Applying Concept Map to develop a new Technical Writing technique for enhancing Reading Comprehension performance

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(ISX and method for improving reading process)

Abstract. *In today dynamic information technology era, technical documents are becoming bigger and are updated frequently more than ever. As a result, people have to spend a huge mount of time and efforts to digest these technical documents.*

Although the traditional technical writing technique helps to produce cohesive and easy-to-be-understood technical documents, it does still suffer the essence problems of the prose text such as language ambiguity and ineffective key concept manipulation.

Nevertheless, interestingly, these problems can be solved effectively by concept map technique. Because of its 2-dimension spatial concept representation, concept map can help to limit the language ambiguity problem, to manipulate the concepts effectively, and to enhance reading comprehension performance.

The research described in this paper aimed to propose a new more effective technical writing technique by applying concept map. The research used some basic experiments in psychology and many examples to demonstrate this proposal.

Keywords. Concept map, technical writing, spatial text technical writing, reading comprehension, language ambiguity.

1. Introduction

Technical documents especially computer technical documents are developing dramatically in information technology era nowadays. As a result, people have to spend a huge mount of time and efforts to digest these ever-increasing technical documents. This research is about how to represent effectively the text in the technical document so that readers can perceive easily and efficiently that technical document.

The research first investigated the essence of reading comprehension process. Then, the research discussed the technical writing technique which is currently a method for producing the good usable technical documents in disciplines such as science, engineering, business, industry, etc. Technical writing forces writers to use simple accurate words and good format layouts to create the good technical documents.

However, because of its word-after-word prose text representation, technical writing still got some problems of the traditional prose text such as language ambiguity and inefficient concept manipulation. Concept map, which has the 2-dimension spatial text representation of a network of concepts, can help to solve these problems. Thus, it can be seen that concept map has a potential to replace the technical writing technique in producing efficient technical documents.

Unfortunately, concept map technique is used to map only key important concepts and is not used to map every word in a whole document. It means concept map diagram is only used to support the prose documents; it is not used to replace the prose document. The main reason is that the graphical representation of every word in a document is impossible because of concept map limitations such as diagrammatic messiness, time and effort consuming, etc.

Hence, this research proposed a new type of technical writing that applies the spatial representation characteristics of concept map. This new technical writing technique is called “spatial text technical writing” (STTW). STTW inherits some logical symbols in knowledge representation in Artificial Intelligence and can resolve the limitations of concept map. STTW can have ability to map the whole technical document. STTW takes the advantages of the usefulness of concept map and technical writing. STTW relies on the STTW grammar which is the

formula for representing spatially the English sentences based on the grammar structure and parts of speech.

The research used a variety of reasonable examples to demonstrate the ability of concept map as well as STTW in reducing the language ambiguity problem and facilitating concept manipulation. Besides, the research also used some very basic experiments in psychology to demonstrate the ability of concept map in helping human to perceive the information quicker.

2. Reading Comprehension

[1] emphasizes that Reading is a complex multilevel interactive process between readers and the material. Firstly, to be able for a reader to understand a sentence, the reader has to understand the word, the syntax and the semantics of that sentence.

Secondly, their previous knowledge is very important in reading. Many students feel it difficult to digest the new knowledge because of their lack of prior knowledge [2].

Thirdly, the context is very important in reading comprehension. If the text is taken out of context, the incomplete understanding will happen. The meaning of language is insufficient to convey the knowledge of the world. Language, thus, is only a vehicle to take us to understand the world. Language is not the world knowledge itself [3].

Next, another important aspect of reading comprehension is the concept manipulation. Reading is dominated by a cognitive manipulation of the concepts. For example, when you are reading a book, you often turn the pages back and forward many times to see how the concepts or ideas in the book interrelated to each other. However, many students are not supported by a good strategy for manipulating the concepts in the text that they are reading [2].

Finally, if the text has an implication, readers have to deduce or draw inferences, form a hypothesis to understand what the text is going to talk about in a bigger context [1].

3. Language Ambiguity

Ambiguity is a common feature of linguistic expressions. Something is ambiguous when it can be understood in two or more possible senses or ways. If the ambiguity is in a single word, it is called lexical ambiguity. If the ambiguity is in a sentence or clause, it is called structural ambiguity [4].

For example, the word “Overlook” got the lexical ambiguity. “Overlook” can be signified as “inspect” (look carefully), or “miss” (look carelessly).

The reference lexical words such as “the”, “this” and “that” can be very ambiguous. For example, “Tom rushes into the room. He grabbed a cake. He should not do that”. We don’t know whether “that” refers to “Tom rushes into the room” or “He grabbed a cake”.

These are examples of structural ambiguity:

-Liz attacked the man with a knife (“Liz attacked the man who had a knife, or Liz used a knife in her attack on the man”), “with a knife” has a direct structural relationship with “attacked” or with “the man”. Other words, “with a knife” modify “attacked” or modify “the man” [5].

-They talked about the disaster on the train (“on the train” modifies “the disaster” or modifies “talked”).

4. Technical Writing

“Technical writing is writing, apart from advertising and public affair writing, that effectively communicates all aspects of technological work in applied science, engineering, business, and industry” [6].

. Technical writing helps to create good documents. Good documents save time and energy for readers. Poor documents can cause confusing, more information that readers need, irrelevant information, & too much jargon [7].

Limitations of technical writing

Although technical writing attempts to create the good prose documents with good syntaxes and simple vocabulary, it still suffers the limitations of the word-after-word prose documents. Technical writing forces the writers to produce the good technical prose documents which have a rigid word control mechanism. Good technical documents are less ambiguous than the prose documents which do not use technical writing method at all. Good technical documents use simple rigorous structure and thus can somehow help readers to reference and manipulate the key ideas. But it does not mean that we can solve thoroughly the language ambiguity and inefficient concept manipulation problem in good technical documents. Language

ambiguity and inefficient concept manipulation still do exist in the good technical documents.

5. Concept Map

What is concept map? "A concept map is a graphical representation of knowledge of a domain. A concept map consists of nodes representing concepts, objects, or actions, connected by directional links defining the relationships between nodes. A node is represented by a simple geometric object, such as an oval, containing a textual concept name. Inter-node relationship links are represented by textually labeled lines with an arrowhead at one or both ends. Together, nodes and links define propositions, assertions about the domain" [8].

Concept Map was first developed by Joseph Novak and his research students in 1970s at Cornell University [9]. In 1984, [10] published a book "Learning how to learn" in which they presented a full discussion of this technique.

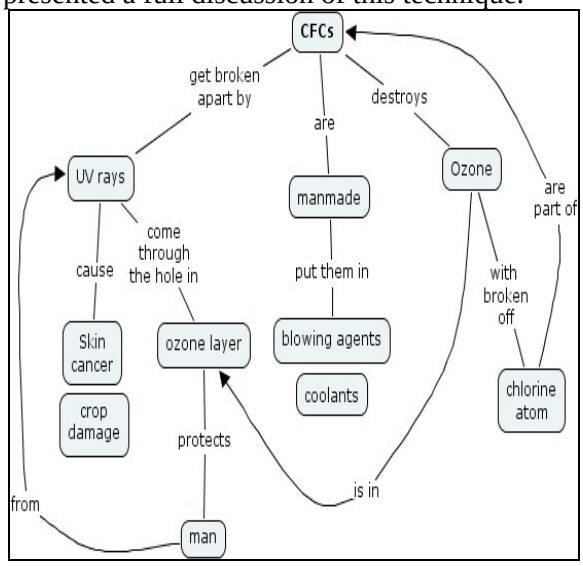


Fig. 1. A concept map is done by eighth-grade student [11].

Currently, concept map is used for checking understanding, planning the instructional curriculum, encouraging critical thinking and creative thinking, facilitating brainstorming, etc. For example, students are required to convert a paragraph to a concept map for checking their understanding. Concept map can help to limit the language ambiguity, facilitate the concept manipulation, and perceive the information quickly. Concept map is often applied for the structured documents in science, chemistry, nursing, etc areas which require representing the relationships among concepts consistently, logically and firmly [12]. Technical documents also require a rigorous structure and thus it can be utilized using the concept map technique.

However, up to now, concept map is only used to support the understanding of the prose structured documents. It means people haven't used concept map to replace completely the prose structured documents. To replace the prose structured documents, concept map has to do an enormous work that is "mapping every key concept and word in every sentence in the whole structured documents". This can be feasible if mapping a few-page document. However, this will be impossible if the documents have a hundred of pages even with the support of concept map software.

There are 6 reasons to explain why concept map is not used to map the whole document. These reasons are the diagrammatic messiness, time/effort consuming and the slowness of concept map software, lack of concept map standard, loss of the goodness of linear sentence-after-sentence document, and inability of representing all English grammar structures:

First, mapping the whole document can be impossible because it can create a huge messy concept map. A very messy concept map is not usable in practice [13].

A messy concept map can be a danger for readers because readers can forget reading some links that are not seen easily. On the contrary, if you have already read all the sentences in a prose document, you will be sure that at least you already read all of them whether you understood them or not.

Second, mapping the whole document (even with the support of Concept Map software) can consume a lot of time and effort because the mappers have to create a lot of links to connect logically all concepts together [14].

Thirdly, because the current concept map software use the drag-and-drop graphical components, a very big concept map can make the Concept map software run very slowly and heavily.

Next, there is no standard for drawing concept map at this moment. The formula for drawing a concept map is rather arbitrary and relies on the creativities of the mappers. For example, the linking word sometimes is a noun, sometimes is a verb, sometimes is a whole sentence, etc. This can make many people feel it hard to understand a particular concept map [10].

Besides, although the linear sentence-after-sentence representation of the prose documents can make it hard for readers to read due to the little spaces among words of the text, the linear prose documents got a goodness that concept map does not have. That is the sentences in the prose document can be organized in a logical sequential order. For example, in an instructional document, the sentences that represent the most basic and easiest knowledge are often discussed first before the difficult ones. However, we can not get that goodness of prose text in the concept map. When we read a concept map, we can not see clearly a logical sequential order of propositions (a proposition in concept map is equivalent to a sentence in the prose text). This is because the spatial text representation of concept map makes readers to capture the meaning as a whole rather than as a logical sequence order. Concept map is often used to represent the propositions which have a highly independence.

Finally, concept map only represent the propositions of the regularity of the facts, events and objects [15]. However, concept map is seldom used to represent the conditional sentences (IF), comparison, relative clause sentences, and other English grammar structures. This is the main reason why concept map is not used to map all sentences in the prose documents.

Hence, to be able to map the whole document, we need a new type of concept map (a new type of technical writing applying concept map) as well as a software that underlines that new concept map. These are the requirements to solve the 6 problems mentioned above.

First, the new type of technical writing has to:

- still inherit the traditional concept map's goodness which includes both minimizing the language-ambiguity and facilitating the effective concept manipulation at the highest level. These benefits are the central points of concept map because they can help readers to speed up their reading comprehension process.
- be un-messy no matter what size the concept map is.
- be easy to be drawn with a lowest effort and in a shortest time.
- adhere a single rigorous standard.
- still keep the goodness of linear sentence-after-sentence documents. That is the propositions should be arranged in a logical sequential order if necessary.
- be able to represent all English grammar structures.

Second, the software that underlines this new technical writing technique should be simple, flexible and easy to be used. Developing a technical document using the new technical writing technique on that software should be as easy as typing a prose text on a word processor. This special software should limit the drag-and-drop graphical components as much as possible in order to be run gently.

6. Applying Concept Map to develop a new technical writing technique

[14] asked an important question for concept map researchers "If maps or other spatial representation can be used for review or can capture the key concepts and relationships in discourse, why should not students learn directly from the map rather than the text?"

The hypothesis of my research is that we can apply the Concept Map to develop a new technical writing technique which is much more effective than the traditional technical writing technique.

The prose documents and even technical documents often got the language ambiguity and inefficient concept manipulation which can slow down the reading performance of readers. Traditional technical writing tries to somehow limit these two problems in technical documents, but it is not as effective as concept map. Concept map can limit the language ambiguity, and facilitate the effective concept manipulation ([16] & [2]) at highest level.

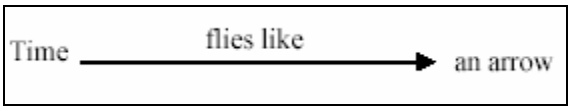
Because the essence of concept map is to link key concepts together, the ability of concept map for facilitating the effective concept manipulation is already clear [2]. We will, now, focus on the ability of concept map for limiting the language ambiguity. However, surprisingly, few researches discuss in details about this ability of Concept Map.

6.1. The ability of Concept Map for limiting the structural language ambiguity

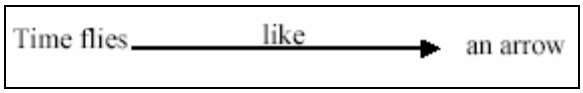
As mentioned in section3, a sentence can have structural language ambiguity.

For example, "Time flies like an arrow" can be understood as "Time(S) flies(V) like an arrow" or "Time flies(S) like(V) an arrow". S stands for subject and V stands for verb.

By applying concept map, we can represent the above sentence as:



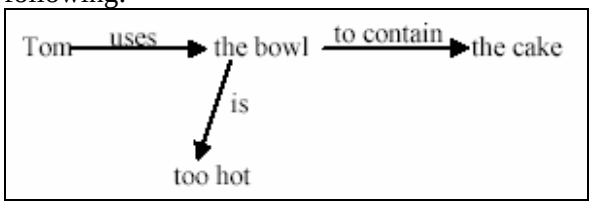
Or



By represent a sentence spatially like this, it will limit the structural language ambiguity because the readers can quickly figure out which word is subject and which is the verb.

Concept map also limits the structural ambiguity across many sentences.

Example: "Tom uses the bowl to contain the cake. It is too hot." (What 'it' refers?). This sentence can be displayed in Concept Map as following:



6.2. Spatial text technical writing (STTW) as a new technical writing type

To response to the 6 problems that prohibit a concept map to map the whole document in the section4, I attempted to propose a new technical writing type which I temporarily call it "spatial text technical writing".

STTW grammar

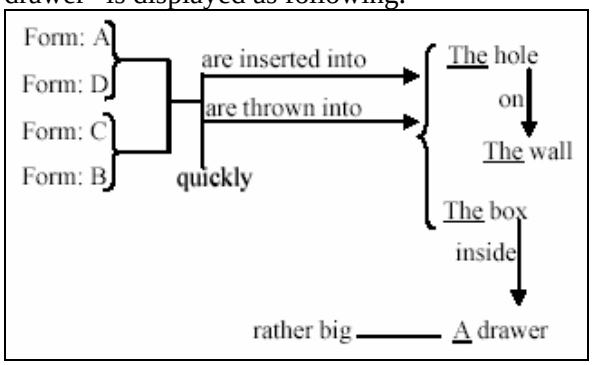
STTW grammar explains how to represent spatially English sentences subject to the English grammar syntax. In STTW:

The verb is represented by sitting on a single arrow just like we did in the concept map. The arrow direction goes from subject to the object in a sentence. If the preposition stands between the verb and the noun, the preposition and the verb should sit on the same arrow. However, if the preposition stands between 2 nouns, that preposition will sit on the arrow linking the 2 nouns.

The adjective is represented by a straight line that connects the adjective to the noun which that adjective modifies. Adverb is also represented by a straight line that connects the adverb to the verb which that adverb modifies. This helps to limit structural ambiguity.

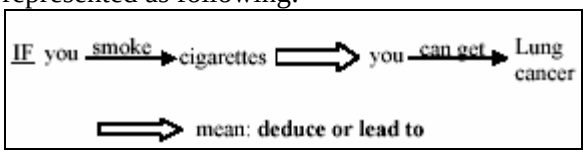
For the Coordinator "AND" and "OR", I adopted to use symbols { and [of logical language. It is because these logical symbols are must more effective in representing the meaning correctly.

Example, "form A and form D or form C and form B are inserted or thrown quickly into the hole on the wall and the box inside a rather big drawer" is displayed as following.



Besides, we can use big arrow to present the deduction for the conditional clauses (IF) and causative clause (Because). This big arrow idea is came from the symbol → of logical language, but its shape was changed to avoid miss using with other arrow symbol which is used to represent the action verb in a sentence in my STTW technique. The symbol → of logical language means "IF…Then". Thus, "a → b" means "if a existed, then b will happened" [17].

For example, the sentence "If you smoke cigarettes, you can get lung cancer" should be represented as following:



7. Conclusion

The major thrust of this research has been to examine the potential of applying concept map technique to develop a new technical writing technique. Concept map is actually a useful method for people to accelerate the reading process. Concept map helps readers to overcome the language ambiguity problems and to manipulate effectively the concepts in the prose text. People can capture the knowledge in the concept map quickly because concept map is very intuitive and attractive. However, the current concept map technique has many limitations that can prohibit this potential happened. These limitations are diagrammatic

messiness, time and effort consuming, the slowness of concept map software, lack of concept map standard, loss of the goodness of linear sentence-after-sentence document, and inability of representing all English grammar structures.

The research suggested a spatial text technical writing (STTW) technique which applied concept map and adopted some logical symbols in KR. The research used many useful examples to demonstrate that STTW can be used to represent the text, particular technical document, effectively and unambiguously.

However, STTW should not be seen as a final solution. This research's main point is to stimulate other researches to think about applying concept map for writing spatially the whole documents.

Besides, the research also pointed out the limitations of the current concept map software such as inflexibility and slowness because the software used heavily the drag-and-drop graphical components. So, a new effective software underlining STTW should be developed in the future. This new software for designing technical documents should be easy-used and run gently.

Finally, if we can develop a technique and software that can help us to enhance the reading comprehension performance of technical documents, we will solve a big problem of human nowadays that is how to digest the technical knowledge in a shortest time and with a lowest effort.

8. Acknowledgements

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