Students' Comprehension for Semantic Relation in Science Textbooks

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Abstract. This study aimed to explore students' comprehension for the semantic relations of Classification and Composition in science textbooks by the Repertory Grid Technique (RGT). We chose a target text from the science textbooks in junior high school and analyzed the semantic relations in this text. In addition, sixty-five eighth grade students participated in this study. They answered the MAST questionnaire after reading a target text. Then the data in MAST would be analyzed by software for RGT. The results showed students could comprehend the difference between Classification and Composition approximately, but were easy to get confuse for more detail relations. They also argued that some semantic forms are poor for understanding some semantic relation. Finally some implications and suggestions were offered for improving science learning.

Keywords: reading comprehension; science language; science learning, RGT

Introduction

The semantic relations of scientific terms are foundational for the organization of scientific information. Halliday (2004) argued that Classification and Composition (C-C) were the two main semantic relations among science words. Classification means the *"kind-of"* relation between the super-ordinate and the sub-ordinate (e.g. *A whale is a kind of mammal*). Composition means the "*part-of*" relation between the whole and its parts (e.g. *The root is a part of plant).* (Unsworth, 2001; Murphy, 2003). These two semantic relations are widespread in the science text topics, such as *Taxonomy of Creatures*; *Earth Structure*; *Acid and Base; and Substance and Atom*. However, to figure out the semantic relations of scientific words in these topics might be difficult because these relations usually were embedded within the text sentences with various forms. For example, "*Acetic acid is a kind of the organic acid*" describes the Classification relaton explicitly. while "*Polymer can be divided into the natural polymer and the synthetic polymer*" states Classification relations more implicitly. That means students need to understand the meaning of these relations from various forms while reading the science texts. It would be interesting to examine how students understand these relations in science reading. Therefore, the purpose of this study would be shed light on the students' comprehension on the C-C relations in science textbooks.

Methodology

Target Text

A paragraph of *Substance and Atom* topic in the science textbook of junior high school in Taiwan was chosen as the target text. The content and relaion features of this target text were analyzed as follows:

(1) Hydrogen gas is composed of hydrogen molecules, (2) and a hydrogen molecule consists of two hydrogen atoms. (3) Because of containing hydrogen atoms only, (4) hydrogen is an element. (5) Similarly, oxygen is also an element. (6) Water produces hydrogen gas and oxygen gas by electrolysis. (7) Each water molecule consists of two hydrogen atoms and one oxygen atom. (8) Therefore, water consists of these two atoms with constant proportion, (9) which called as compound. (10) A mixture is usually blended by two or more than two pure substances with inconstant proportion. (11) For example, air is blended by many pure substances, such as nitrogen gas, oxygen gas, argon gas, carbon dioxide and so on.

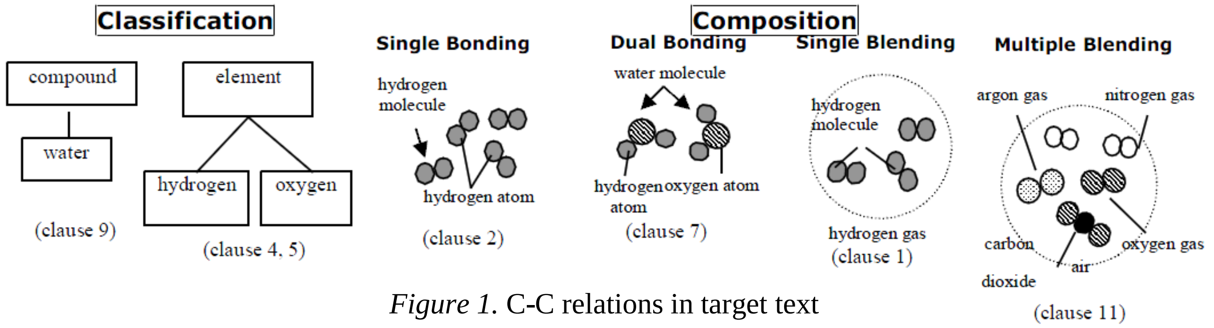

Figure 1. C-C relations in target text

Instrument

A questionnaire of "Matter and Atom Semantic Test" (MAST) was designed by Repertory Grid Technique (RGT) was developed from Kelly's personal construct theory and became a common methodology in science education research, (Bezzi, 1999). In this technique, "*Element*" and "*Construct*" were two core ideas. Figure 2. showed that *Element* meant the lexicon relations between 6 noun sets(e.g. air / nitrogen). *Construct* meant the 11 forms (e.g. divide, include). Each *Element* and *Construct* could pair as a questions in MAST, therefore 66 (6*11) questions could be evaluated from 1 to 5 by their semantics for C-C relations. Cronbach α value of MAST in pilot study was .88 (N=33).

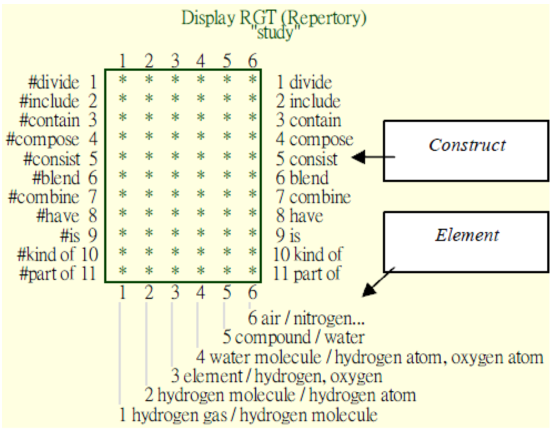

Figure 2. Element and *Construct* in MAST

Participants and data analysis

Sixty-five students of grade 8 of a junior high school participated in this study. They were asked to answer the MAST instrument after reading the target text. The data would be analyzed by RepIV 1.10 software for RGT.

Findings

Students' comprehension

In Figure 3, *element/hydrogen and oxygen* and *compound/water*, indicating the Classification, were distributed at the right side of horizontal axis. The result showed students could distinguish Classification from Composition and understand the meaning of multi-blending Composition (e.g. *air/nitrogen gas*) was different from other Compositions. Furthermore, the distribution of the rest of Compositions in Figure 3 might implied that students might not definitely understand the differences among the single-bonding, dual-bonding, and single-blending Composition and the acutal relations that the form of *compose of* or *consist of* indicated. In addition, students argued *is* and *kind of* were fit to interpret Classification relation; *blend* is fit for the multiple blending Composition (air/nitrogen gas) and *compose of* and *consist of* could be used for dual-bonding. However, some forms were located near the axis cross (e.g. *include, have, contain,* and *part of*). This result showed that students might not think these forms could interpret C-C relations definitely, or they might not recognize the real relations the forms interpreted. In conclusion, these results implied that students could recognize the C-C relations but they also got confused for some of Compositions. In addition, students argued that some forms were poor for interpreting the semantic relations because of their obscurity in interpreting the semantic relations.

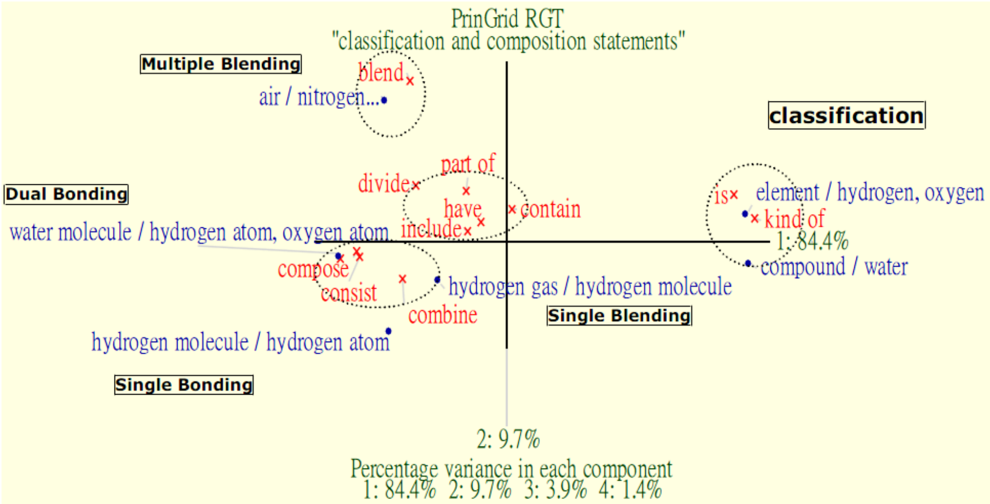

Figure 3. Students' comprehension regarding C-C relation

Conclusion and Suggestions

In this study, the sophisticated Classification and Composition relations were found in a short target text in science textbooks, students could undersand Classification was different from Composition, but they could not recognize further the complicate meaning of some Composition relations. They also showed some forms could make them recognize the semantic relations easily, but some could not. These results implied students might confront the understanding difficulities in semantic relations while reading the science textbooks. Therefore, we suggested that science teachers could pay attention to the meanings of semantic relations in science textbooks, and students' reading comprehension for these semantic relations.The obstacles of science learning were common for students due to the misunderstanding of science language (Wellington & Osborne, 2001). Students need to understand the semantic relations of words by reading the languate of science textbooks, and the lanugate of science might be the obstacles for science reading and udnerstanding. Thus it is worht to concern the conprehension difficulties of science learning while students read the science textbooks.

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