, investigation should continue about the influence of the newly developed concept mapping method on learning.

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