Making Graphic Organizers of Graph Vocabulary

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This study investigated the use of a modified version of the Frayer model as graphic organizer to improve the vocabulary comprehension of Japanese university students. Students were separated into test and control groups. Pre- and posttests on graph vocabulary comprehension were administered to both groups. The test group alone used model cards with the modified framework, but both groups completed the assigned graph exercises. A questionnaire was then administered to assess student feelings of the modified model's usefulness. Although results showed improvement in both groups, the test group showed a larger gain in mean scores, and they found the model helpful in graph vocabulary comprehension. Findings suggest the modified Frayer model has potential to help students better understand graph vocabulary.

日本人大学生による語彙の理解を高めるためのｸﾞﾗﾌｨｯｸｵｰｶﾞﾅｲｻﾞｰとして、修正したFrayer modelを使用することについて調査した。学生を試験群・対照群に分け、両群に対し事前と事後にｸﾞﾗﾌ用語の理解度を測定するテストを実施した。両群は指定されたｸﾞﾗﾌ演習を行ったが、試験群の 学生だけが修正された枠組みに従ってﾓﾃﾞﾙｶｰﾄﾞを使用した。演習後、修正ﾓﾃﾞﾙの有効性に対す る学生の反応を調べるためにｱﾝｹｰﾄを実施した。両群ともに理解度の向上が認められたが、試験 群の平均値がより大きく上昇し、学生は、ｸﾞﾗﾌ用語を理解するのに本ﾓﾃﾞﾙの使用が有効であると 感じていた。これらの結果から、修正したFrayer modelの使用によって、ｸﾞﾗﾌ用語に対する学生の 理解を高められる可能性が示唆される 。

This paper came about in part from my talk at the 20th Anniversary Conference, Tokyo in an attempt to develop a student-generated approach that would improve learner comprehension of graph vocabulary. In my short talk, I introduced a word card based on the original Frayer model for vocabulary acquisition, providing participants with reasons why the model as graphic organizer was developed, and a step-by-step procedure on how to create and use the model effectively in class. As in my talk, I start this paper by defining a graphic organizer, by explaining the original Frayer model word card and why it should be corrected, and by introducing a modified

version of the Frayer model. This is followed by an outline of my study which sets out to determine the usefulness of my version of the Frayer model word card for learners. Finally, I draw some conclusions from the study, reflect on the model's relevance to learner development and then go over how use of the model has impacted classes since the conference talk.

Introduction

A graphic organizer is defined as a two-dimensional visual framework that presents conceptual relationships (Rice, 1994; Vaughan, Vos, & Schumm, 2007). The basic structure of an organizer has boxes or circles, or both, with connecting lines that can visually represent the ways in which ideas link with one another and how words can be classified and described.

The Frayer model word card is one type of graphic organizer. It assists students in describing vocabulary in detail. The model (see Figure 1) is a large square made up of four quadrants with a circle in the middle. Inside each quadrant is a category by which the given word can be described (Greenwood, 2002; Nessel & Graham, 2007), and these categories help explain which characteristics relate and do not relate to a concept (Frayer, Frederick, & Klausmeier, 1969).

Relevant Attributes - measured in grams - property of all matter - an object's weight is different from its mass	**Irrelevant Attributes** - static forces - projectile motion
Example An American penny has a mass of 2.50 grams	**Non-Example** A carton of milk contains 1 liter (volume, not mass)

Figure 1. Example of original Frayer model.

When used in the original model, the irrelevant attributes and non-examples of a math concept (such as *yard*) or a social studies concept (such as *states' rights*) were found to be as useful for student comprehension as the term's relevant attributes and examples (Monroe & Pendergrass, 1997; Peters, 1974). However, could the same

model apply to abstract vocabulary used to describe graphs, such as *slightly*? I assumed that the model might not work because many possible non-examples and irrelevant attributes of a graph word could exist—for example, the representation of the concept *slightly* may vary based on perception (Wiemer-Hastings & Xu, 2005)—and therefore, the model would not necessarily promote a clearer, deeper understanding of the targeted graph vocabulary. It seemed that the original Frayer model may be somewhat incompatible with abstract graph terms, and so a modified form was deemed more appropriate.

The Study

The purpose for developing an alternative graphic organizer based on the original Frayer model was to find an effective way of helping students comprehend abstract graph vocabulary. In the modified version of the Frayer model, new headings were assigned to each of the four quadrants. That is, it retains the original box-like structure of the original, with a circle in the middle, but the categories in each box differ (see Figure 2).

Definition (in own words)	**Synonym/Antonym**
Visual Representation	**Example Sentence (in own words)**

Figure 2. Example of graphic organizer based on original Frayer model.

Research Questions

1. What effect would this modified graphic organizer based on the original Frayer model have on student comprehension of graph vocabulary?

2. Would the students find this modified version of the Frayer model useful?

Context

The study was conducted in two compulsory English Technical Writing classes for first-year Masters Chemistry students at a university in western Japan. The students met once a week for 90 minutes. Thirty-six students participated in the study and were divided equally into two classes (based on pre- existing class allocations) at roughly the same, relatively low English proficiency level. The study took place near the end of the second half of the term during the two-week unit on describing graphs.

Procedure

For the purposes of the study, students were divided into two groups: the test group and the control group. Twenty graph vocabulary items (Figure 3) were chosen for the study. The targeted words were selected because they were required terms for the final exam and were neither used nor discussed in any previous units in the textbook (Mann & Wever, 2007). All vocabulary items were chosen to have the same relative language burden for students (see Nation, 2006). One way to assure this is to restrict the words by grammatical category (Dodigovic, 2013), so verbs and adverbs were chosen as they represented the majority of words to be tested.

Figure 3. List of graph vocabulary words

Both the control group and the test group were given the same multiple-choice test on the targeted words before

swiftly	considerably	fluctuate	collapse
substantially	dramatically	climb	plunge
abruptly	gradually	soar	crash
steadily	significantly	flatten out	bounce back
moderately	slightly	shoot up	level off

and after the graph unit (see Appendix). Between these test sessions, the instructor gave both groups identical graph description exercises to learn the graph vocabulary. In addition, both groups were given the time and encouragement to study the targeted vocabulary.

After the pretest, each student in the test group was given 20 word cards based on the new version of the Frayer model, on each of which was written one of the targeted graph terms. These students were instructed to fill out the cards. They were also encouraged to write L1 equivalents on the cards (in the *Definition* quadrant), as it would support a form-meaning link between the L2 word and the L1 word already present in memory (Nation, 2001). Once completed, the cards were examined by the instructor to check that all quadrants were filled. Upon examination, all test group students had written information in each quadrant. However, some only wrote single-word entries for three of the four quadrants (excluding visual representation), while others provided more details (e.g. short lists). For each graph exercise (e.g. a pair work graph description exercise using no numbers) over the course of the unit, the students were asked to refer to their own model cards to help them describe/explain the graph data.

At the end of the unit, a multiple choice posttest was administered to both groups. The questions on the posttest were identical to those on the pretest. Afterwards, a questionnaire was distributed to all test group students to determine if they felt the model cards were useful.

Results

Research Question One

Table 1 shows the results of the pre- and posttests of 36 test and control group students.

Table 1 Results of Pre- and Posttests Evaluating Graph Vocabulary Comprehension

Note. Tests were on 20 multiple-choice vocabulary items. The maximum score for each test was 20.

According to the results of paired sample (2-tailed) *t* tests, carried out to judge whether the students improved

Group	*n*	Test	*M*	*SD*
Control	18	Pre	9.72	2.78
		Post	14.94	2.78
Test	18	Pre	7.72	2.08
		Post	13.78	3.49

their comprehension with or without the new version of the Frayer model, a statistical significant change

between the pre- to posttest scores for both the control group and the test group resulted: $t(17) = -5.958$, $p < .05$ for the control group and $t(17) = -6.882$, $p < .05$ for the test group.

Although the test group's pretest and posttest mean scores were lower than those of the control group, there was a larger gain in mean score on the posttests by the test group than by the control group. This is further evident after examining the test data in histograms (Figures 4 and 5), which show a greater positive shift in test scores for most of the students in the test group compared to the control group.

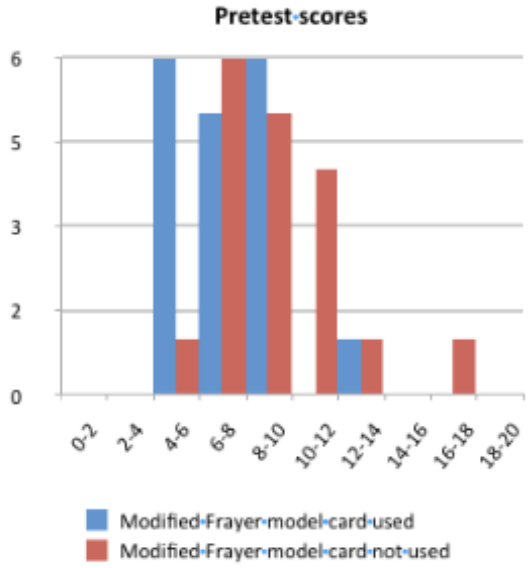

Figure 4.
Pretest scores of test and control groups ($n = 18$).

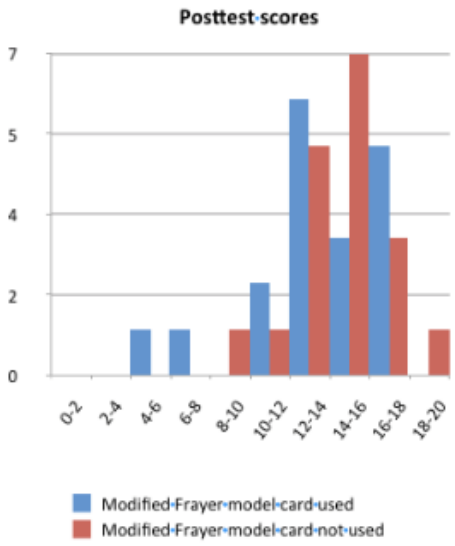

Figure 5.
Posttest scores of test and control groups ($n = 18$).

As for the standard deviation of both groups, the test group experienced a greater deviation from the average score on the posttest than the control group, implying that some students in the test group scored much better or worse than the average. In fact, two-thirds of the test group students—the very students who wrote many more details than the others in each of the four card quadrants—made significant improvement gains (50% or higher) on their test scores, while the rest made smaller increases or none at all (see Table 2).

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Table 2

Results of Individual Test Group Pre- and Posttest Scores

Student	Pretest	Posttest
1	6	14
2	6	17
3	6	15
4	7	14
5	5	13
6	9	15
7	10	17
8	10	18
9	7	5
10	7	14
11	13	13
12	7	18
13	9	12
14	8	11
15	9	13
16	8	15
17	6	17
18	5	7

Research Question Two

Table 3 shows the results of a two-part student feedback questionnaire, completed by test group students only at the end of the graph description unit. In answer to the first question, all students in the group affirmed they had a better understanding of the vocabulary. As for the second part, all feedback on card use was positive, mainly focusing on the card's usefulness in aiding comprehension and recall of the graph vocabulary.

Table 3

Questionnaire Feedback from Test Group on the use of new model cards

Question	Yes	No
1. Do you have a better understanding of the vocabulary using the cards?	18	0
2. Write feedback on the use of the graph cards.	Sample Feedback: • Definition and illustration are useful for me • Graph cards (have) many words, so I can explain graph details • I can also understand synonyms • I understand meaning of graph vocabulary • Easy to remember using graph cards • I can study not only definitions (of the word) but also synonyms	

Discussion

Results from this study provided evidence to help answer the two research questions. The first question asked what effect this modified graphic organizer based on the Frayer model would have on the learner's understanding of the graph vocabulary. Results revealed that based on posttest mean scores, the test group using this modified version based on the Frayer model with graph-related textbook exercises did not do better in comprehending concepts than the textbook-focused control group. Yet, in considering *the size of the improvement* between the two groups, the test group showed slightly more improvement in mean score than the control group, lending (partial, at least) support to Peters' (1974) claim that the Frayer model helps facilitate the understanding of concepts (p. 108).

The second research question asked if the students found the modified version of the model to be useful. The students responded positively to the modified graphic organizer based on the Frayer model and appreciated its usefulness in deepening their knowledge of the vocabulary, and this matched teacher expectations. What may have accounted for this positive feedback was that each student's set of model cards was developed by the student him- or herself, and that they were encouraged to use, share, and discuss card information with other students while doing graph-related activities in class.

Conclusion

The findings in this study suggest that the use of my alternative graphic organizer based on the Frayer model to help students themselves understand graph vocabulary has potential. In studying this modified version of the model's usefulness to students and its effect on their comprehension, it is fair to conclude that (a) the test group students found the modified version of the Frayer model useful, largely because this model aided them in arranging, describing and explaining, and remembering a great deal of known and new lexical information about each graph word, that (b) the student group using the cards made relatively greater improvement in their comprehension of the graph vocabulary than the group using textbook exercises alone, and that (c) the test group students who made the greatest improvement on the posttests had written the most information in each quadrant on their word cards.

Upon reflection, I feel the model presented in this study had relevance to the learner development group and conference. Despite the criticism that the model is laborious and a large use of student time (Greenwood, 2002), the model is *learner-generated* and *learner-directed*. The number of details the students write on each of their own cards depends on student input and interest; the teacher merely serves to give feedback on what they have written and provide activities that encourage the use of the model cards. Second, in line with the theme of the LD20conference, the model presented a somewhat different perspective or way of thinking—in this case, on vocabulary comprehension. This alternative graphic organizer based on the Frayer model is unlike a dictionary or simple word card entry, as it encourages students to efficiently compile a great deal of appropriate, meaningful and detailed information about a (graph) term on a single card.

Post Script

Since presenting this study at the LD20 conference, my modified graphic organizer based on the original Frayer model has continued to positively impact on student comprehension of the targeted graph vocabulary. My current students are required to give a presentation (general or technical) using graphs, and so, to better understand graph language, these cards have been both created and used by the students. What I have found, as

before, is that with the help of the cards, all of the students improved in graph-related exercises in the graph description unit and in their explanations of the graphs in their own presentations at the end of the class term. Several students have reported to me that although it took time for them to write out details on the graph model cards for themselves the cards have been useful in more fully comprehending the targeted vocabulary. Moving forward, I plan to keep using these cards as self-study aids for students to help them remain engaged in the learning process. I would further encourage the students to create other categories if they wish in order to better understand the key terms.

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Appendix
Graph Vocabulary Comprehension Test

Graph Vocabulary Test Name: _____ Class #:____ Score: _____
Task: The following 20 words are used in describing graphs. For each of the words below, circle the definition that best describes its meaning.

1. Swiftly a. to move slowly b. to move quickly c. to move at a constant rate d. None of the above	11. **Crash** **a.** to decrease slowly b. to move up and down c. to decrease sharply d. None of the above
2. Fluctuate a. to move slowly b. to move up and down c. to move quickly d. None of the above	12. **Soar** **a.** to increase little by little b. to decrease sharply c. to increase sharply d. None of the above
3. Level off a. to move slowly b. to move up and down continuously c. to move quickly upward d. None of the above	13. **Flatten out** **a.** to move up and down continuously b. to go up slowly c. to go down quickly d. None of the above
4. Substantially a. to make a very large change b. to make a large change c. to make a small change d. None of the above	14. **Dramatically** a. to make a very large change b. to make a large change c. to make a small change d. None of the above
5. Abruptly a. to move sharply b. to move slowly c. to move at a regular pace d. None of the above	15. **Shoot up** a. to increase little by little b. to increase sharply c. to increase then decrease d. None of the above
6. Plunge a. to decrease sharply b. to increase sharply c. to decrease little by little d. None of the above	16. **Moderately** a. to make a very large change b. to make a large change c. to make a small change d. None of the above
7. Steadily a. to move up and down b. to move quickly c. to move slowly d. None of the above	17. **Climb** a. to go down slowly b. to go up c. c. to move up and down d. None of the above
8. Considerably a. to make a very large change b. to make a small change c. to make a large charge d. None of the above	18. **Gradually** a. to move sharply b. to move slowly c. to move suddenly d. None of the above
9. Slightly a. to make a small change b. to make a large change c. to make a very large change d. None of the above	19. **Significantly** a. to make a very small change b. to make a very large change c. to make a large change d. None of the above
10. Bounce back a. to increase slowly b. to move sharply c. to decrease sharply d. None of the above	**20. Collapse** a. to decrease sharply b. to move up and down c. to decrease slowly d. None of the above

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