US-China Education Review B 4 (2011) 467-474
Earlier title: US-China Education Review, ISSN 1548-6613

Utilizing a Graphic Organizer for Promoting Pupils' Argumentation

Fu-Pei Hsieh
Kuang-Hua Primary School,
Kaohsiung, Taiwan

Sung-Tao Lee
National Taichung University of Education,
Taichung, Taiwan

The purpose of this study was utilizing a GO (graphic organizer) for promoting pupils' argumentation. The method of case study was employed. A total of eight fifth grade pupils from two classes were assigned (n = 4, two high achievers, two low achievers) with GOI (graphic organizer instruction), and the others (n = 4, 2 high achievers, 2 low achievers) received no treatment. The instrument was composed of six open-ended questions based on Toulmin's Argument Pattern (Toulmin, 1958). Qualitative data were collected and analyzed through qualitative description. The results indicated that students with GOI performed better on recognizing data, claim, warrant and backing than the others. They can make main claims and justify them by data provided in the text and their claims were consistent with data, warrant and backing. Additionally, they all thought that GOI was an effective method for promoting argumentation. On the other hand, students without GOI made less important claims and supported them only by their own experience and opinions. Finally, the interviews showed that the low achievers benefited more from GOI than the high achievers and the GOI can facilitate both the comprehension and argumentation ability.

Keywords: argumentation, graphic organizer, graphic organizer instruction

Introduction

Kuhn (2005) stressed that argument is a way to comprehend and has the virtue of exhibiting its importance. An individual's potential would be decreased without the arguing ability. Siegel (1995) thought that argumentation is involved with the force of reasons. Rationality is essential for someone to solve problems effectively and live professional life. It links education and argumentation and provides educators to care about argumentation. Many scholars (Duschl & Osborne, 2002; Lewis & Leach, 2006; Nussbaum, 2002) mentioned that developing students' argumentation skills is an important component of developing their active learning, reasoning, critical thinking and assessment.

How to advance students' argumentation skills? Many investigations revealed that structured knowledge, the use of prior knowledge and cognitive ability, making thinking overt and GO (graphic organizer) are effective components for argumentation (Duschl & Osborne, 2002; Hyerle, 1995). Recently, there have been a number of studies found that argument mapping is an effective method for students to organize the arguments in text and facilitate logical reasoning (Butchart, Forster, Bigelow, Oppy, Korb, & Gold, 2009; Dwyer, Hogan, & Stewart, 2010; Twardy, 2004; Gelder, 2002). Dwyer et al. (2010) discovered that psychology students who

Fu-Pei Hsieh, Ph.D., Kuang-Hua Primary School.
Sung-Tao Lee, Ph.D., Department of Science Application and Dissemination, National Taichung University of Education.

studied the argument maps scored higher than those who studied on tests of memory. Butchart et al. (2009) observed that when the automated argument mapping exercises were used, undergraduate students showed a higher improvement in critical thinking. Twardy (2004) detected that argument mapping often showed precisely and made students fix their errors. Nevertheless, Hyerle (1995) pointed out that GO and simple maps for structuring information are a few tools being used to activate student learning. Lee, Hsieh, Lin, and Chen (2009) ascertained out that fifth and sixth competent readers can easily identify the conclusion and supported evidence that were hard to be persuaded by the counterparts. All good and poor readers liked underlining specific words or phrases to assist their comprehensions while reading. However, they did not make any mention of uncomplicated GO and maps in reading science argumentative texts.

Furthermore, based on Ausubel's cognitive theory, concept maps are generally graphical tools for organizing and representing knowledge, and showing the relationships among concepts. They are composed of concepts, link, and cross-link, linking phrases, hierarchical structure and example (Chang, Sung, & Chen, 2002). However, Anohina, Pozdnakovs, and Grundspenkis (2007) stressed that there were a variety of concept map tasks with different degrees of difficulty. At the first stage, the learner can request to reduce the degree of difficulty during the task-solving. Besides, Griffin, Malone and Kameenui (1995) said that GO was developed to translate Ausubel's meaning learning into practice. They examined that participants acquiring the GO instruction performed better on the measure of transfer than the control groups. It appeared that GO was a simpler instrument for a novice at reading science argumentative texts.

For these reasons, the purpose of this study was utilizing a GO for promoting pupils' argumentation. In this paper, the authors described the development and assessment to assist elementary school students in argumentation. Three research questions constructed the present study, which are: (1) Do students who use a GO perform better on the reading of science argumentative text? (2) For students who used a GO during reading, do they think GO helpful for their reading? and (3) Do students after GOI (GO instruction) have better perceptions in their reading?

Research Design

In present study, a quasi-experimental, pre- and post- test was used. The pretest was executed at the beginning of the research. The data collection during this study included a series of measurements from two testing situations: a pretest administered prior to the GOI and a post-test. The pretest attempted to assess students' prior abilities about reading science argumentative text. The post-test was performed as a measure of learning resulting.

Subject

A total of eight fifth grade pupils from two classes were assigned (n = 4, two high achievers, two low achievers) with GOI, and the others (n = 4, two high achievers, two low achievers) received no treatment.

Achievement level (high and low) is based on Mandarin course grades last semester. Grade percentages used for achievement categories were as follows: Low (less than 16%) and High (more than 84%), that is, the score of the low level was lower than one SD (standard deviation), and the high level was upper than one SD. One female student and one male student were included in each group.

Instrument

Both groups read the identical science texts and the same instruments were administered. The instruments

were executed in pretest and post-tests, which were composed of two parts, that is, the texts without titles about different topics and six open-ended questions followed the text based on Toulmin's Argument Pattern (Toulmin, 1958). The texts constructed by authors were about "nutrition of tomato" and "understanding earthquake", while the questions were:

(1) What is possible title of the passage? (Students were guided to write suitable titles with the passage.)

(2) What topic is the passage concerned? (Students were asked to completely describe the topics.)

(3) What are the key claims or ideas proposed in the passage? (Students recorded what they found appropriately from the passage.)

(4) What evidence will support author's claim in the passage? (Students interpreted claims by providing evidence for each claim.)

(5) Do you believe author's claim, why or why not? (Students justified claims by their backing, warrant or rebuttal.)

(6) Can you think of any associations with the passage? (Students compared their ideas with additional sources.)

Treatment

The treatment in the current study was GOI, and the participants were divided into the control group and the GOI group (experimental group). The study took place over five weeks. Each class lasted for 50 minutes. In week 1, all participants were asked for a pretest. From week 2 to week 4, experimental group was provided with an instruction on GOI. In the last week, all participants were asked for a post-test.

In view of the previous research, GOI in this study includes five principles of instruction for reading science argumentative texts. The instruction texts without titles constructed by authors were about "the contribution and harm of plants", "effective vision and safe driving", and "understanding of corrosion". We take the first instruction text, the contribution and harm of plants, for an example:

Important words and concepts were analyzed for students to understand. For example, seaweed, photosynthesis, carbon dioxide, oxygen, eutrophication, etc..

Students were asked to verbalize the relationships of concepts. The example is as in Figure 1.

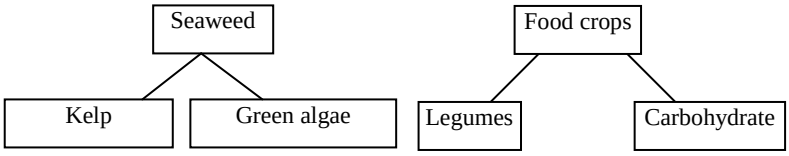

Figure 1. The interrelationships of concepts from Jack's (GOI—low achiever).

Students were asked to organize the concepts by visual GO. The example is as in Figure 2.

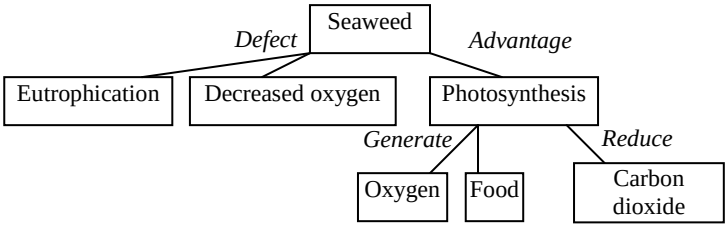

Figure 2. Demonstrate the relationships among concepts.

Students reflected on the information by responding to the questions in the instrument. For example, advantage of food crops (Jack's previous answer on the first question—title), and he had a quite different perception of the problem and said that "I think my answer is not good for the title".

Give feedbacks to students in accordance with their answers. For example, after reflecting the demonstrating figure, Jack (GOI—low achiever) modified the title "advantage and defect of the plant".

Data Collection and Analyses

After reading the text, students were asked to answer the six open-ended questions. At the end of the task, a semi-structured interview was conducted. Two questions were identical for both groups, for example: "Were the texts difficult for you? How did you think when completing them?". Two questions were different to think about the treatment; for example, for the control group: "Do you use any effective way in reading the text? How?". The corresponding question for the GOI group: "Do you think the GO is an effective way to help you to read? Why?".

Data from the instrument and interview were accumulated on a spreadsheet to develop the main categories. The two researchers then met to discuss differences in categories and grouping criteria. Through discussions, a scoring mechanism was used to organize the explanations students provided for their responses under the appropriate category. Then, qualitative data were collected and analyzed through qualitative description.

Findings and Discussions

Assertion 1: Students with GOI performed better on recognizing data, claim than the others. They can make main claims and justified them by data provided in the text and their claims were consistent with evidence.

Students without GOI could not make main claims and justify them by data provided in the text (see Table 1). Tom (control—low achiever) answered to the third and the fourth questions on the post-test, "What will happen during earthquake and an earthquake strike in many places (the third question—claim); Earthquake epicenter occurred near Taiwan for nine times (the fourth question—evidence)". Mary (control—high achiever) wrote: "The earthquake in Taiwan caused serious damage (the third question—claim); The earthquake caused serious damage (the fourth question—evidence)". The low and the high achievers only underlined few keywords and no more strategies used during reading. They were discordant opinions on claim and evidence. Because the frequencies of the earthquake could not be the evidence of what would happen during the earthquake. In addition, the high achiever wrote the same on claim and evidence. These data showed that the students in control group could not explain the claim by applicable evidence and got confused, even though a high achiever.

Table 1

Students' Performances on Claim and Evidence

Students	Third question—claim	Fourth question—evidence
Control (low)	What will happen during earthquake and an earthquake strike in many places.	Earthquake epicenter occurred near Taiwan for nine times.
Control (high)	The earthquake in Taiwan caused serious damage.	The earthquake caused serious damage.
GOI (low)	The earthquake caused serious damage and fright.	The earthquake is too impossible to anticipate when it will happen and to prevent damage.
GOI (high)	The earthquake is only a natural phenomenon which is the result of a sudden release of energy in the Earth's crust.	A larger earthquakes release greater energy and influence coverage hugely.

Within the GOI group, however, students performed better on recognizing data and claim than the others. Jack (GOI—low achiever) replied: "The earthquake caused serious damage and fright (the third question—claim); The earthquake is too impossible to anticipate when it will happen and to prevent damage (the fourth question—evidence)". Pam (GOI—high achiever) also saw the distinctions, "The earthquake is only a natural phenomenon which is the result of a sudden release of energy in the Earth's crust (the third question—claim); A larger earthquakes release greater energy and influence coverage hugely (the fourth question—evidence)". While interview, Jack said: "Because the earthquake does not precisely anticipate through technological devices nowadays, it did cause serious damage and fright". Pam considered that there is stupendous energy in the Earth's crust, when it is released, it would influence us.

In Figures 3 and 4, the experimental students constructed their own GO to help they understand the content. We can find that the low and the high achievers utilized different words and concepts. The low achiever employed the word which they were familiar with experience like "damage" and "fright", yet the high achiever paid attention to the new concepts like "coverage" and "Earth's crust". No matter what they noticed, they could figure out the texts by the GO they organized and found the consistence on claim and evidence.

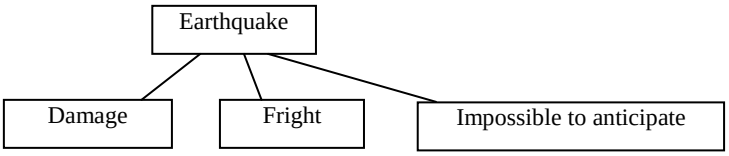

Figure 3. Parts of the interrelationships of concepts from Jack's (GOI—Low achiever)

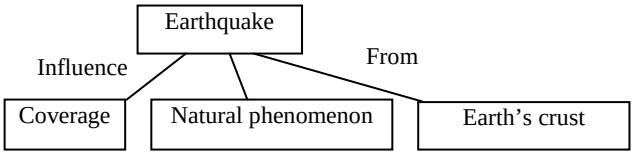

Figure 4. Parts of the interrelationships of concepts from Pam's (GOI—high achiever).

Assertion 2: Students with GOI all thought GOI was an effective method for promoting their reading abilities in argumentation. On the other hand, students without GOI made less important claims and supported them only by their own experience and opinions.

Table 2

Students' Perception on Reading Science Argumentative Texts

Students	Students' perceptions
Control (low)	The text was too long and hard to figure out… I did not know what the answers to the questions are.
Control (high)	The texts I perused are very difficult to understand, I did not grasp the main meaning of the all passage during I read.
GOI (low)	I thought that GOI helps me to understand the text because I had to relate each main concept together.
GOI (high)	GOI let me to find the data, claim, warrant and backing… then help me understand what we were learning.

Students' replies from the control group viewed the texts as puzzles with much trouble answering the questions (see Table 2). Amy (control—low achiever) complained during reading the texts, because "The text was too long and hard to figure out… I did not know what the answers to the questions are". Her answer to the fifth question, "I believed the author's claims, because the earthquake really happened (the fifth question—warrant)". Paul (control—high achiever) also said: "The texts I perused are very difficult to understand, I didn't grasp the main meaning of the all passage during I read". And he answered, "I believed the

author's claims, because the earthquake often occurred in Taiwan (the fifth question—warrant)". According to both Amy's and Paul's replies, they did mention of what the author had said, they justified by their own experience or opinions, not by evidence the author provided.

Within the GOI group, however, students felt that they had to think differently when completing the questions; Jean (GOI—low achiever) answered, "I believed the author's claims, because the author talked a lot of good sense about the earthquake (the fifth question—warrant)" and explained, "I thought that GOI helps me to understand the text because I had to relate each main concept together".

Adam (GOI—High achiever) also saw the distinctions, "GOI lets me to find the data, claim, warrant and backing… then help me understand what we were learning". And he responded, "I believed the author's claims, because the author gave lots of illustrations about the earthquake (the fifth question—warrant)". The experimental students used the GO to relate the main ideas in the text and viewed GO as an effective method for promoting argumentation. Besides, they justified by evidence the author supplied, not by their own experience or opinions.

Assertion 3: The interviews showed that the low achievers with GOI from which benefited more than the high achievers and the GOI can facilitate students' reading comprehension abilities.

The low achievers claimed and judged by the context incorrectly during pretest (see Table 3). Jack (GOI—Low achiever) answered to the third and the fourth questions on the pretest, "Every one should eat 30 milligram of tomato in a day (the third question—claim); To ease the damage of alcoholic drink and cigarette (the fourth question—evidence)". But as we know, eating 30 milligram of tomatoes in a day could not ease the damage of alcoholic drink and cigarette. That means that students did not understand the relationship of claim and evidence. After GOI, he replied more precisely with confidence on the post test: "The earthquake caused serious damage and fright (the third question—claim); The earthquake is too impossible to anticipate when it will happen and to prevent damage (the fourth question—evidence)".

Table 3

The Performance and Interviews With GOI Group

Test	Students	Interview	Third question—claim	Fourth question—evidence
Pretest	Low achiever		Everyone should eat 30 milligram of tomato in a day.	To ease the damage of alcoholic drink and cigarette.
Post-test	Low achiever		The earthquake caused serious damage and fright.	The earthquake is too impossible to anticipate when it will happen and to prevent damage.
	High achiever	GOI lets me to be clear about the context and give a better title to the texts.		

The high achievers made great progress in title. Pam's (GOI—High achiever) reply to the first question on the pretest was "advantages of tomato". But this title could not display the whole texts. After GOI, she understood clearly whether the title revealed the contents of the texts or not. Pam interpreted, "GOI lets me to be clear about the context and give a better title to the texts".

These revealed that students got different advantages from GOI, because they could not realize the components of the argumentation at the beginning of the instruction. During GOI, they needed to think the relationships of all concepts and phrases, seeing the claim should be supported by the evidence, and the title had to show the contents. At the end of the treatment, they made much greater advancement. Besides, the present study showed that the low achievers advantaged more than the high achievers in GOI group and they

thought GOI assisted their comprehension and argumentation.

Conclusions and Implications

The reports were positive in argumentation with the GOI on fifth graders in Taiwan. These findings indicated that answers which the students in GOI group replied consisted with the interview and they could relate the main ideas in the text and response to the questions more accurately than the control group. That is, the results from this experiment suggest that GO is an effective tool for all experimental participants to read argumentation texts, especially students with lower achievement . They attempted to use a simple GO to make the connections in perusing. Furthermore, the results are particularly meaningful when the subjects begin to utilize the GO for argumentation and cognitive learning.

The findings suggest that there are different apprehensions and outcomes in completing GO. Especially, the low achievers got more gains than the high achievers. The low achievers could understand the texts in spite of using simpler concepts and phrases. There are two possible reasons for this finding. First, they could figure out the relationships of concepts. Second, they could perceive that they could read and understand the texts. Thus, the relationships of concepts were the key factor for reading and understanding. These were supported by Ausubel's (1968) theory that cognitive structure is an important variable in learning.

As Yerrick's research (2000) displayed that the lower track students' arguments were improved with tentativeness of claims, use of evidence and viewpoints about the scientific authority. In the present results, the low achievers were less than 16% students on Mandarin course grades last semester. They had a few difficulties while reading a lot of texts, and in the beginning of the treatment, they felt more trouble during reading science argumentative texts. After GOI, they could use a GO and comprehend the texts more easily. It actually encouraged the researchers to apply a GO for aiding students' science learning, that is, it could be possible to make low achievers progress.

In spite of small sample in this study, it did support a little evidence that there is a necessity to attempt GOs while reading science argumentative text. When the concepts are linked, it can provide students meaningful understanding. To sufficiently use visual strategies, students need to have occasions to engage in mapping the relationships that require them to relate the conceptual ideas within the context. Overall, the results of the current study revealed GO as a very beneficial tool for organizing concepts and understanding.

Further research is needed before we understand the conditions that best foster argument comprehension through GO, and compulsory to observe the circumstances that influence levels of achievement and find other variables that might effect on comprehension, such as motivation and disposition. In addition, the effects in GO on general reasoning ability should be examined, based on the results that the construction of GO can assist deeper understanding. Such research would provide an important further test of the effect of GO on learning and critical thinking.

References

Anohina, A., Pozdnakovs, D., & Grundspenkis, J. (2007, July). Changing the degree of task difficulty in concept map based assessment system (pp. 443-450). Proceedings of *the IADIS International Conference "e-Learning 2007*". Lisbon, Portugal.

Ausubel, D. P. (1968). *Educational psychology: A cognitive view*. New York: Holt, Rinehart & Winston.

Butchart, S., Forster, D., Bigelow, J., Oppy, G., Korb, K., & Gold, I. (2009). Improving critical thinking using web-based argument mapping exercises with automated feedback. *Australasian Journal of Educational Technology, 25*(2), 268-291.

Chang, K. E., Sung, Y. T., & Chen, I. D. (2002). The effect of concept mapping to enhance text comprehension and summarization. *The Journal of Experimental Education, 71*(1), 5-23.

Duschl, R. A., & Osborne, J. (2002). Supporting and promoting argumentation discourse in science education. *Studies in Science Education*. *38*, 39-72.

Dwyer, C., Hogan, M., & Stewart, I. (2010). The evaluation of argument mapping as a learning tool: Comparing the effects of map reading versus text reading on comprehension and recall of arguments. *Thinking Skills & Creativity*, *5*(1), 16-22.

Griffin, C. C., Malone, L. D., & Kameenui, E. J. (1995). Effects of graphic organizer instruction on fifth-grade students. *The Journal of Educational Research*, *89*(2), 98-107.

Hyerle, D. (1995). Thinking maps: Seeing is understanding. *Educational Leadership*, *53*(4), 85-89.

Kuhn, D. (2005). *Education for thinking*. Cambridge, M. A.: Harvard University Press.

Lee, S. T., Hsieh, F. P., Lin, Y. W., & CHEN, P. J. (2009). A comparative investigation of students' reading comprehension performances in science argumentative text. Paper presented at *the Annual Conference of the Australasian Science Education Research Association (ASERA)*. Geelong, Australia.

Lewis, J., & Leach, J. (2006). Discussion of socio-scientific issues: The role of science knowledge. *International Journal of Science Education*, *28*(11), 1267-1287.

Nussbaum, M. E. (2002). Scaffolding argumentation in the social studies classroom. *Social Studies*, *93*(3), 79-84.

Siegel, H. (1995). Why should educators care about argumentation. *Informal Logic*, *17*(2), 159-176.

Toulmin, S. E. (1958). *The uses of argument*. Cambridge: Cambridge University Press.

Twardy, C. (2004). Argument maps improve critical thinking. *Teaching Philosophy*, *27*, 95-113.

Van Gelder, T. (2002). Argument mapping with reason: Able. *The American Philosophical Association Newsletter on Philosophy and Computers*, *2*(1), 85-90.

Yerrick, R. K. (2000). Lower track science students' argumentation and open inquiry instruction. *Journal of Research in Science Teaching*, *37*(8), 807-838.