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Vocabulary and Content Learning in Grade 9 Earth Science: Effects of Vocabulary Preteaching, Rational Cloze Task, and Reading Comprehension Task

This study examines strategies for supporting vocabulary and content learning in 5 grade 9 Earth Science classes that are part of a SDAIE program (Specially Designed Academic Instruction in English) in an urban California high school. Students received vocabulary and content instruction during a unit on Earthquakes. One group of students performed rational cloze (gap-filling) exercises as a postinstruction activity, while a second group performed reading comprehension exercises. In immediate and delayed posttests, the 2 groups showed no differences in receptive learning of vocabulary and content. However, in delayed posttests, students in the rational cloze group performed better on paragraph summary writing using content-area vocabulary and expressing content knowledge. Their superior performance may be attributable to 2 factors: The rational cloze activity gave them opportunities for text rehearsal (i.e., reading and understanding the passages while filling gaps) and the rational cloze passages gave them discourse-level language models. In a follow-up questionnaire, students in the reading comprehension group characterized their activity as equally useful to other instructional activities. However, students in the rational cloze group characterized their activity as distinctively more useful than all other instructional activities. Thus, rational cloze activities appear to provide learners with useful scaffolding for vocabulary use and summary writing.

Introduction

In K-12 school settings, the acquisition of academic *vocabulary* and the learning of academic *content* are inextricably linked. Academic content tends to be organized around key vocabulary terms within a given topic (Flowerdew, 1992); thus there is a close relationship between learning topic-specific vocabulary and learning the content of a topic. However, the acquisition of content-related academic vocabulary poses difficulties: Words may have specialized meanings within a specific content area; they may occur with only a

low to moderate frequency in a narrow range of disciplines and small number of texts; the exact meaning of technical words may also be difficult to guess from context; and, dictionaries generally do not provide adequate assistance in determining context-specific definitions (Godman & Payne, 1981).

Providing students with background information about a topic (e.g., schema-building activities) may aid reading comprehension; however, students' lack of content-related vocabulary still presents a hurdle to content learning. For example, Stahl, Jacobson, Davis, and Davis's (1989) study of 6th-grade L1 students' reading of social studies texts showed that preteaching of background information did not help students solve vocabulary difficulties that affect reading comprehension. Vocabulary knowledge affects recall of details, understanding of the relationships between concepts, and recall of order of events. Given the importance of vocabulary, teachers in K-12 ESL and SDAIE programs (Specially Designed Academic Instruction in English) typically include vocabulary preteaching before teaching content. The purpose of this study was to examine two practice activities in addition to vocabulary preteaching: *rational cloze* (gap-filling) exercises and *reading comprehension* exercises. The study asked which of these two activities was more effective for:

1. *Receptive learning of vocabulary* of a content-area topic, as tested in vocabulary-recall and vocabulary definition-matching tasks;
2. *Receptive learning of content,* as tested in a True/False task; and
3. *Productive use of technical vocabulary* of a content-area topic and *expression of conceptual relationships,* as tested in a paragraph summary-writing task.

Vocabulary Preteaching Activities

K-12 ESL and SDAIE teachers typically offer some type of vocabulary instruction before they teach content; I shall refer to this instruction as *vocabulary preteaching*. Effective vocabulary preteaching requires "rich instruction" that focuses on important words in the text (e.g., Freebody & Anderson, 1983; Stahl, 1990; Stahl & Jacobson, 1986). Beck, McKeown, and Omanson (1987) define "rich instruction" as giving students elaborated attention to a word and explicitly exploring its meaning and use (p. 149). According to Stahl and Fairbanks (1986), the most effective vocabulary preteaching includes giving information about the definitions of words and how they are used in context; it involves students in *deep processing*; and it gives students more than one or two exposures to target words. Gass (1988) states that vocabulary preteaching serves as the most basic level of input about words that helps learners to notice words so that they pay selective attention to target vocabulary items so that they become salient. Vocabulary preteaching in the form of definitions is also important because definitions embedded within texts typically provide less precise information than definitions isolated from the rest of the text. Examination of the textbook used by students in this study showed that word definitions were often embedded within different parts of the text (within paragraphs, captions of illustrations, and glossary) and were worded in different ways for the same

vocabulary word, as confirmed by Lambrou (as cited in Flowerdew, 1992). This may confuse learners. Another problem students face in understanding and learning definitions is that in spoken classroom discourse, content information rather than definitions is the focus of the lesson; teachers introduce definitions as and when they are needed to make sure students comprehend content information as the lesson progresses (Flowerdew, 1992). Moreover, when teachers produce definitions under pressure of real time during instruction, they are subject to false starts, hesitation, and repair, and they may not be precise. Thus vocabulary preteaching with definitions provides learners with more precise word meanings and concepts that are essential to the understanding of content. Vocabulary preteaching may be effective for vocabulary learning, but its measurable effects on receptive or productive learning depends on the kind of vocabulary assessment used by teachers. Unfortunately, vocabulary instruction tends to focus only on receptive learning (Webb, 2005); the result is that learners recognize words without being able to produce them. Teachers (and many researchers) emphasize receptive knowledge because it is assumed that learners have to know words before they can produce them (Celce-Murcia & Olshtain, 2000), or because it is easier to teach and assess receptive knowledge of words (Webb, 2005). Also, because of the role that high-stakes testing plays in schools, teachers tend to "teach to the test"; if standardized content-area tests do not require writing, teachers are not inclined to teach or test learners' productive use of vocabulary.

Rational Cloze and Reading Comprehension Exercises

The rational cloze, initially defined by Bachman (1985), is a gap-filling exercise in which target linguistic items, for example, vocabulary words or prepositions, are left out. When filling in these gaps, learners perform deep processing, using syntactic and semantic cues and other contextual cues in the text to reason and construct meaning (Honeyfield, 1987; Rye, 1982). Laufer and Osimo (1991) consider the rational cloze to be a problem-solving activity because the wording of the cloze passage is typically different from the original text to which the passage refers. The relational cloze has been shown to promote vocabulary acquisition. For example, Lee's (2008) study of secondary school students demonstrated positive effects of rational cloze on both receptive and productive vocabulary acquisition, the latter in a story rewriting task.

Reading comprehension exercises, like rational cloze, can be constructed to draw learners' attention to specific target vocabulary and content. Reading comprehension exercises, often found in content-area learning materials, can be evaluated from the depth-of-processing perspective. Seamon and Virostek (1978) define depth of processing as the mental effort required for learning that correlates highly with effectiveness of learning tasks, applicable to learning new information in studying (Anderson & Armbruster, 1982) or vocabulary learning (Stratton & Nacke, 1974). Cognitive processes that take place during reading comprehension include the following: locating information about a word in a text, expressing information in a sentence, and drawing on prior knowledge (Pearson & Johnson, 1978). According to Stahl (1985), different kinds of vocab-

ulary exercises involve different levels of depth of processing. For example, using a word in a sentence, writing an original sentence, and writing a definition in the learner's own words involve successively more depth of processing. Thus, answering both content questions and vocabulary questions in reading comprehension involves deep processing (Slamecka & Graf, 1978). Nation (2001) provides several guidelines for promoting vocabulary learning through reading comprehension. Questions should require students to use target vocabulary in order to strengthen the connection between word and meaning, to repeat part of the text, and to use information from the text in a creative way. It is also important that learners notice how contexts, that is, wording of information, provided in answers are different from those provided in the text.

Study Design

This study was conducted in five grade 9 Earth Science classes that were part of a SDAIE program at an inner-city school in Central California. Eighty-four *(n=84)* students participated.[1] Seventy percent of the students were US born and 30% were foreign born. Most of the foreign-born students started school in the US before grade 3. In a survey of language and literacy practices, 73% of the students reported bilingual language use at home, and 40% reported that they were biliterate (i.e., they read in both English and their L1). Of the biliterate students, 89% reported that most of their reading was in English. Average English proficiency, determined by the California English Language Development Test (CELDT), was 3.39 on a 1-5 scale (rational cloze group = 3.43, reading comprehension group = 3.34), with fluent oral social interactional skills. The ethnicities of the students were as follows: 71% Latino, 19% Hmong, and 10% Filipino, Kampuchean, and Laotian.

The same teacher taught all five classes, which met for 50 minutes every day. Students had two copies of the required textbook, one in class and one at home. For the study, three morning classes were assigned to the rational cloze group because of the larger number of code 61 special-needs students in these classes who were excluded from the analysis. Two afternoon classes were assigned to the reading comprehension group.

Vocabulary Assessments

The researcher created four vocabulary assessments, based on the chapter Earthquakes in the students' regular course textbook (Appendix A).[2] These assessments targeted 12 single words (e.g., "lithosphere") and 8 lexical phrases (e.g., "ground subsidence") and were administered to all students. Assessment 4 (*Definition matching*) was administered as a preinstruction and immediate and delayed postinstruction test, while the other three assessments (*Vocabulary recall, Paragraph summary,* and *T/F)* were administered as immediate and delayed postinstruction tests.

Vocabulary recall. *Vocabulary recall* (Assessment 1) asked students to complete the spellings of the 20 target vocabulary items, with the first two letters of each target word provided and the number of missing letters indicated. This activity tested receptive knowledge of vocabulary. Example:

SE __ __ __ __ __ *VI* __ __ __ __ __ __ __

Paragraph summary. *Paragraph summary* (Assessment 2) asked students to write summary paragraphs using five target vocabulary items each. This activity tested productive vocabulary knowledge. Students were instructed to show connection of concepts represented by the target words, to write in complete sentences, and to use the vocabulary items in any order they wished. Students were reminded not to write "stories" about experiences of earthquakes, real or imagined. Example:

FOCUS, FAULT, CRUST, LITHOSPHERE, EPICENTER

True/False. *True/False* (Assessment 3) asked students to indicate T or F for 20 statements. This was a test of receptive knowledge of content. Example:

(*T/F) Earthquakes happen in large faults.*

Definition matching. *Definition matching* (Assessment 4) asked students to connect a given definition to its corresponding target vocabulary item. Items scrambled in different orders for each test. This activity tested receptive knowledge of vocabulary. Example:

_____ *Waves of energy created by an earthquake.*

Practice Activities for the Comparison Groups

The researcher also created two types of practice activities for the two comparison groups: rational cloze exercises (Appendix B) and reading comprehension exercises (Appendix C). Each rational cloze passage consisted of one or more paragraphs with 11 to 19 blanks: solid line blanks for single words and dotted lines for lexical phrases. A few other words were included for gap filling to blur the items targeted. Examples:

A _____ is a large fracture in Earth where movement has occurred.
Movements along a fault can be vertical or _____.
Earthquakes occur in large _____.

Each reading comprehension exercise consisted of 6 to 12 questions on vocabulary and content, with spaces for writing answers after each question. Students were reminded to write answers in complete sentences. Examples:

What causes an earthquake?
What do you call the thin rocky outer layer of earth?
What is another name for this outer layer of earth?

The researcher also created a preinstruction questionnaire to determine L1 backgrounds and opinions about vocabulary and reading textbook and teacher's notes, and a posttest questionnaire to determine usefulness of the various instructional activities (Appendix D).

Procedure

Students began by filling in the preinstruction questionnaire and performing a 20-item vocabulary definition-matching activity as a pretest. Statistical analysis of the scores confirmed that the two groups were comparable, t (df 82)=0.728 *ns*.

Vocabulary instruction for the unit on earthquakes was divided into five lessons, taught over roughly 8.5 class sessions (one session was only 30 minutes) (8.5 x 50 minutes = 413 minutes), excluding testing time. Instruction proceeded as follows:

1. Vocabulary preteaching;
2. Copying definitions;
3. Content instruction;
4. Copying teacher's notes; and
5. Either the rational cloze activity or reading comprehension activity.

Activities 1-4 were part of the teacher's regular lesson sequence. Activity 5 was added for the purpose of this study.

For each lesson, students copied 3-5 target vocabulary items and their definitions, which the researcher projected on a whiteboard, with target items typed in bold capital case. Then students received oral explanation of the definitions followed by explanation of content. For definitions, the researcher used contextual elaboration and examples from everyday life to augment the definitional meanings. For example, in Lesson 1, for the item *crust,* the researcher presented its technical meaning in earth science in the definition and explained it; then she elaborated its meaning with analogy to an everyday life example, that is, the outer layer of a loaf of bread. She also defined the term *lithosphere* as "another name for earth's outer layer" and again brought in the word *crust* into the elaboration. This kind of vocabulary teaching constitutes "rich instruction" in vocabulary preteaching. Content explanation consisted of information on the relationships between concepts; for example, for *crust, lithosphere,* and *fault,* the explanation the researcher provided was: "An earthquake occurs in a fault in the earth's crust or lithosphere."

After the teacher's explanation of the content of each lesson, the respective groups performed rational cloze or reading comprehension based on each lesson. Students were encouraged to use their copied notes and textbooks as references. The reading comprehension group was reminded to write in complete sentences for all questions. Students in both groups then discussed and compared their answers with those of a peer.

For both groups, exercises were projected on a white screen to be peer marked. Students took turns to answer a reading comprehension question or to read a sentence from the rational cloze passage and provide the answers for gaps. In both activities, the researcher gave feedback on each answer and wrote the answer on the space provided. The projected exercises were exactly the same as students' hard copies. For the rational cloze exercise, the researcher wrote target vocabulary items in the blanks of the passages, while for the read-

ing comprehension exercise, the researcher wrote sentences on the lines provided after each question. Since reading comprehension answers could vary in terms of style and sentence pattern, students were instructed to look for key words in peers' answers. Both groups were reminded to check for spelling accuracy of the target vocabulary. Exercises were turned in at the end of each class session. Students performed an immediate postinstruction test 1 day after the last day of instruction and the delayed postinstruction test 14 days later. This time lapse was agreed upon by the researcher and the regular teacher, given school curriculum and state examination time constraints. Students completed the posttest questionnaire after the immediate posttest.

Immediate posttest and delayed posttest consisted of the four assessments conducted in the following order to ensure minimum cueing between tasks:

- 20-item vocabulary recall;
- 4 paragraph writing prompts with 5 target vocabulary items per prompt;
- 20 T/F questions on content comprehension;
- 20-item vocabulary definition-matching.

The test items were scrambled for each test. The researcher collected each completed section from students before they started on the next. Students were not allowed to use dictionaries, notes, or textbooks during all tests.

For interrater reliability, both the researcher and a university writing instructor scored both the vocabulary recall and summary paragraph writing assessments for the immediate and delayed posttests.[3] When discrepancies arose, the two scores were averaged. A graduate research assistant scored the T/F and definition-matching sections of the tests.

Findings and Discussion

The researcher compared student scores using statistical *t*-tests to determine whether students improved between the pretest and the postinstruction tests, and whether students maintained their improved scores in the delayed posttests. The alpha level of 0.01 was adopted to ensure that the results were not due to chance, given the small sample size and the fact that the pre-, post-, and delayed posttests measured knowledge of the same vocabulary and/or content. All results are reported in Tables 1-3 in Appendix E.

The first research question focused on the effects of rational cloze and reading comprehension activities on *receptive learning of technical vocabulary* in a content-area topic, as measured in vocabulary-recall and vocabulary definition-matching tasks. A comparison of scores indicated that both groups improved significantly in the immediate posttest on the vocabulary definition-matching task; this improvement was still evident in the delayed posttest 14 days later. Both groups also showed no significant loss in scores between the immediate postinstruction test and delayed postinstruction test on vocabulary recall. This means that rational cloze and reading comprehension activities did not have significantly different effects on receptive learning of vocabulary.

The second research question focused on the effects of rational cloze and reading comprehension activities on *receptive learning of content*, measured in the True/False task. Scores indicated no significant differences between the groups for the T/F task on immediate post- and delayed posttests. This means that rational cloze and reading comprehension had no significantly different effects on receptive learning of content.

The third research question focused on the effects of rational cloze and reading comprehension activities on *productive use* of technical vocabulary of a content-area topic and expression of relationships of concepts, as tested in a paragraph summary-writing task. Although there was no significant difference between the groups on paragraph summary writing on the immediate posttest, the difference became significant on the delayed posttest. This means that reading comprehension and rational cloze made no difference if students had to produce content and vocabulary immediately after the practice activity; however, there was a significant difference if the production task took place after a delayed period.

The conditions proposed by Nation (2001) for reading comprehension were satisfied in the instructional phase of this study, that is, providing students the opportunity to make connections between words and their meanings, to use vocabulary to express content knowledge and to share answers. Results showed that, despite satisfying these conditions, reading comprehension was not as effective as rational cloze for students to produce vocabulary and content in a delayed writing task. It could be argued that not all students wrote complete sentences to answer reading comprehension questions; in fact, most students were inconsistent, writing fragments and sentences for different questions. However, it could also be argued that rational cloze students did not write sentences or fragments but only filled gaps with single words or lexical phrases. This showed that productive use in the reading comprehension activity did not transfer to delayed productive tasks.

Both groups' scores fell significantly in paragraph summary writing between the immediate posttest and the delayed posttest. However, the significantly higher scores of the rational cloze group on the delayed postinstruction test indicated that rational cloze was a more effective practice exercise. We would expect students to have more writing practice on vocabulary and content in reading comprehension questions since they would have to write sentences or at least fragments that contained information required by the questions. However, this task did not better prepare them for writing paragraph summaries than did the gap-filling rational cloze activity. Several reasons for this are suggested here. First, as proposed by Laufer and Osimo (1991), in the rational cloze passages, the same content from the textbook is reworded in a different way, making the texts in the passages different from those in the teacher's notes that students had copied, and different from those in the textbook. This forced students to deeply process language to comprehend content of the rational cloze passages, using target and nontarget vocabulary at the same time. Second, although students did not write sentences or fragments, they had the benefit of text rehearsal in the sense of reading and reconstructing content meaning con-

tained in the rational cloze passages. Students also had to fill gaps with nontarget items, which required further text processing. Processing and text-rehearsal opportunities were absent in reading comprehension. Third, it was also likely that in reading comprehension, students were more focused on getting the correct answers than really processing the language input. Moreover, learners could identify certain cue words in reading comprehension questions and look for them in the text to answer questions without really noticing and processing language to understand vocabulary and content (Paribakht & Wesche, 1999).

Hulstijn and Laufer's (2001) involvement load hypothesis may help to explain students' performance in the tests. According to the involvement load hypothesis, cognitive load or amount of learner involvement in different learning tasks influences extent of learning. In vocabulary learning, the cognitive aspects of involvement are *search* and *evaluation*. *Search* is the attempt to find meanings of an L2 word or how to express a concept by consulting an authority, such as the teacher or dictionary; *evaluation* is assessing whether a word fits a particular context. According to Hulstijn and Laufer (2001), gap filling involves no search and only moderate evaluation if vocabulary glosses are provided. In this study, glosses were not provided for words in the rational cloze exercises; thus both search and evaluation would be high because word meanings had to be correct and words had to fit the context of the passage syntactically and semantically. In contrast, in the reading comprehension exercises, search and evaluation would be lower than in rational cloze activity because students could answer questions correctly by looking for corresponding cues in the text without really understanding target words or concepts.

The rational cloze passages also served as models for writing, similar to Cotteral and Cohen's (2003) scaffolded instruction on grammatical vocabulary, that is, transitional or linking words. The researchers use text models to show learners how the links are used in highly elaborated contexts. In their study, these texts provide models of language structures for learners, who produce close imitations of these models. Thus the rational cloze can be viewed as a form of scaffolding, providing students with a text model containing target technical vocabulary that showed how the vocabulary is used in expressing relationships between concepts. Admittedly, students' summaries contained language of oral interaction (e.g., "After an earthquake, it is messy") and expression of conceptual relationships that leads to concise phrasing was not always apparent (e.g., "Aftershocks is there are small shaking after the earthquake" rather than "Aftershocks are smaller seismic vibrations after a major earthquake"). Expressing relationships between concepts is perhaps inherently complex, and not all definitions contain linkage of concepts. This was why definitions were accepted as correct in paragraph summary writing. As stated earlier, in Lee's (2008) study, secondary school students reported that text modeling for later story rewriting was the most important advantage of rational cloze, compared with other rational cloze–related activities such as teacher-student discussion and peer discussion on answers and dictionary work.

In the preinstruction survey (Appendix D), only about 42% to 56% of students indicated they habitually read their textbooks and teacher's notes, and

they had problems reading and understanding the textbook. The majority of students in both groups (78% to 91%) indicated that it was important to know vocabulary from their textbook or teacher's notes that related to concepts and ideas they were learning; however, only between 17% and 30% considered vocabulary as problematical in learning content. Reasons provided by both groups for the importance of vocabulary were that vocabulary knowledge could help them learn and understand the "ideas" of the topic and that tests always asked about vocabulary. No reference was made to writing using vocabulary, perhaps because students were not accustomed to performing productive tasks with vocabulary they learned. The regular teacher indicated that course assignments focused on receptive learning of both vocabulary and content in the form of vocabulary definition-matching and True/False tests.

Postinstruction questionnaire responses (Appendix D) revealed students' reactions to the various instructional activities. The researcher's explanation of the topic and vocabulary, copying of definitions, and copying of notes were generally perceived to be useful by higher percentages of the reading comprehension group than by the rational cloze group. For the reading comprehension group, all the activities, including reading comprehension exercises, were judged to be useful by between 82% and 87% of the students. For example, while 84% indicated that reading comprehension was useful, 87% judged the teacher's explanation of content as useful. In contrast, for the rational cloze group, while 85% judged the rational cloze exercise as useful, between 57% and 61% judged the other activities as useful. Thus, unlike reading comprehension, rational cloze stood out as a distinctively more useful learning activity compared with other activities.

Reasons provided by the reading comprehension group for usefulness of the reading comprehension activity were that it helped them to learn, remember, and know what to learn, helped them in tests, how to answer comprehension questions, to understand the topic better, and to explain words. The rational cloze group gave a wider variety of reasons for usefulness of the rational cloze: It was easier to know word meanings and to know and remember what they learned; it helped them to review the topic; it gave them ideas on what words to use in writing; they learned to read and understand better; it was easier to understand ideas and remember vocabulary; and they could remember the spellings and meanings of words for writing. These comments showed that the rational cloze group made reference to writing and vocabulary and its use, while the reading comprehension group focused on topic learning. The former focused more on vocabulary and how it was used in completing the rational cloze while also learning content. On the other hand, the reading comprehension group focused mainly on content; this may be explained by the impression given by reading comprehension exercises that content information was the focus of the exercise, even though some questions targeted vocabulary.

Pedagogical Implications and Conclusions

In this study vocabulary preteaching involving rich instruction benefited *receptive* learning of technical vocabulary and *receptive* learning of content.

Thus, vocabulary preteaching activities should benefit students in preparing for tests such as the California High School Exit Exam (CAHSEE), which emphasize receptive learning.

When teachers use practice, review, or assessment exercises that require writing, they most often use reading comprehension exercises, perhaps because content-area materials almost always contain reading comprehension activities. However, this study has indicated that rational cloze may be more effective than reading comprehension activity. Teachers should therefore experiment with rational cloze activities. Of course teachers face many time constraints; if rational cloze exercises are not readily available, having to construct them would make extra demands on teachers' time. To solve this problem, several teachers using the same textbook could share the task of preparing rational cloze exercises. Alternatively, teachers could write a short rational cloze passage targeting the main concepts of each chapter to provide scaffolding for paragraph summary writing. Later, this scaffolding could be removed and the teacher could provide only target vocabulary to be used in writing (Boyle & Peregoy, 1990).

Horowitz (1986) claims that summarization of content is one of the most frequent writing assignments at college and university. For secondary school English learners, summary writing tasks following rational cloze exercises helps them to prepare for postsecondary content-area writing by getting them to use technical vocabulary and academic expressions. As the regular teacher observed, use of friendly informal language in explanations and contextual elaborations was necessary, even though target technical vocabulary was also used. However, learners would pay more attention to such accessible language than technical vocabulary and academic expressions because the former aids comprehension. Without explicit emphasis by teachers, and without overt written models to help learners phrase content knowledge, learners would fail to notice technical vocabulary and academic language. Therefore, teachers should make summary writing a part of learning and assessment to raise learners' awareness of using technical vocabulary and academic language in content-area learning. This study has indicated that secondary school English learners are capable of producing technical vocabulary in short extended writing if teachers provide text models and practice opportunities.

Of course, besides rational cloze and summary writing, learners should be encouraged to read their textbooks and teachers' notes as a long-term strategy for improving vocabulary and content learning. In this study, the majority of students indicated that they did not read the textbook and teacher's notes, thus limiting their exposure to academic language models. Although students recognized the importance of vocabulary in content learning, only a small minority considered vocabulary a problem in learning content, probably because of emphasis on receptive learning in the course. Content-area teachers should devote some time to writing using technical vocabulary, making it part of students' homework and/or assessment.

English learners in secondary school face major challenges in learning technical vocabulary and expressing content knowledge in writing. Vocabulary preteaching involving rich instruction is potentially an effective instructional

tool for receptive learning of content vocabulary and is certainly beneficial in preparing students for the CAHSEE. However, it is likely insufficient for preparing learners for the demands of postsecondary content-area learning. Students need preparation for productive use of vocabulary. The rational cloze appears to be an effective activity for preparing students for the *productive use* of vocabulary in expressing content knowledge.

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Notes

[1]Nineteen students designated as requiring learning assistance (code 61) and 10 students who did not participate in all steps of the study were excluded from the data analysis.

[2]Tarbuck and Lutgens, 2006, pp. 217-232

[3]One point was awarded for each correct answer for the T/F and vocabulary definition-matching tasks. No points were deducted for spelling errors for the latter task as it was a receptive task and participants copied the target items from a vocabulary list provided into the appropriate spaces provided beside the given definitions. For the vocabulary-recall task, one point was awarded for each correctly spelled answer, one-quarter point was deducted for a spelling error involving one or two letters but where the essential pronunciation of the word was preserved (e.g., "lithosphear" for "lithosphere"). No credit was awarded if the answer resembles another word in English (e.g., "force" for "focus") or contained errors in more than two letters. One-half point was deducted for any one missing word or incorrect word in a lexical phrase (e.g., "action earthquake belt" for "active earthquake belt"; "ground substance" for "ground subsidence"). For paragraph summary writing, a target item used with the correct meaning was awarded one point, with a half-point penalty for spelling errors in a target item. Incorrect definitions or incorrect concepts expressed for an item received no credit. Grammar errors were not penalized unless they affected communication of concepts and conceptual relationships. Narratives, that is, writing about an earthquake experienced, whether imaginary or real, received no credit.

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Appendix A
Assessments: Earthquakes Ch. 8: 8.1, 8.2

Assessment 1

a) Think of all the single words you have learned in the chapter on "Earthquakes." Complete each word. The first two letters of every word are provided. The number of dashes for each word tells you the number of missing letters in the word.

1. FA __ __ __
2. TS __ __ __ __ __
3. AF __ __ __ __ __ __ __ __
4. FO __ __ __ __ __ __ __
5. EP __ __ __ __ __ __ __
6. LA __ __ __ __ __ __ __
7. CR __ __ __
8. MA __ __ __ __ __ __ __
9. LI __ __ __ __ __ __ __ __ __
10. PL __ __ __
11. FO __ __ __
12. LI __ __ __ __ __ __ __ __ __ __

b) Think of all the phrases you have learned in the chapter on "Earthquakes." Complete each phrase. The first two letters of every word in the phrase are provided. The number of dashes for each word tells you the number of missing letters in the word.

1. FA __ __ __ CR __ __ __
2. SE __ __ __ __ __ WA __ __ __
3. EL __ __ __ __ __ EN __ __ __ __
4. GR __ __ __ __ SU __ __ __ __ __ __ __ __
5. SE __ __ __ __ __ GA _
6. SE __ __ __ __ __ VI __ __ __ __ __ __ __
7. AC __ __ __ __ EA __ __ __ __ __ __ __ __
8. EL __ __ __ __ __ RE __ __ __ __ __

Assessment 2

Answer ALL FOUR questions. Write each answer in complete sentences to make up a paragraph. You may use the given words in any order in your paragraphs. Show how the concepts are related.

1. FOCUS, FAULT, CRUST, LITHOSPHERE, EPICENTER

……
……

2. ELASTIC REBOUND, ELASTIC ENERGY, SEISMIC WAVES, MAGNITUDE, SEISMIC VIBRATIONS

……
……

3. ACTIVE EARTHQUAKE BELT, SEISMIC GAP, FAULT CREEP, PLATE, TSUNAMI

……
……

4. FORESHOCKS, AFTERSHOCKS, LIQUEFACTION, LANDSLIDE, GROUND SUBSIDENCE

……
……

Assessment 3

Answer T for TRUE and F for FALSE.

( ) 1. Earthquakes happen in large faults.
( ) 2. Earthquakes occur mostly in remote regions that are not populated.
( ) 3. The source or starting point of an earthquake is located along a fault.

( ) 4. Earthquakes of the moment magnitude of 8.0 cannot be felt.
( ) 5. In a tsunami, waves travel more gradually in the deep ocean. When the waves get closer to the shore, they move faster.
( ) 6. The elastic rebound hypothesis states that before an earthquake, movements cause stress on rocks until they bend and slip, but after the earthquake, the rocks return to almost their original shapes.
( ) 7. There are no signs or precursors to indicate that an earthquake is going to happen.
( ) 8. After an earthquake, there will be no more movements or vibrations.
( ) 9. Scientists have not found successful methods to make short-range predictions and long-range predictions of earthquakes.
( ) 10. When an earthquake occurs, elastic energy is not released.
( ) 11. There are three main active earthquake belts in the world.
( ) 12. In an earthquake, buildings on soft ground are more likely to be damaged than buildings on solid ground.
( ) 13. The greatest damage from an earthquake occurs at the epicenter.
( ) 14. The weakest point along a fault is the focus.
( ) 15. Liquefaction occurs when a fault is filled with water, but the land is dry.
( ) 16. Earthquakes do not happen under the ocean; they happen only on land.
( ) 17. Steel-framed buildings suffer more damage in an earthquake than concrete buildings.
( ) 18. Wooden buildings are safer than concrete buildings in an earthquake because wooden buildings flex in an earthquake.
( ) 19. Tsunamis are tidal waves.
( ) 20. Plates move at the rate of 45 miles a year.

Assessment 4

In each blank provided, write the word or phrase from the list below that matches the definition.

_____ 1. Another name for Earth's crust.
_____ 2. Vibrations caused by an earthquake.
_____ 3. Waves of energy created by an earthquake.
_____ 4. An area where earthquakes have happened recently and will happen again.
_____ 5. Energy stored in rocks as they are bent by Earth's forces.
_____ 6. Small vibrations produced AFTER an earthquake.
_____ 7. The place on Earth's surface directly above the focus of an earthquake.
_____ 8. The process in which rocks are stressed and bent by Earth's forces, and then pushed back to its original shape.

_____ 9. The segments into which Earth's crust is divided; their movements cause earthquakes.
_____ 10. An area in a fault where earthquakes have not happened for a long time.
_____ 11. The exact place inside Earth where an earthquake starts.
_____ 12. A large wave caused by an earthquake under the ocean.
_____ 13. A large fracture in Earth where movement has occurred.
_____ 14. Slow smooth movement of a fault.
_____ 15. Sinking of land caused by vibrations of Earth.
_____ 16. Soil and rocks rush down a slope during an earthquake.
_____ 17. The thin rocky outer layer of Earth.
_____ 18. Small vibrations BEFORE an earthquake.
_____ 19. The amount of energy released at the source of the earthquake.
_____ 20. Loose soil becomes saturated with water, causing structures to collapse.

crust	**landslide**	**aftershocks**	**seismic gap**
focus	**liquefaction**	**magnitude**	**seismic waves**
plates	**epicenter**	**fault creep**	**ground subsidence**
tsunami	**foreshocks**	**elastic energy**	**active earthquake belt**
fault	**lithosphere**	**elastic rebound**	**seismic vibrations**

Appendix B
Rational Cloze Practice Activity

Grade 9 Earth Science
Ch. 8, Earthquakes (Tarbuck & Lutgens, 2006, Boston: Pearson Prentice Hall)

8.1 WHAT IS AN EARTHQUAKE?

Ex. 1. Fill each blank with ONE WORD from the vocabulary list below. A word may be used more than once. (Refer to pp. 218-219)

More than 30,000 earthquakes occur each year that are strong enough to be felt. Fortunately, most of these earthquakes are minor _____(1) which cause little damage. Only about 75 major earthquakes take place each year, and most of them occur in _____(2) unpopulated regions. Occasionally, a major earthquake occurs in a city causing a lot of damage. (See Figure 1, p. 218.)

An earthquake is caused by vibrations within earth. The vibrations are caused by the rapid release of energy when slippage occurs along a _____(3) in Earth's crust. The _____ (4) is the thin outer rocky layer of Earth. Another name for Earth's crust is _____(5).

A _____ (6) is a large fracture in Earth where movement has occurred. Movements along a fault can be vertical or _____ (7). Earthquakes occur in large _____(8).

Vibrations of an earthquake start within Earth, not on the land surface. The _____(9) is the point within Earth where the earthquake starts. We also call it the source of the earthquake. The focus of an earthquake is located at a point along a fracture or _____(10).

lithosphere	**faults**	**crust**	**tremors**	**fault**
horizontal	**forces**	**focus**	**remote**	

Ex. 2. Fill each blank with ONE WORD or ONE PHRASE from the vocabulary list below. A word or phrase may be used more than once. (Refer to p. 218-219)

The vibrations of an earthquake are called …… (3). The energy that is released in an earthquake radiates in all directions from the focus. The energy radiates in the form of waves called ……. (4). These waves are produced in a similar way when you drop a pebble into a calm pond. The _____ (5) is the location on Earth's surface that is directly above the focus. In news reports of earthquakes, the reporter always reports the location of the earthquake on Earth's surface, that is, the _____ (6). The damage of an earthquake is greatest at the _____ (7).

The San Andreas _____ (8) extends for 1300 kilometers north and south through Southern California. A fault divides the land into two segments called _____ (9). San Francisco and Los Angeles, California, are on either side of the San Andreas _____ (10). The plates on either side of the fault move at about the same rate as your fingernails grow, or about 45 mm. a year. This slow gradual movement of a fault is called …… (11) San Francisco will reach Los Angeles' present location in about 10 million years, an example of a ……..(12).

seismic waves **epicenter** **focus** **fault** **plates**
seismic vibrations **fault creep**

Ex. 3. Fill each blank with ONE WORD or ONE PHRASE from the vocabulary list below. A word or phrase may be used more than once. (Refer to p. 219-221)

Before the great 1906 San Francisco earthquake, actual causes of earthquakes were not well understood. This earthquake caused a big horizontal slippage of the land, unlike the slow……..(1) Scientists studied the land slippage after the earthquake and found that the land on the western side of the fault had moved as much as 4.7 meters to the north compared to the land on the eastern side of the _____ (2).

Scientists developed a hypothesis to explain the earthquake. This is the …….. (3) hypothesis. Figure 4 on page 220 illustrates the elastic rebound hypothesis. Part A shows an existing fracture or _____ (4) in Earth. Part B shows that forces within Earth slowly push and deform or bend the rocks on both sides of the _____ (5). These forces cause the rocks to bend and store or build up ……(6) just like a wooden stick stores or builds up energy if it is bent. This energy is the same kind of energy that is stored if you stretch a rubber band.

The internal friction causes the rocks to slip at the _____ (7) point along the fault. This weakest point is the _____ (8). The slippage causes ……. (9) to be released rapidly. It also allows the rock to _____ (10) or snap back into its original shape. Vibrations occur and we call these …….. (11)

Before the main earthquake, smaller or weaker vibrations occur. These vibrations are called _____ (12). Foreshocks can happen days or even years before a major earthquake. After the main earthquake, there are again smaller or weaker vibrations called _____ (13). Aftershocks can sometimes destroy structures which have been weakened by a major earthquake.

elastic energy **seismic vibrations** **fault** **weakest** **rebound**
elastic rebound **fault creep** **focus** **foreshocks** **aftershocks**

8.2 MEASURING EARTHQUAKES

Ex. 4. Fill each blank with ONE WORD or ONE PHRASE from the vocabulary list below. A word or phrase may be used more than once. (Refer to p. 222-223, p. 226-227)

Scientists measure elastic energy that is released in an earthquake. This ……..… (1) spreads out as waves in all directions from the focus. These earthquake waves are called…… (2). The instrument used to measure seismic waves is called a _____ (3). The instrument produces a diagram of waves called a _____ (4).

There are two types of seismic waves, surface waves and body waves. ……. (5) travel along Earth's crust along the ground and cause the ground and anything resting on it to move. ……. (6) travel through Earth's interior. There are two types of body waves, P waves and S waves. …….. (7) are push-pull waves – they push (compress) and pull (expand) rocks. In contrast, ……..…… (8) shakes the particles of Earth as they travel through the rocks and temporarily change their shape or bend the rocks.

About 95% of the major earthquakes occur in a few narrow zones. Earthquakes have occurred recently here and will occur again. We call these zones ……(9). There are three active earthquake belts. One of these is the outer edge of the Pacific Ocean, known as the …….. (10) Japan, Chile, the Philippines, and Alaska's Aleutian Islands are in this zone or belt. The Cascade Mountains in Oregon and Mount St. Helens in Washington, USA, are located in the Ring of Fire. So are Mount Popocatepetl and Mount Paricutin in Mexico.

There are areas where earthquakes have not happened for a long time. These are called ……(12).

Scientists use two types of measurements to describe the size or severity of an earthquake. They are intensity and magnitude. _____ (13) measures the amount of earthquake shaking at a given location and the amount of damage caused. _____ (14) measures the amount of energy released at the source of the earthquake, using seismograms.

A more precise measurement of earthquakes is the…….. (15). This is calculated using several factors, seismic waves, amount of movement along a fault, the surface area of the fault, and the strength of the broken rock.

An earthquake with moment magnitude of < 2.0 is generally not felt; a …… (16) of 8.0 and above are great destructive earthquakes. The Good Friday Alaskan earthquake in 1964 had a ……. (17) of 9.2. The quake left 131 people dead and thousands homeless.

The damage to buildings and other structures depends on the intensity and duration of the seismic vibrations. It also depends on the material the structure is built with, and the design of the structure. ……. (18) buildings can withstand vibrations because steel can flex with the vibrations. Wood-frame buildings such as homes are also flexible and suffer less damage. _____ (19) buildings cannot flex, so they break with the vibrations.

seismograph	**steel-frame**	**elastic energy**	**concrete**	**magnitude**
seismogram	**body waves**	**moment magnitude**	**intensity**	**seismic gap**
surface waves	**Ring of Fire**	**seismic waves**	**active earthquake belts**	

Ex. 5. Fill each blank with ONE WORD or ONE PHRASE from the vocabulary list below. A word or phrase may be used more than once. (Refer to p. 229-232)

Sometimes, an earthquake occurs under the ocean on the ocean floor. An earthquake under the sea creates seismic sea waves called _____ (1). This means that there is a fracture or _____ (2) on the ocean floor and there is movement along the fault. Elastic energy radiates in all directions as waves. (See Figure 11, p. 230.) The waves travel across the ocean at the _____ (3) of 500 to 950 kilometers per hour. At this speed, a tsunami is not felt in the open ocean because its height is usually less than one meter. However, speed gradually slows as the waves get closer to the shore. At the _____(4) of 20 meters, the speed of the tsunami is 50 kilometers per hour, but the waves are higher because the water is piled up, sometimes reaching greater than 30 meters. When it reaches shore, it hits land with tremendous _____ (5).

Tsunamis are not tidal waves. Tidal waves are large oceanic waves caused by the gravitational pull of the sun and moon

Fortunately, most earthquakes do not cause tsunamis. In December 2004, a powerful earthquake in the Indian Ocean produced a series of _____ (6) that struck coastal areas of Indonesia, Sri Lanka, India, Thailand and other countries. There was no warning system to inform the countries that the earthquake might cause tsunamis. As a result, the tsunami killed 300,000 people and one million were left homeless. After this disaster, scientists and government officials planned to develop a tsunami …….. ….(7) for the Indian Ocean.

Earthquakes cause other dangers, including landslides, ground subsidence and fires. _____ (8) occur when vibrations loosen the soil and rock on slopes. The soil and rock move down the slopes very rapidly. Very often land sinks. The sinking of land is called ……... (9). Fires break out because gas and electricity lines break. The greatest damage after the 1906 San Francisco earthquake was caused by fires. During an earthquake, loose soil can become saturated with water and acts like water. This is called_____ (10). The soil cannot support buildings and other structures, causing them to _____ (11).

Scientists are trying to make predictions of earthquakes. The goal of short-range predictions is to provide an early warning of the location and magnitude of a large earthquake. Scientists monitor things like uplift, ……. (13) and strain in the rocks near active faults. These warn us of coming earthquakes. So far, methods for short-range predictions have not been successful. Long-range forecasts aim to predict large earthquakes within 30 to 100 years. Scientists do not understand enough to make long-term forecasts about earthquakes.

force	**fault**	**ground subsidence**	**landslides**	**collapse**
speed	**height**	**warning system**	**liquefaction**	**tsunamis**
depth	**force**			

Appendix C
Reading Comprehension Practice Activity

WHAT IS AN EARTHQUAKE?

Ex. 1. Answer the questions below. Write in complete sentences. (Refer to p. 218-219)

1a) What is an earthquake?
……
b) Do ALL earthquakes cause damage?
……
2. Where do most earthquakes occur?
……
3. What causes an earthquake?
……
4a) What do you call the thin rocky outer layer of earth?
……
b) What is another name for this outer layer of earth?
……
5. What is a fault?
……
6. Are Earth movements vertical OR horizontal or can they be vertical AND horizontal?
……
7. Do earthquakes occur in small faults or large faults?
……
8. What is the focus of an earthquake? Where is it located?
……

Ex. 2. Answer the questions below. Write in complete sentences. (Refer to p.218-219)

1. What do we call the vibrations of an earthquake?
……
2. What do we call the waves of energy that radiates from the focus of an earthquake?
……
3. What is epicenter?
……
4. Where is the damage of an earthquake the greatest?
……
5. What are plates?
……
6a) San Francisco and Los Angeles are located on different sides of the San Andreas fault. What will happen to their locations in about ten million years?
……

7. What is fault creep?
……
8. Give an example of where fault creep occurs in the world.
……

Ex. 3. Answer the questions. Write in complete sentences. (Refer to p. 219-221)

1. Was the San Francisco earthquake of 1906 a major earthquake or a fault creep?
……
2. Scientists developed a hypothesis to explain the San Francisco earthquake. This hypothesis is called the …….hypothesis.
3. Forces within Earth push and pull the rocks, creating and storing energy. What do you call this energy?
……
4. Rocks that are bent during seismic vibrations in Earth also snap back into their original shape. What do you call this action of rocks?
……

5a) At which point along the fault does land slippage occur, the weakest point or the strongest point?
……
b) What do you call this point where land slippage occurs?
……

6a) What do you call seismic vibrations BEFORE a major earthquake?
……
b) What do you call seismic vibrations AFTER a major earthquake?
……
c) Are these seismic vibrations before and after a major earthquake weak or strong?
……

Ex.4. Answer the questions below. Write in complete sentences. (Refer to p. 222-223, p. 226-227)

1. How does elastic energy of earthquakes spread out, in waves or in straight lines?
……
2. What are the two types of seismic waves?
……

3a) What is a seismograph?
……
b) What is a seismogram?
……

4a) Where do surface waves travel?
……

b) Where do body waves travel?

……

5a) What are the two types of body waves?

……

b) "P waves" refers to the …….. (push and pull/twist) waves. (Circle one.)
"S waves" refers to the …….. (push and pull/ twist) waves. (Circle one.)

6. What do you call zones where earthquakes have occurred recently and will occur again?

……

7. Which earthquake belt are Japan and California located in?

……

8. What do we mean by "intensity" of an earthquake?

……

9. What do we mean by "magnitude" of an earthquake?

……

10a) Does a moment magnitude of <2.0 cause any damage?

……

b) What was the moment magnitude of the 1964 Alaskan earthquake?

……

11a) Why can steel frame buildings withstand an earthquake?

……

b) Why do wooden frame buildings suffer less damage than concrete buildings?

……

Ex.5. Answer the questions below. Write in complete sentences. (Refer to p. 229-232)

1a) What is a tsunami?

……

b) Is a tsunami caused by earthquake on land or on the ocean floor?

……

2a) Where is the speed of tsunami greater, far out in the ocean or closer to land?

……

b) Where is the height of the tsunami waves greater, far out in the ocean or closer to shore?

……

c) Where is the force of the tsunami greater, far out in the ocean or closer to shore?

……

d) In a tsunami, where would you be safer, far out in the ocean or closer to shore?

……

3a) Why were so many people killed in the tsunami of December 2004?
……
b) How can scientists and governments prevent so many deaths in a tsunami?
……
4. What is ground subsidence?
……
5. What is a landslide?
……
6a) What is liquefaction?
……
b) What happens to buildings and structures when there is liquefaction?
……
7. Have scientists been successful in making short-term and long-term predictions of earthquakes?
……

Appendix D
Questionnaire Summary

Preinstruction questionnaire:

(To simplify reporting, the data for each question are grouped into two categories and only questions with majority answers are indicated below.)

	Question	*RCP group*	*Read Comp group*
1.	Do you read your course textbook?	55.56%	54.05%
2.	Do you read your teacher's notes plus course textbook?	57.77%	53.24%
3.	Do you read only your teacher's notes?	42.22%	46.75%
4.	Do you have problems reading your textbook? (always and sometimes)	46.67%	51.35%
5.	What is your main problem with the textbook and teacher's notes?		
	a) Many difficult words.	17.78%	29.73%
	b) Many ideas and concepts to learn.	35.56%	37.84%
6.	Do you think it is important to learn vocabulary from your textbook or teacher's notes that relates to concepts and ideas you are learning? (Yes)	91.11%	78.38%

Q 6: Give your reason or reasons for your answer.

Postinstruction questionnaire:

	Question	*RCP group*	*Read Comp group*
1.	The researcher's explanation of the topic(very useful to useful)	56.62%	86.84%
2.	The researcher's explanation of vocabulary (very useful to useful)	69.56%	84.21%
3.	Writing definitions (very useful to useful)	67.39%	92.11%
4.	Writing notes (very useful to useful)	69.57%	81.58%
5.	Answering RCP exercise (very useful to useful)	84.78%	
6.	Answering ReadComp questions (very useful to useful)		84.21%

Q. 6: Give your reason or reasons for your answer.

Appendix E
Tables 1, 2, and 3

Table 1
Rational Cloze Group: Pre-, Immediate Post-, and Delayed Posttests

Test task		*Average*	*Range*	*s.d.*	*t(df 45)*
Vocabulary recall	i) immediate post	15.07	5.25 - 20.00	4.16	
	ii) delayed post	14.69	2.50 - 19.00	3.78	0.962 n.s.
Paragraph writing	i) immediate post	12.78	3.00 - 17.75	4.54	
	ii) delayed post	10.58	2.00 - 17.00	4.45	3.434 0.001 *
True/False	i) immediate post	12.76	4.00 - 18.00	2.66	
	ii) delayed post	12.78	8.00 - 18.00	2.92	-0.048 n.s.
Vocabulary-definition matching	i) pre-	4.33	0.00 - 12.00	2.88	
	ii) immediate post	11.43	2.00 - 20.00	4.25	-11.421 0.000*
	iii) delayed post	10.72	2.00 - 20.00	4.91	1.227 n.s.

*$p < 0.01$

Table 2
Reading Comprehension Group:
Pre-, Immediate Post-, and Delayed Posttests

Test task		*Average*	*Range*	*s.d.*	*t(df 37)*	
Vocabulary recall	i) immediate post	14.41	2.50 - 20.00	4.51		
	ii) delayed post	13.73	5.75 - 18.75	3.62	1.941	n.s.
Paragraph writing	i) immediate post	11.01	2.00 - 17.75	5.43		
	ii) delayed post	6.41	0.00 - 16.25	4.44	7.090	0.000 *
True/False	i) immediate post	13.29	8.00 - 18.00	2.49		
	ii) delayed post	11.84	7.00 - 16.00	2.31	3.568	0.001 *
Vocabulary-definition matching	i) pre-	4.24	0.00 - 10.00	2.17		
	ii) immediate post	8.79	1.00 - 20.00	4.50	-5.913	0.000*
	iii) delayed post	8.79	2.00 - 18.00	4.24	1.000	n.s.

*$p < 0.01$

Table 3
Rational Cloze and Reading Comprehension Groups:
Pre-, Immediate, Post-, and Delayed Posttests

Task	*Group*	*Average*	*Range*	*s.d.*	*t (df 82)*		*d*
Vocabulary recall							
i) immediate post-	Rat Cloze	15.07	5.25 - 20.00	4.16			
	Read Comp	14.41	2.50 - 20.00	4.55	0.711	n.s.	
ii) delayed post-	Rat Cloze	14.49	2.50 - 19.00	3.78			
	Read Comp	13.73	5.75 - 18.75	3.62	0.933	n.s.	
Paragraph summary writing							
i) immediate post-	Rat Cloze	12.78	3.00 - 17.75	4.54			
	Read Comp	11.01	2.00 - 17.75	5.43	0.108	n.s.	
ii) delayed post-	Rat Cloze	10.57	2.00 - 17.00	4.45			
	Read Comp	6.41	0.00 - 16.25	4.44	4.276	0.000*	0.94
True/False							
i) immediate post-	Rat Cloze	12.76	4.00 - 18.00	2.66			
	Read Comp	13.29	8.00 - 18.00	2.49	-0.933	n.s.	
ii) delayed post-	Rat Cloze	12.78	8.00 - 18.00	2.92			
	Read Comp	11.84	7.00 - 16.00	2.31	1.612	n.s.	
Vocabulary-definition matching							
i) pre-	Rat Cloze	4.33	0.00 - 12.00	2.88			
	Read Comp	4.24	0.00 - 10.00	2.17	0.728	n.s.	
ii) immediate post-	Rat Cloze	11.42	2.00 - 20.00	4.25			
	Read Comp	8.79	1.00 - 20.00	4.50	2.754	0.007*	0.42
iii) delayed post-	Rat Cloze	10.72	2.00 - 20.00	4.91			
	Read Comp	8.7	2.00 - 18.00	4.24	1.905	0.06 n.s.	

*$p < 0.01$