Vocabulary assistance before and during reading

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Abstract

Intermediate learners of Spanish read a Spanish newspaper article with vocabulary
assistance either before reading, while reading, both, or without any such assistance.
Reading performance was significantly better for students receiving vocabulary
assistance during reading, but not for those receiving it before reading. Reading time of
the newspaper article was less for students receiving prereading vocabulary assistance,
but total lesson time (the prereading time plus reading time) was more for those students.
Given the particular activities of this study, a vocabulary activity before reading appears
to speed up reading without affecting comprehension, while vocabulary assistance during
reading appears to improve comprehension without affecting speed.

Keywords: vocabulary, second language reading, prereading, hypertext glossing

Most second language (L2) readers would assert that their main obstacle to reading is their lack
of vocabulary. They feel that they must frequently stop reading and look up words (whether in a
dictionary, a corpus, or elsewhere) before they can continue. Even when trying to read just for
the gist, they frequently give in and begin looking up what appear to be the critical words.
Furthermore, when they do look up words, they often are frustrated by what they find.
Translation dictionaries give only the more common translations, and they often do not make
sense within the context the student is reading. Corpora are somewhat better in this regard, but
they are more useful for writing than reading; and few students use them or even know what they
are.

Given learners' vocabulary deficiencies and the weaknesses of translation dictionaries, many L2
researchers have investigated glossing or other hypertext techniques. Their goal is to make
access to vocabulary faster and easier (to facilitate the flow of reading) and provide word
meanings more tailored to the context of what the learner is currently reading.

However, most teachers and researchers would agree that knowing vocabulary before reading
and having vocabulary knowledge that is well developed (i.e., knowing a variety of meanings,
idiomatic uses, and nuances for the vocabulary words) is much better for fluent and successful
reading in the L2. For that reason language instructors and textbooks often precede a reading
selection with a vocabulary list or activity that introduces new or important vocabulary.

So there appear to be different relative advantages, some rooted in L2 reading theory and some based on logistics, for knowing vocabulary before a reading activity versus having quick access to vocabulary while reading. Knowing it ahead of time prevents interruption of the reading process and emulates reading as performed by the first language (L1) reader. Providing vocabulary assistance during reading may permit more contextually appropriate word meaning assistance and gives readers more control, because they can select just that vocabulary they do not know.

The purpose of this study, therefore, was to investigate and contrast two vocabulary assistance techniques—providing a prereading vocabulary exercise versus providing a particular type of glossing (contextualized translation to the reader's L1) during reading. One group of learners received the prereading activity (practice on the key vocabulary in a Spanish-language newspaper article), a second group received during-reading assistance (contextualized L1 translation in the form of hypertext glossing), a third group received both, and a fourth group (a control) read the newspaper article with neither form of assistance.

Our two general research questions were: (a) Will vocabulary assistance (either before or during reading) improve reading comprehension? (b) Will vocabulary assistance (either before or during reading) affect reading time? Our specific null hypotheses were as follows:

 1. Students receiving prereading vocabulary assistance will comprehend a Spanish newspaper article equally well (based on open-ended questions posed and answered in English) as students not receiving that assistance.

 2. Students receiving during-reading vocabulary assistance will comprehend a Spanish newspaper article equally well as students not receiving that assistance.

 3. Students receiving both prereading and during-reading vocabulary assistance will comprehend a Spanish newspaper article equally well as students receiving either no vocabulary assistance or just one type of vocabulary assistance.

 4. Students receiving prereading vocabulary assistance will read a Spanish newspaper article in the same amount of time as students not receiving that assistance.

 5. Students receiving during-reading vocabulary assistance will read a Spanish newspaper article in the same amount of time as students not receiving that assistance.

 6. Students receiving both prereading and during-reading vocabulary assistance will read a Spanish newspaper article in the same amount of time as students receiving either no vocabulary assistance or just one type of vocabulary assistance.

We wanted to contrast two approaches to vocabulary support (prereading versus during-reading) based on different theoretical and practical rationales. Prereading support is based on stronger theoretical foundations. Ajideh (2006, p. 3) claimed that "students are more likely to experience success with reading if they are familiar with selected vocabulary items before they begin reading" using activities like questioning, creating semantic maps, and studying word definitions.

Hunt and Begler (2005) supported lexical instruction to facilitate reading and claimed that prereading activities like highlighting vocabulary will improve lexis acquisition.

Schema theory is another rationale for prereading activities. Ajideh (2006), Cook (1989), Liontas (2001), and Romero-Ghiretti et al. (2007) all contended that activation of learners' prior knowledge and schema will facilitate reading. However, it is unclear if vocabulary introduced right before reading can be considered part of the reader's prior knowledge in the sense that term is used by cognitive psychologists. Prior knowledge (what some researchers prefer to call knowledge of the world) is generally considered to be well-learned and well-integrated information and goes beyond mere vocabulary. Presenting vocabulary right before reading probably provides only superficial hooks into the rest of the reader's knowledge. Even a prereading activity that goes beyond vocabulary, for example, explaining the cultural context of a reading selection, is probably not well integrated with the reader's own cultural knowledge.

On the other hand, the argument that a prereading vocabulary activity will activate relevant schemata is more sound. A prereading activity, whether it be simple vocabulary or more connected cultural information, may not create well-integrated prior knowledge, but it can bring to the reader's mind similar (or contrasting) vocabulary or cultural information. For example, in a classic study on the effect of activating schema, Pichert and Anderson (1977) demonstrated that varying a single word in the directions to a reader (whether to take the perspective of a homebuyer or a burglar) could dramatically affect the reader's recall of a story in which a house is described.

In contrast to the more theoretical support for prereading activities, the support for during-reading activities is more empirical. Several studies have demonstrated that during-reading activities do improve reading performance (whether it be recall, comprehension, main ideas, or details). Most of these studies contrasted different types of during-reading activity. Aust, Kelley, and Roby (1993) found that students using a bilingual hypermedia dictionary looked up more words and read texts more quickly, without any comprehension decrement, than students using traditional dictionaries. Gettys, Imhof, and Kautz (2001), investigating different types of glosses, found that the type of definitions given in dictionaries was better for learning the vocabulary than the type of definitions tailored to the sentences being read, although both types were equivalent for overall reading comprehension. De Ridder (2002) compared glosses that were more or less visible (by virtue of color and other cues) and found that more visible glosses were used more by students, though they affected comprehension equally. Jacobs, Dufon, and Hong (1994) showed differences between better and poorer readers, with the former profiting more from glosses. Knight (1994) found students' comprehension was better when they made use of translation dictionaries while reading. Ko (2005), comparing glosses given in the readers' first versus second language, found that while the second language glosses proved superior on a quantitative measure of reading comprehension, a qualitative think-aloud measure demonstrated benefit for both types of glosses. Lomicka (1998) found that full glosses (which combined definitions, images, pronunciation help, and translations) were better than simple glosses for student inferences, and she argued that that should improve reading comprehension. Rott (2005) showed that multiple-choice glosses (presenting several word meanings the reader could select among) were significantly better than glosses showing a single definition. Finally, Roby's (1999) literature review identified significant empirical support for glosses available while reading.

In addition to the empirical support for during-reading activities, a practical consideration is that they accommodate individual differences better than prereading activities. For example, Taylor (2006) suggested that while first language glosses might be useful for beginning learners, only second language glosses should be used for more proficient ones, a suggestion partially confirmed by Ko's (2005) study. The argument is that different readers come to the reading material with different prior knowledge. A prereading activity might waste the time of some readers (because they already possess the information), or be over the head of other readers (because it does not activate any knowledge or schemata) and thus only beneficial to a fraction of all readers. Furthermore, any of those readers might profit more from other vocabulary or information that the teacher or designer did not think to provide. While prereading activities usually include a small amount of new vocabulary, texts with glosses generally provide such glosses for a much larger number of words, which the reader may choose to use or to ignore. This provides accommodation to individual differences through the reader's own selection of words. A reading selection may contain a very large number of hypertext glosses that a reader may ignore and not be distracted by at all, or use frequently, receiving contextualized help on exactly those words for which the reader wants help.

Another practical advantage of during-reading assistance is that it occurs just when it is required. Prereading assistance does not occur exactly when required. Vocabulary presented before reading may be forgotten by the time the vocabulary is again encountered during the reading selection. However, no research has investigated this "just-in-time" advantage.

The utility of both prereading and during-reading vocabulary assistance are supported by cognitive load theory (Sweller, 2005). Researchers and teachers alike claim that frequent use of a print dictionary disrupts fluent reading and should be avoided (e.g., Liontas, 2001). Cognitive load theory suggests the nature of this disruption and how to reduce it. According to that theory, human cognitive processing is limited and there are three types of load placed on a learner's processing: *intrinsic*, *germane*, and *extraneous* cognitive load. Intrinsic cognitive load is due to the innate complexity of the content and is considered unavoidable. Germane cognitive load is due to relevant instructional activities or learning strategies and is considered good, that is, it facilitates learning. Extrinsic cognitive load is due to characteristics of the learning context that are not necessary for learning the content (such as navigation in a computer program) and may even interfere with it, so is considered detrimental and should be decreased as much as possible. The complexity of a Spanish text represents intrinsic cognitive load. Reading the text and mentally processing it is germane cognitive load and is the activity that primarily benefits learning. The amount of unknown or difficult vocabulary also contributes to intrinsic cognitive load while thinking about that vocabulary contributes to germane cognitive load and benefits learning as well. However, searching through a print translation dictionary contributes to extraneous cognitive load and will likely disrupt the reading process because it reduces the amount of cognitive processing available for thinking about the vocabulary and the text. Both prereading and during-reading vocabulary assistance should reduce the need for using a dictionary and thus reduce the extraneous cognitive load that dictionary use imposes. Furthermore, use of hypertext glosses may contribute to germane cognitive load, the reader's processing of the text, and thus be even more beneficial to learning.

In summary, this study investigated prereading vocabulary assistance as suggested by schema-activation theory and cognitive load theory, and during-reading vocabulary assistance as suggested by prior empirical findings, cognitive load theory, and practical considerations such as accommodating individual differences.

Given the theoretical and empirical arguments above, we expected readers receiving prereading vocabulary assistance to comprehend the Spanish newspaper article better than readers receiving no assistance because relevant schema (e.g., those relevant to railroads, the sea and poetry) would be activated and cognitive load would be reduced, permitting better processing of the text. We expected readers receiving during-reading vocabulary assistance to comprehend the Spanish newspaper article better than readers receiving no assistance as a result of reduced cognitive load and accommodation to their individual differences in vocabulary knowledge. We expected readers receiving both prereading and during-reading vocabulary assistance to comprehend the Spanish newspaper article better than readers in all the other treatments due to the combined effects of schema activation, cognitive load reduction, and accommodation to their individual differences. Those expectations were our alternative hypotheses. Our analyses tested the null hypotheses that there would be no differences between the treatments.

Concerning reading speed, we expected readers receiving prereading vocabulary assistance to finish reading the Spanish newspaper article faster than readers receiving no assistance because they would infrequently need to look up words. We expected readers receiving during-reading vocabulary assistance to finish reading the Spanish newspaper article faster than readers receiving no assistance because they would not look up words in the dictionary and clicking to see glosses is very fast. Finally, we expected readers receiving both prereading and during-reading vocabulary assistance to finish reading the Spanish newspaper article faster than readers in all the other treatments because they would less frequently use either the dictionary or the glosses. Once again, our analyses tested the null hypotheses, that there would be no differences between the treatments.

Method

The study utilized a completely crossed between subjects experimental design with random assignment to treatments. The independent variables were prereading vocabulary assistance (presence or absence) and during-reading vocabulary assistance (presence or absence). The readers receiving neither type of assistance served as controls. The dependent variables were reading comprehension (assessed by open-ended questions asked and answered in English), reading time, and responses to a questionnaire.

Participants

The participants were 76 undergraduate students taking intermediate Spanish at a large public university in the United States. They participated in the research study at the time of and as a part of one of their regularly scheduled Spanish classes. They were not required to participate, but the activity replaced a weekly quiz. If they choose not to do the reading activity, they took their usual class quiz. If they choose to do the reading activity, they received full credit (10 points) for

the quiz without taking it.

Materials

A Spanish language newspaper article (from the online *CNN en Español* web site) about a group of Chilean youth participating in a tribute to the poet Neruda was embedded in a hypermedia program. Some small changes to the article were made based on the advice of a professor of Spanish. The resulting article (Appendix A) was 431 words long and divided into three pages on a computer. Page 1 had 170 words, page 2 had 145 words, and page 3 had 116 words. Students in all treatment conditions could move forward and backward among the pages freely. All students read the exact same article.

The Spanish professor and several Spanish teaching assistants identified 40 vocabulary words and phrases (Appendix B) that they believed students were likely to have difficulty with or were the most critical to understanding the article. A program was constructed (the prereading vocabulary activity) that first displayed those words and phrases (exactly as seen in Appendix B) and then allowed students to practice them by typing their English meanings. This type of activity is not typical of either Spanish textbooks or classroom activities. More than the usual number of new vocabulary words were introduced, and the words were practiced to facilitate retention in working memory, something neither books nor teachers tend to do. However, experimental research studies must strike a balance between several factors, especially realism (similarity to real textbooks and classroom activities), control (treatments being equivalent except for the key experimental variables), and power (treatments being as effective as possible to increase the likelihood of producing educational benefits and statistically significant results). In this case we choose to emphasize power and introduce a strong treatment to produce the best possible learning outcome by activating schema as much as possible and reducing cognitive load as much as possible. However, we sacrificed control and realism as a result.

For the same 40 vocabulary words plus 80 additional words and phrases, a hypertext gloss facility (the during-reading vocabulary assistance) was constructed. The 80 additional words included all but the most common Spanish words in the article. When the hypertext facility was active (that is, for two of the four experimental conditions), students could simply click with the mouse on a word or phrase and see in the upper-right corner of the screen an English translation of the word or phrase as it was being used in the context of the article. These glosses were invisible in the sense that they were not colored differently than the rest of the text, nor were they underlined (De Ridder, 2002). However, when the mouse cursor was pointed at them, it changed from the ordinary pointing arrow to a pointing hand. We provided glosses for a large number of words and phrases (120 of them, or a little more than one-quarter of the text) and did not want so much color and underlining in the text in that they would distract from reading. De Ridder had found that visible glosses are chosen more frequently than invisible glosses, but that visibility did not affect reading speed or comprehension significantly. We did not want to encourage students to select glosses frequently just because they were available. Rather, we wanted students to select glosses when they really needed to know the meaning of a word or phrase.

More glosses were provided (120) than prereading practice words (40) because the during-reading condition precluded use of a print dictionary while the prereading condition did not. We

wanted students to use the glosses (and not a dictionary) but we did not want to disadvantage them with the inability to get help on words they did not know. Thus, the similarity of the prereading and during-reading treatments was compromised. In the design of this treatment we emphasized both power and realism over control. That is, a hypertext glossing facility is only likely to affect reading comprehension if it is available for all the words a reader might want help with. Additionally, the hypertext glossing techniques of most research and instructional materials do provide glossing for a large number of words. However, to accomplish both power and realism we had to sacrifice control. The during-reading assistance was provided for more words and phrases than was the prereading assistance. Given the nature of these techniques, there is no way to maximize all three: power, realism, and control.

Finally, a reading comprehension assessment and a questionnaire program were created. The comprehension assessment administered five short-essay questions (Appendix C) in English and allowed students to type (also in English) what they understood about key points of the newspaper article. The questionnaire (Appendix D) asked students to rate particular features of the online reading program and their prior knowledge of the poet Neruda, a main subject of the article.

Procedure

Students came to the University's foreign language computer lab at the time of their usual Spanish class. They were sent randomly to one of twenty Macintosh computers. Five computers had been programmed to run the *reading-only* condition, five to run the *hypertext-reading* condition, five to run the *practice-before-reading* condition, and five to run the *practice-plus-hypertext* condition. All computers were otherwise identical.

Reading-only condition. All students started with a page of directions that were slightly different for each of the four conditions. In this condition they were told they could use their print Spanish-English dictionaries, which instructors had told them to bring. If students had not brought a dictionary they were provided one. They next received the three-page article with freedom to move forward or backward among the pages. The text of the article was identical for all conditions. After reading the article as long as desired, students received five short-essay questions (Appendix C) both asked and answered in English. Students could type as much as they wanted. The first four questions asked about specific aspects of the article (the train trip, Neruda's relationship to the sea, Neruda's house, and why Neruda was famous in Chile). The fifth question asked students to type whatever they remembered about the article. Each question was on an individual page, and all five questions were identical for the students in the four different conditions. After the fifth question, students received a one page questionnaire with four Likert-style questions. These four questions were common to all the research conditions. Students answered by clicking on their choices (strongly agree, agree, disagree, or strongly disagree). The questions included affect (whether or not they enjoyed reading online), self-report of their own behavior (how often they had to look up words), and prior knowledge (how much they knew about Neruda). After completing the questionnaire and going to the next page, the students were thanked for their participation and could leave.

Hypertext-reading condition. Directions in this condition told students that they would be able to

click on words during the article to see their English meaning. They were asked to not use a print dictionary. They next received the same three-page article. The only difference from the reading-only condition was that 120 of the more important words or phrases could be clicked on, in which case their meaning (within the context of the article) appeared in English in the upper-right corner of the screen. After the article they received the same five short-essay questions. They then received the questionnaire with the four questions common to all conditions and one additional question asking how much they liked the glossing feature.

Practice-before-reading condition. Directions in this condition told students that they would begin with an activity introducing the article's critical vocabulary. They were told (like the reading-only condition) that they could use a print Spanish-English dictionary while reading. They next received a page showing the 40 critical vocabulary words and phrases and their English meanings. The meanings given were identical to what appeared as glosses for the students who received glosses. After that page students received a practice activity in which each of the words was presented and they were required to type the English meaning. If answered correctly, a word was not asked again. If answered incorrectly, a word was repeated three items later. If a word was answered incorrectly during the last two items of the practice activity, some of the other words (which had been correctly answered on previous occasions) were used to pad the list. After the 40 words were correctly answered, students received the same three-page article as for the other conditions. They did not receive hypertext glosses. After the article they received the same five short-essay questions as the other conditions. They next received the questionnaire with the four questions common to all conditions and one additional question about how much they thought the vocabulary practice helped them in reading the article.

Practice-plus-hypertext condition. Directions in this condition told students they would begin with an activity introducing the article's critical vocabulary and that they would be able to click on words during the article to see their English meaning. They were asked to not use a print dictionary. They received the vocabulary display page and practice activity as in the practice-before-reading condition followed by the same three-page article. Like the hypertext-reading condition, the 120 identified words and phrases could be clicked to see glosses. After the article they received the same five short-essay questions as all the other conditions. They then received the questionnaire with the four questions common to all conditions and two additional questions about how much they liked the hypertext feature (the same as was given to students in the hypertext-reading condition) and how much they thought the vocabulary practice helped them in reading the article (the same as was given to students in the practice-before-reading condition).

Data Analysis

Online data recording and retrieval. While students worked, the program recorded all their activities in a formatted text file. Every line of this file included a time stamp and a description of the activity (e.g., entering or leaving a page of the article). Events recorded included starting and ending the program, starting and ending the vocabulary list, starting and ending the prereading practice activity, each practice item presented and the answer given by the student, starting and ending each page of the article, each hypertext (glossed) word clicked upon, words clicked upon which did not have glosses, starting and ending each essay question, the typed answer given to each essay question, starting and ending the questionnaire, and the choice

clicked for each questionnaire item (including changing one's mind and clicking a new choice). In addition to the above event data, each text file recorded the experimental condition and the number of the computer used by the student. Nothing identifying the student (name or university ID number) was stored. The text files were formatted allowing them to be retrieved by a word processor (to print and grade the typed essay answers), a spreadsheet (to read times and other objective data for analysis), and a preprocessing program created by the researchers to prepare the data for the primary statistical analysis using Statistical Package for the Social Sciences (SPSS). Preanalysis processing included, for example, counting the number of hypertext clicks and summing the total time spent reading.

Objective data preparation. The spreadsheet and preprocessing program generated a file with objective information for each participant including their condition, time in various parts of the activity, number of appropriate and inappropriate hypertext clicks, and final questionnaire choices.

Reading performance test scoring. For each of the five essay questions a scoring key was created. The scoring key identified the primary correct idea units (those present in the article) and possible incorrect idea units (those reflecting misunderstanding or mistranslation of idea units in the article). The first four essay questions (on specific topics) had 4–7 correct idea units and the same 14 incorrect idea units, which had been compiled during a prior reading of all the students' responses. The fifth essay question (which asked students to type anything they could remember) had a longer list of 35 correct idea units and the same 14 incorrect idea units. These keys were used to score each student's essay questions, assigning each student a number correct and a number incorrect for each of the five questions. Both researchers (the authors) performed blind scoring of all responses by all students and discussed score differences so as to come to agreement. These numbers, plus the total correct and incorrect, were added to the objective data file. The data were analyzed with a univariate analysis of variance, using SPSS.

Results

Reading Performance

A completely crossed 2 × 2 (Glossing During Reading for the First Factor × Prereading Practice for the Second Factor) analysis of variance was performed on the total number of correct idea units given (across all five questions). Reading-only students had a mean of 10.35 idea units ($n = 23$, $SD = 6.7$), hypertext-reading students had a mean of 15.53 idea units ($n = 19$, $SD = 5.41$), practice-before-reading students had a mean of 10.0 idea units ($n = 16$, $SD = 5.38$), and practice-plus-hypertext students had a mean of 13.06 idea units ($n = 18$, $SD = 6.73$). The main factor of glossing was significant, $F(1, 72) = 8.39$, $MS = 316.58$, $p < .005$, indicating that students who were able to click on words for their meaning performed significantly better. Neither the main factor of prereading practice nor the interaction of the two factors was significant for this dependent variable. Thus, Null Hypothesis 2 was rejected, but Null Hypotheses 1 and 3 were not. During-reading vocabulary assistance appeared to be the most beneficial treatment with regard to reading comprehension.

The same analysis was performed on the five essay questions individually. Three of the five questions (1, 3, and 5) were significant at better than the .05 level for the main effect of hypertext glossing, with students receiving hypertext glossing performing better.

For students who received glossing, we performed a Pearson Correlation between the number of times students looked up word meanings (that is, clicked on words) and the total number of idea units reported. The correlation ($r = .305$) was not significant at the .05 level, but was close to it ($n = 37$, $p = .066$). This suggests, albeit tentatively, that the more students looked up words, the more they understood about the article.

Study Time

The same 2×2 analysis of variance was performed on the time spent reading the article and the combined time spent both practicing the vocabulary before reading and then reading the article. For reading the article alone, reading-only students spent a mean of 653 seconds reading the article ($n = 23$, $SD = 394$), hypertext-reading students spent a mean of 631 seconds reading the article ($n = 19$, $SD = 202$), practice-before-reading students spent a mean of 385 seconds reading the article ($n = 16$, $SD = 212$), and practice-plus-hypertext students spent a mean of 371 seconds reading the article ($n = 18$, $SD = 191$). The main factor of prereading practice was significant, $F(1, 72) = 17.165$, $MS = 1,296,224$, $p < .001$, indicating that students who had done the prereading practice read the article significantly faster. Neither the main factor of glossing nor the interaction of the two factors was significant for this dependent variable. Thus, Null Hypothesis 4 was rejected, but Null Hypotheses 5 and 6 were not. Prereading assistance appeared to be the most beneficial treatment with regard to article reading time. However, the importance of this result is tempered by the next analysis.

For the time spent in both the prereading activity plus reading the article the results were the opposite. Reading-only students spent a mean of 653 seconds overall ($n = 23$, $SD = 394$), and hypertext-reading students spent a mean of 631 seconds overall ($n = 19$, $SD = 202$). Practice-before-reading students spent a mean of 1,345 seconds overall ($n = 16$, $SD = 305$), and practice-plus-hypertext students spent a mean of 1,245 seconds overall ($n = 18$, $SD = 369$). The main factor of prereading practice was significant, $F(1, 72) = 73.122$, $MS = 7,981,458$, $p < .001$, indicating that students who had done the prereading practice spent significantly more time in the combination of prereading and reading activities. Neither the main factor of glossing nor the interaction of the two factors was significant for this dependent variable.

Questionnaire Responses

On the first question, difficulty of the article, all students in all conditions found the article moderately difficult ($M = 2.45$ on a 1–4 Likert scale).

On the second question, how much they had to look up vocabulary words (whether online or offline), all students in all conditions did so moderately ($M = 2.11$ on a 1–4 Likert scale).

On the third question, how much they liked the online vocabulary help (hypertext glossing), which was only asked of students who received glossing, the students who only received

glossing liked it significantly more ($M = 1.05$, $n = 19$, $SD = .23$) than students who received both glossing and prereading practice ($M = 1.94$, $n = 18$, $SD = .94$) on a 1–4 Likert scale, $F(1, 35) = 16.191$, $MS = 7.351$, $p < .001$.

On the fourth question, how much they thought the prereading vocabulary activity helped them, which was only asked of students who received that prereading activity, all students (whether they received glossing or not) thought it helped moderately ($M = 2.0$ on a 1–4 Likert scale).

On the fifth question, comparing the interactive reading to reading a regular book, there was a significant main effect for glossing and a significant interaction. Control students had a mean of 2.35 on a 1–4 Likert scale ($n = 23$, $SD = .775$), hypertext-reading students had a mean of 1.42 ($n = 19$, $SD = .838$), practice-before-reading students had a mean of 1.94 ($n = 16$, $SD = .443$), and practice-plus-hypertext students had a mean of 1.72 ($n = 18$, $SD = .895$). The main effect for glossing was significant, $F(1, 72) = 10.342$, $MS = 6.09$, $p < .003$. The interaction was significant, $F(1, 72) = 4.014$, $MS = 2.364$, $p < .05$. Overall, students receiving hypertext glossing liked online reading more than students who did not receive glossing. The significant interaction was produced because that effect (favoring hypertext glossing) was much more pronounced for students who did not have the prereading vocabulary practice. Students who did receive the prereading vocabulary practice had a much smaller effect for hypertext glossing. That is, they only liked having it a little more than not having it.

On the sixth question, prior familiarity with the poet Neruda, all students in all groups were equally unfamiliar with him ($M = 3.5$ on a 1–4 Likert scale). We had chosen a topic we hoped and expected students would not have prior knowledge of, and this confirmed our expectation.

Discussion

Comparing the two techniques in this study, prereading vocabulary assistance (the practice activity) and during-reading vocabulary assistance (hypertext glossing), the latter was clearly more effective. The hypertext glossing had significant positive impact on reading performance even though participants did not have access to regular dictionaries, and without significantly affecting the time to read.

On the other hand, the prereading assistance showed mixed results. It did appear to shorten reading time without affecting reading performance significantly, which would itself seem good; but that is only true if we measure reading time of the article alone. If we include the time spent studying the vocabulary, the total time in the lesson is significantly increased by the prereading activity. On the one hand, reading itself may be a little more efficient, but on the other hand overall study time is less efficient, requiring more time without improved comprehension.

A concern is that the condition that combined both prereading and during-reading vocabulary assistance demonstrated slightly worse reading performance (though it was not a significant difference) than the condition with during-reading vocabulary assistance alone. One should not overinterpret a nonsignificant difference, but what might account for this if the difference is real (that is, if it were to be shown significant with a greater number of participants)? One possibility

is that the combination of two types of vocabulary assistance imposed too much cognitive load and thus detracted from the cognitive processing available for reading comprehension. This particular prereading vocabulary exercise was considerably more effortful than just looking at new vocabulary words or being told a little about the context, both of which are more common prereading activities in second language classrooms and textbooks. Students who had the prereading practice might have been growing weary and becoming eager to finish the entire activity. That is supported by the fact that overall time (prereading and reading) was slightly less for the condition with both types of assistance than for the condition with just prereading assistance (although that contrast was not significant either). It is also supported by the responses to the fourth questionnaire item. Students who only received hypertext glossing liked it much more than students who received both hypertext glossing and the prereading activity.

The greater benefit of the during-reading vocabulary assistance (hypertext glossing) is also supported by the data from the fifth questionnaire item. In that question, students were asked to compare online reading to regular books. Students who received hypertext glossing rated online reading better than regular books significantly more than students who did not receive hypertext glossing, and students who only received hypertext glossing rated online reading the best of them all, as evidenced by the interaction.

Theoretical Implications

The contention of schema theory that prereading activities activate learners' relevant schemata (background knowledge relevant to the reading selection) is not supported by our results. Schema theory would predict a benefit for reading comprehension and not for time. Quite the opposite was found. The prereading activity did not improve reading performance, it only reduced reading time and only if we do not count the prereading activity itself as part of the reading time. One might maintain, however, that our particular prereading activity emphasized vocabulary practice in a way that is less likely to activate schemata than, for example, providing some cultural context for the reading selection or presenting vocabulary that activates learners' own cultural knowledge in a way relevant to that of the reading selection.

In contrast to the lack of support for schema activation through prereading activities, our results do support and add to findings of the practical effects of during-reading vocabulary assistance (e.g., Taylor, 2006), the effect of cognitive-load reduction (Sweller, 2005) and are consistent with several studies (De Ridder, 2002; Ko, 2005; Lomicka, 1998) providing empirical evidence that hypertext glossing facilitates L2 reading.

Practical Implications

For teachers and designers of instructional materials we have both good news and bad news. During-reading support may be more effective than prereading support, but it is currently more difficult to implement. Prereading activities (a list of vocabulary, a cultural orientation given orally) can be easily created and delivered by teachers and can be used for any type of reading material, whether it is in a book or on a computer.

In contrast, during-reading activities such as hypertext glossing are only practical when reading

on a computer, and they demand a level of technical development (such as creating a glossing utility and connecting it to appropriate vocabulary) that most teachers would find difficult. During-reading vocabulary assistance clearly finds more support in research studies, but its practical application is dependent on two things. First, more reading materials must become available online. Second, programs must be developed that generate hypertext vocabulary assistance automatically for any electronic text.

We are on a good trajectory for the first to occur. More and more reading material is available online. That is not the same, however, as students reading the material online. Many readers still prefer to print electronic texts and read them on paper, which obviates hypertext support. Although academic texts are quickly going electronic, the movement of students toward being comfortable with reading on line is occurring a little more slowly. That may change (i.e., students may be much more willing to read on line) if online texts provide beneficial features that paper texts do not. More students will be willing to read online texts (rather than print them) if they get additional benefits not available with the print materials.

There is also progress towards programs that automatically provide hypertext support in electronic texts. Providing glosses with basic word translation is fairly easy, but there will be greater benefit in programs that can automatically generate the context-sensitive support most hypertext glossing programs provide. That will require more intelligent programming that incorporates some degree of language understanding, enough to determine context and thus select and present glosses that are truly helpful to readers.

Limitations of the Study

In the Method section we discussed the need to balance realism, control, and statistical power. In one instance we choose to compromise realism (the prereading activity is much longer and more intensive than most textbook or classroom prereading activities) to benefit power. In another instance we choose to compromise control (providing bilingual dictionaries only to the students who did not receive glossing) to benefit realism. However, the first instance turned out to compromise not only realism but also control. The data indicate that students spent considerably more time in the conditions with prereading assistance. That confuses the issue of whether reading was really more efficient (equal learning in less time) or not. Furthermore, the effort required to complete the prereading vocabulary practice may have caused fatigue and, subsequently, diminished reading effort and performance. Perhaps just presenting our vocabulary list would have been equally effective. That would be a worthwhile follow up study. Not only would it be less time consuming and less likely to fatigue students, but it would be more like the prereading activities of real textbooks and classrooms.

Conclusion

This study contrasted prereading vocabulary assistance (presenting and practicing new vocabulary) and during-reading vocabulary assistance (hypertext glosses). During-reading assistance proved more valuable as it significantly improved reading comprehension and students liked that assistance the most. The effect of prereading assistance was mixed. If one

only considers the time to read the article, prereading assistance significantly decreased reading time without affecting comprehension. On the other hand, if we consider the combined time of both the prereading activity plus reading the article, prereading assistance significantly increased the time, thus lowering overall efficiency.

The greatest benefit will likely accrue from combining glossing and automated processing of text. Because hypertext glossing is clearly effective (as demonstrated not only in this study but many others) and students like it, techniques for automatically generating hypertext glosses for arbitrary L2 texts would be very beneficial. Software development towards that goal would be welcomed by L2 learners as well as effective in improving their reading comprehension.

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Appendix A

The following three screen shots show the three pages of the article. The third page also demonstrates the appearance of a hypertext gloss, in this case for the word *suelo* in the second to last line. The first and second pages have a small letter D in the upper-right corner, indicating to the researchers that those students are allowed use of print dictionaries. The student who received glosses (the third page) was not allowed use of a print dictionary.

Page 1 of 3   D

Un recorrido en tren por la vida del poeta chileno Pablo Neruda

10 de septiembre 2001
Actualizado: 5:47 PM hora de Nueva York (2147 GMT)

Santiago (Reuters) — Un tren a vapor cargado de poetas rememorará en Chile la vida del premio Nóbel de Literatura Pablo Neruda, que falleció hace 28 años a consecuencia de un cáncer que padeció silenciosamente en su casa frente a las costas del Océano Pacífico.

En vísperas del nuevo aniversario, la fundación que lleva su nombre prepara el "Tren de la poesía" que recorrerá el centro y sur de Chile, desde su ciudad natal Parral, en el centro del país, hasta la sureña Temuco, donde vivió toda su infancia. El convoy acarreará a jóvenes poetas chilenos y extranjeros que recitarán versos sobre ruedas en homenaje a Neruda y su vida ligada a los trabajadores de ferrocarriles por su padre maquinista. El poeta, cuyo verdadero nombre fue Neftalí Reyes, recibió el Nóbel literario en 1971, mientras residía en Francia como embajador del gobierno socialista de Salvador Allende.

Next page

El barco de la Isla Negra

Unos 120 kilómetros al oeste de Santiago está el más emblemático de los museos que recuerdan a Neruda. Es su propia casa enclavada en la playa de Isla Negra, una construcción con forma de barco de la que él se autonombró "marinero en tierra".

"Lo que pasa es que don Pablo quiso recrear el ambiente de un barco y él mismo diseñó la casa. Él era el capitán de este barco y cuando divisaba otro barco en el horizonte hacía repicar las campanas", explicó Patricio Quiroz, restaurador del museo.

La casa, que alberga cientos de colecciones de objetos diversos e insólitos como: conchas marinas, botellas y piezas de barcos, acoge cada día a turistas extranjeros y durante octubre recibirá también la visita de un coro de niños daneses que entonarán versiones musicales de la obra "100 sonetos de amor".

`[ Previous page ]`   `[ Next page ]`

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floor or ground

Según la directora del museo, Maria Eugenia Zamudio, más de 95.000 personas lo visitaron el 2000 y desde su apertura, a principios de la década pasada, han desfilado por sus salones personajes como la diseñadora Carolina Herrera, el príncipe Felipe de Borbón y el vocalista de U2, Bono.

No sólo la forma de barco de la casa de Neruda y sus pasillos estrechos evocan su amor por el mar. En ella lucen, además, botellas de colores con veleros y navíos en miniatura, mesas confeccionadas con ruedas de timón apernadas al suelo, completan el panorama marino. En los jardines una campana mayor en el suelo y dos menores arriba saludaban con repiques a los navíos de paso.

`[ Previous page ]`   `[ Done Reading ]`

Appendix B

The screen shot below shows the forty Spanish words presented and practiced in the prereading vocabulary activity.

Below are some Spanish words and phrases used in the article you will read. Look over this list. Please **do not** try to memorize them or write them down. Starting on the next page you will be able to practice them. Please **do not** use a dictionary while practicing. The idea is to **remember** the words.

acarreará	- will transport	maquinista	- machinest
alberga	- houses or protects	marinero en tierra	- a sailor ashore
autonombró	- he called himself	natal	- place of birth
cargado	- carried	navíos	- naval ships
conchas	- shells	no solo . . . además	- not only . . . but also
confeccionadas	- crafted by hand	padeció	- suffered
convoy	- event	pasillos	- hallways
coro	- choir	príncipe	- prince
daneses	- Danish	recorrido	- trip or voyage
desfilado	- paraded or marched through	recrear	- to recreate
diseñadora	- designer	recuerdan	- remember
divisaba	- contemplated	repicar las campanas	- play or sound the bells
enclavada en la playa	- right on the beach	ruedas de timón	- steering wheel of a ship
entonarán	- sing in harmony	salones	- large rooms
falleció	- died	saludaban	- greeted
ferrocarriles	- railroad workers	sobre ruedas	- on wheels
homenaje	- a tribute	sureña	- the southern part
insólitos	- unusual	tren a vapor	- steam train
ligada	- linked to	veleros	- sail boat
lo que pasa . . .	- the idea is . . .	vísperas	- preceding

Click here when ready to practice the words.

Appendix C

Below are the five short-essay questions given to students after reading. Questions were displayed one per computer page and students typed their answers in English.

     Why was the trip done on a train?
     What was Neruda's relationship to the sea?
     Describe Neruda's house on Isla Negra.
     Why is Neruda revered in Chile?
     Please type a summary of the newspaper article.

Appendix D

The screen shot below shows the questionnaire. Items 1, 2, 5 and 6 were seen by students in all conditions. Item 3 was only seen by students receiving during-reading hypertext assistance. Item 4 was only seen by students receiving prereading vocabulary practice. This particular screen, with all six items, was seen by students in the practice-plus-hypertext condition. *Strongly agree* was scored as 1, *agree* as 2, *disagree* as

3, and *strongly disagree* as 4.

Please give us your opinions about this learning activity by clicking on the appropriate boxes below.

	Strongly Agree	Agree	Disagree	Strongly Disagree
I thought the newspaper article was easy to read.	☒	☐	☐	☐
I had to look up vocabulary words a lot.	☐	☒	☐	☐
I like the on-line dictionary more than a regular paper dictionary.	☒	☐	☐	☐
I thought the vocabulary practice helped me understand the reading.	☐	☒	☐	☐
I like this type of interactive lesson more than just reading a book.	☒	☐	☐	☐
I was already familiar with Pablo Neruda before reading this article.	☐	☒	☐	☐

I am done

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