The Effects of Response Modes and Cues on Language Learning, Cognitive Load and Self-Efficacy Beliefs in Web-based Learning

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An experiment was conducted to examine how different response modes for practice questions and the presence or absence of cues influenced students’ self-efficacy beliefs, perceived cognitive load, and performance in language recall and recognition tasks. One hundred fifty-seven 6th grade students were randomly assigned to one of four conditions: 1) MC (multiple-choice only), 2) MC-C (multiple-choice with cues), 3) CR (constructed-responses only), or 4) CR-C (constructed-responses with cues). The results indicated that students who practiced with constructed-response questions performed better in recalling and recognizing English vocabulary, and reported higher self-efficacy beliefs than those who practiced with multiple-choice questions. This finding adds to our knowledge that constructed-response questions might have helped to increase the students’ confidence in learning the materials. The findings also indicated that the presence of cues improved students’ performance in recall and recognition tasks, and increased their self-efficacy toward learning the materials. In addition, the study extends our understanding about the influence of different response modes and cues on students’ perceived cognitive load in web-based language learning.

Keywords: response modes, web-based language learning, cognitive load, self-efficacy beliefs
INTRODUCTION

Various forms of interactions exist in web-based learning environments. These include the interactions between the learner and the course content, the instructor, and other learners (Kahveci & Imamoglu, 2007). In content-learner interactions, learners are frequently given questions to rehearse or apply the content they have just learned. Different types of response modes are used for such questions, including multiple-choice and constructed-response questions. For multiple-choice questions, learners choose one correct answer from the provided choices. In comparison, constructed-response questions are often open-ended and require learners to write their own answers. Studies comparing the effects of these two response modes have shown that constructed-response questions have significantly better effects on learners’ recall and knowledge transfer in computer-based or web-based learning (Clariana, 2003; Yun, Miller, Baek, & Jung, 2008). While both multiple-choice and constructed-response questions are used in web-based learning, their effectiveness in promoting younger students’ learning still requires further investigation. Moreover, existing research is mostly focused on using the questions as a way of assessment rather than as a means of learning and practice. Accordingly, this study focused on language learning, where practice questions are vital in helping students to rehearse what they have learned. Particularly, this study presented elementary students with different types of practice questions to help them rehearse the vocabulary learned from each short web-based instructional module, and examined how multiple-choice and constructed-response questions influenced the students’ language learning outcomes. It offers practical implications for the use of these response modes in web-based learning environments.

The use of different response modes in web-based learning is closely related to the cognitive load theory, which suggests that tasks requiring learners’ extra mental efforts may induce excessive cognitive load and hinder learning (Moreno & Valdez, 2005). A better understanding of cognitive load helps us to design multimedia instruction that produces lower cognitive load and better learning outcomes (Mayer, 2001; Sweller, 1994; Tindall-Ford, Chandler, & Sweller, 1997). From the cognitive load perspective, when learners respond to constructed-response questions, they often need to recall a larger amount of information when compared with answering multiple-choice questions. The studies by Smith and Karpicke (2013) consistently found that constructed-response questions were more challenging and required more response time than multiple-choice questions. Hypothetically, constructed-response questions may entail a high cognitive load and may consequently interfere with learning. In such a context, providing cues along with constructed-response questions may guide the learner’s attention
to the most relevant content (Fischer & Schwan, 2009). Therefore, cues may lead to the reduction of cognitive load.

In addition to the cognitive aspects of web-based learning, researchers have been paying increasing attention to learners’ motivation in web-based learning environments (Pintrich, Conley, & Kempler, 2003). Although web-based learning is theoretically suitable for students to take charge of their own learning, research indicates that motivation in online learning may easily decline when the assigned tasks induce excessive cognitive load or when a student cannot keep up with the pace of the course or understand the material (Chang & Lehman, 2002; Kim, Yoon, Whang, Tversky, & Morrison, 2009; Sins, Savelsbergh, & Van Joolingen, 2009). Linking to the two different question response modes discussed earlier and their possibly different demands for cognitive load, it would be worthwhile to explore how different response modes and cues may either help or impede learners’ motivation when learning a language in a web-based environment. In this particular study, the motivation construct under investigation was learners’ self-efficacy, which is discussed in detail in the next section.

THEORETICAL PERSPECTIVES

Web-based response modes

For many years, web-based learning environments with different multimedia tools have been used to supplement conventional activity-based lessons and to engage students in language learning (Akbulut, 2007; Chang, 2007). Because language learning typically involves a large vocabulary, the effectiveness of web-based learning on vocabulary acquisition has been a focus of research (Acha, 2009; Laufer & Hulstijn, 2001). Multiple-choice and constructed-responses questions are two common approaches to learning and practicing English vocabulary in web-based learning.

Multiple-choice and constructed-response questions are used in web-based learning to both assess students’ content knowledge and for students to assess themselves. Research has suggested that different response modes activate different cognitive skills and stimulate different memory retrieval processes (Godden & Baddeley, 1975). For example, Clariana and Lee (2001) found that multiple-choice questions helped learners to recognize relevant content, whereas constructed-response questions helped to improve content recall. Glover (1989) theorized that recall tasks (usually constructed-response) are more instructionally effective than recognition tasks (usually multiple-choice) because the latter tends to elicit superficial responses. Constructed-response questions force students to think before responding and are more effective than multiple-choice questions due to
deeper and more elaborate encoding (Berg & Smith, 1994). Smith and Karpicke’s (2013) studies of college students suggested that while constructed-response questions were more time consuming than multiple-choice questions, they led to better learning outcome when students were given time to study materials and practice with the questions early in the process. Generally, researchers have agreed that constructed-response questions are more effective for learning in all academic areas because they involve a much more complex memory retrieval process (e.g., Tobias, 1973; Yun et al., 2008).

Web-based cues

A great deal of research and theories favor the use of feedback (Butler & Winne, 1995; Danielson et al., 2007), yet there is a lack of empirical research examining the effect of cues in web-based language learning. Unlike feedback, cues offer “just-in-time” procedural guidance during the learning process rather than “just-in-case” outcome-based support (Hummel, Paas, & Koper, 2004). Cues can give hints to learners on how to proceed with problem-solving tasks and also stimulate evaluative questioning (Hummel & Nadolski, 2002). Hummel, Paas, and Koper (2006) used web-based cues to provide immediate, individualized response and customized follow-up coaching, and found that web-based cues reduced potential confusions which sometimes occurred during the learning process and further strengthened students’ mental models of concepts (Hummel et al., 2006). In the context of language learning, very few studies have examined the effects of cues. Proctor, Dalton, and Grisham (2007) embedded cues and reading strategy prompts in digital text to scaffold fourth-grade student’s vocabulary acquisition and comprehension, and found that students’ usage of the embedded support was significantly correlated with their improvement of comprehension but not vocabulary. In another study, Higgins and Cocks (1999) used animation cues to support third-grade students’ vocabulary development, and found in the posttest that students had made significant improvement. Both of these studies adopted a single-group, pretest-posttest research design. An experimental study designed to investigate the use of cues in language learning would provide us with a clearer picture about the effects of cues on language learning.

Cues can appear as graphics or audios in addition to the usual text format. According to the dual-code theory, humans have two separate working-memory systems or channels: verbal and imagery systems. Humans use a verbal system to process textual or pictorial information, and use an imagery system to process non-verbal information such as audios or animations (Baddeley & Logie, 1999; Paivio, 1986). Research on multimedia learning has shown that, in some cases, showing pictures with text may enhance the
retention process (Tindall-Ford et al., 1997), while in other cases simultaneous presence of a picture and a word may overburden the verbal system (Mayer & Moreno, 2003). Since each system has limitations, learning with the auditory channel can help reduce the load on the verbal channel alone. In other words, to partially overcome the limit of working memory, part of the information can be presented in a visual or pictorial mode and the rest in an auditory mode. Therefore, the current study used audio cues to accompany the practice questions which were presented verbally.

**Cognitive load in web-based learning**

Chandler and Sweller (1991) defined cognitive load as “the manner in which cognitive resources are focused and used during learning” (p. 294). According to the cognitive load theory, there are three types of cognitive load - intrinsic, germane, and extraneous, and each has different implications for instruction. Intrinsic cognitive load refers to “the complexity of the learning material” (Renkl & Atkinson, 2003, p. 17). It is dependent on the number of elements and the degree of interactivity required by the learning material (Sweller, van Merrienboer, & Paas, 1998). Germane load refers to the “demands placed on working memory capacity that are imposed by mental activities that contribute directly to learning” (Renkl & Atkinson, 2003, p. 17). Contrary to germane load, extraneous or ineffective load refers to information or activities that are irrelevant to the learning task (Paas, Renkl, & Sweller, 2004).

Cognitive load theory indicates that instructional activities should not interfere with the construction of schemas so that extraneous cognitive load can be kept at a minimum during the learning process (Chandler & Sweller, 1991). Paas and van Gog (2006) contended that the method of reducing extraneous load is to allocate more cognitive resources to germane cognitive activities. There has been a growing interest examining the effects of different instructional activities on students’ cognitive load, particularly in web-based learning environments (Boucheix & Guignard, 2005; Cierniak, Scheiter, & Gerjets, 2009; Schnotz & Kurschner, 2007). For example, de-Hann, Reed, and Kuwada (2010) found that music video games intended to help learners acquire second language vocabulary produced extraneous cognitive load that interfered with learners’ vocabulary recall. On the other hand, few studies have examined the effects of different response modes, with or without cues, on learners’ perceived cognitive load. Further, most research on cognitive load in multimedia learning has been conducted on adults. The ability to generalize these findings to other age groups, such as elementary school children, is weakened (Acha, 2009). Therefore, this study investigated the effects of response modes and cues on younger learners’
perceived cognitive load. It was expected that the findings would advance our knowledge base and shed light on the design of web-based learning for younger learners.

**Self-efficacy beliefs**

As one of the most important factors driving human motivation (Bandura, 1995), self-efficacy is the belief that one has the capacity to complete a particular task successfully (Bandura, 1977). Most researchers would agree that self-efficacy is a strong motivational indicator for students’ learning behaviors, beliefs about learning, and performance (Lane, Lane, & Kyprianou, 2004; Tremblay & Gardner, 1995). For example, self-efficacy has consistently been found to be positively associated with general academic achievement (e.g., Lane & Lane, 2001; Pajares, 1996; Pajares & Kranzler, 1995) as well as performance in specific domains, including math (Pajares & Miller, 1994), writing (Pajares, Britner, & Valiante, 2000), and foreign languages (Hsieh & Schallert, 2008; McCollum, 2003). Further, a notable amount of research has also found the correlation between self-efficacy beliefs and active learning strategies (Ames, 1992; Pintrich & DeGroot, 1990; Runhaar, Sanders, & Yang, 2010; Schunk, 1995; Zimmerman & Martinez-Pons, 1990).

While web-based learning continues to increase, researchers have found that learners’ motivation easily declines in such a self-directed environment (Wang & Reeves, 2006). Unlike classroom settings, students rely on themselves to learn in a web-based environment. Wang and Wu (2008) found that students with high self-efficacy were likely to succeed in web-based learning because they tended to adopt more high-level learning strategies and better self-regulate their own learning. Self-efficacy is considered a strong and important indicator of students’ learning outcomes, behavioral patterns and attitudes in web-based learning (Chang & Tung, 2008; Conrad & Munro, 2008; Tsai, 2009). While many studies have investigated the relationship between self-efficacy and performance in web-based learning, research is scant on how different types of practice questions influence students’ self-efficacy in web-based language learning. We postulated that the use of different response modes and cues might potentially affect learners’ self-efficacy in web-based language learning. Therefore in the current study, learners’ self-efficacy became an important variable under investigation.

**PURPOSE OF THE STUDY**

To summarize what has been reviewed so far, while the effects of different response modes (multiple-choice or constructed-response) and cues (present or absent) on web-based learning have each been studied sepa-
rately, few studies have simultaneously examined the impact, especially in web-based language learning for young students. In this study, we were interested in not only the cognitive impact (students’ language learning performance and perceived cognitive load), but also motivational impact (students’ self-efficacy beliefs). It was expected that the findings from this study would shed light on the design of web-based learning and practice for young language learners. The specific research questions are stated below:

When learning language from web-based multimedia materials, what are the effects of practice questions’ response modes and cues on 1) students’ performance in language recall and recognition, 2) their perceived cognitive load, and 3) their self-efficacy beliefs?

METHODS

Design and participants

To answer our research questions, this study employed a 2 x 2 factorial design in which the independent variables were response modes (multiple-choice and constructed-responses) and cues (present or absent). Dependent variables were students’ English vocabulary learning outcomes, cognitive load, and self-efficacy. A total of 157 sixth graders (71 males and 86 females) with an average age of 12 years from a large suburban elementary school in Taiwan participated in this study. They were recruited from four different classes in the same school. Without reference to what classes they were in, all students were randomly assigned to one of the four intervention conditions: (a) multiple-choice only (MC only), (b) multiple-choice with cues (MC-C), (c) constructed-responses only (CR only), and (d) constructed-responses with cues (CR-C). One third (33%) of the participants reported that they attended English cram schools, which offer private English classes supplementary to regular schoolwork. Although 91% of the participants said that computer-assisted language learning was new to them, 67% of them reported that they had experience using multimedia tools (i.e., websites, CDs, English-language magazines) to learn English.

Materials

The learning materials’ topic was about the animal kingdom. This topic was chosen for two reasons. First, the topic was covered in the sixth grade English curriculum in Taiwan. Second, learning about the animal kingdom was fun and practical for the students. The learning materials consisted of two self-paced learning modules. Each module presented the students with vocabulary words, example sentences that used the words, and stories de-
scribing animals from different continents. All materials were developed using Adobe Flash software, which allowed us to integrate texts with pictures and animations. Students could read words, sentences and stories, view pictures, watch animations, and use buttons to navigate between pages of the module. The practice lessons following each learning module presented questions for students to answer. Each of the four treatment groups (i.e., MC, MC-C, CR, and CR-C) worked on different practice lessons that were designed using Adobe Captivate software. For the MC group, students were required to choose one correct answer to each question from four possible options. If the correct answer was chosen, the screen read, “That’s right, this is the correct answer. Click next for the next question.” If students chose an incorrect answer, they would be told, “No, this is not the correct answer. Please try again” until they gave the correct answer. The practice lessons for the MC-C group were similar to those for the MC group except that students could click a “Cue” button for help if needed. For the CR group, students were required to type their answers to practice questions in a blank text box. The screen read “Right” for a correct response or “That is incorrect. Please try again” for an incorrect response. The practice lessons for the CR-C group were similar to those for CR except that students could click “Cue” for help if needed. The cues were identical for MC-C and CR-C treatment groups. When “Cue” was clicked, a voice prompt would play. Students could press the “Cue” button as many times as they wanted.

**Instruments**

*Recall and recognition pretest and posttest*

The recall and recognition pretest and posttest had 20 questions: 10 recall (constructed-response) and 10 recognition (multiple-choice) questions. In a recognition question, students were presented with a picture of an animal they learned about from a learning module, and were asked to choose the correct name of the animal from four different options. In a recall question, students were presented with a picture of an animal and asked to type the name of the animal. The pretest and the posttest were identical. The possible scores ranged from zero to 100. The split-half internal consistencies for the pretest and posttest were .75 and .81, respectively.

*Self-efficacy questionnaire*

The Chinese version of the Motivated Strategies for Learning Questionnaire (MSLQ) was used to measure students’ self-efficacy beliefs. MSLQ is a self-report instrument designed to assess student motivation and cognition, including task value, self-efficacy, test anxiety, cognitive strategy use, and regulatory strategy use (Pintrich, Smith, Garcia, & McKeachie, 1991).
The Chinese version of the MSLQ was found to be highly reliable, with a Cronbach’s alpha of .91 (Wang & Lin, 2000). For the purpose of this study, only the self-efficacy subscale of the MSLQ was used, which consisted of eight items. Each item was a statement that required the students to rank on a scale from 1 (indicating “not at all true of me”) to 7 (indicating “very true of me”). An example statement is, “I am confident I can understand the most difficult material presented in the readings for this course”. The split-half internal consistency for the self-efficacy subscale was .85.

Cognitive load questionnaire

To measure cognitive load, the researchers adapted the instrument used by Paas (1992). Upon the completion of the study, a self-report question asked students to indicate the amount of mental effort they had invested in learning the web-based content. Students rated perceived difficulty of learning on a scale from one to nine, with one representing very, very low mental effort, and nine indicating very, very high effort.

Procedures

The study took place in an elementary school’s computer lab. Each computer had Internet access and a headset. The study lasted 40 minutes per day for two days a week over a period of two weeks. Before each study session began, the researchers demonstrated how to use the web-based learning system and explained the study procedures (Figure 1). After a brief introduction to the study, participants used their assigned username and password to log into the system and complete the pretest. Upon the completion of the pretest, students completed the first learning module. The total length of the module was about 20 minutes. After that, the computer system randomly assigned the students into the four treatment groups. Depending on which group they were assigned to, students would answer either multiple-choice or constructed-responses practice questions, with or without the help of cues. Students were given approximately 20 minutes to complete the practice questions before exiting the first session of the study. A week later, students came back for the second session. As in the first week, students used their assigned username and password to log into the system. The procedure was the same as the first week. After they completed the second learning module and answered practice questions corresponding to their treatment condition, students were asked to complete a posttest as well as the self-efficacy belief and cognitive load questionnaires.
RESULTS

Both descriptive statistics and analysis of variance (ANOVA) were used to analyze the data collected. The analysis determined if there was a statistically significant difference in the mean cognitive and motivational outcomes resulting from the use of different response modes and the presence or absence of cues. The three dependent variables were vocabulary posttest results, perceived cognitive load, and self-efficacy beliefs.

The results of the pretest indicated that students had little knowledge about the content covered in this study. For response modes, $F(1, 157) = 1.38, p = .24, \eta^2 = .01$, with an observed power of .21. For cues, $F(1, 157) = 0.10, p = .75, \eta^2 = .01$, with an observed power of .06. Students’ prior knowledge, therefore, was comparable across the two treatment conditions.

Two-way ANOVA was conducted to examine the effects of the two factors (response modes and cues) on each of the three dependent measures. Levene’s test, the assumption of equal variance, was met at the $\alpha = .05$ level and thus met the ANOVA testing assumption that the residual errors followed a multivariate normal distribution in the population. The results revealed a significant main effect for both response modes and cues. For response modes, $F(1, 157) = 452.65, p = .001, \eta^2 = .75$, with an observed power of .56. As indicated in Table 1, students who practiced with constructed-response questions (M=84.46, SD=5.36) performed significantly better on the posttest than those who practiced with multiple-choice questions (M=64.84, SD=6.26). In addition, the provision of cues also had a main effect on posttest results. Students who received cues (M=75.25, SD=11.08) performed
better than those who did not (M=73.65, SD=11.79). While the difference was significant, the effect size of cues was small to modest. The partial Eta squared was .03, indicating that the cues by themselves accounted for only 3% of the overall variance. Finally, there was no interaction between response modes and cues on the posttest, $F(1, 157)=.21$, $p=.650$, $\eta^2 = .01$, with an observed power of .08.

### Table 1
Means and standard deviations of posttest, self-efficacy beliefs, and perceived cognitive load

<table>
<thead>
<tr>
<th></th>
<th>Multiple-choice</th>
<th>Constructed-response</th>
<th>Total</th>
</tr>
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<tbody>
<tr>
<td></td>
<td>M SD N</td>
<td>M SD N</td>
<td>M SD N</td>
</tr>
<tr>
<td><strong>Posttest</strong></td>
<td></td>
<td></td>
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</tr>
<tr>
<td>Cues</td>
<td>66.00 6.09 41</td>
<td>85.24 4.64 38</td>
<td>75.25 11.08 79</td>
</tr>
<tr>
<td>No cues</td>
<td>63.62 6.29 39</td>
<td>83.69 5.94 39</td>
<td>73.65 11.79 78</td>
</tr>
<tr>
<td>Total</td>
<td>64.84 6.26 80</td>
<td>84.46 5.36 77</td>
<td>74.46 11.43 157</td>
</tr>
<tr>
<td><strong>Self-efficacy beliefs</strong></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Cues</td>
<td>2.88 0.40 41</td>
<td>4.00 0.81 38</td>
<td>3.42 0.84 79</td>
</tr>
<tr>
<td>No cues</td>
<td>2.62 0.49 39</td>
<td>3.80 0.66 39</td>
<td>3.21 0.83 78</td>
</tr>
<tr>
<td>Total</td>
<td>2.75 0.46 80</td>
<td>3.90 0.74 77</td>
<td>3.31 0.84 157</td>
</tr>
<tr>
<td><strong>Perceived cognitive load</strong></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Cues</td>
<td>5.66 0.91 41</td>
<td>3.42 1.22 38</td>
<td>4.58 1.55 79</td>
</tr>
<tr>
<td>No cues</td>
<td>5.95 0.72 39</td>
<td>3.59 1.35 39</td>
<td>4.77 1.60 78</td>
</tr>
<tr>
<td>Total</td>
<td>5.80 0.83 80</td>
<td>3.51 1.28 77</td>
<td>4.68 1.57 157</td>
</tr>
</tbody>
</table>

Regarding students’ self-efficacy beliefs, significant main effects were found for both response modes and cues. For response modes, $F(1, 157)=141.94$, $p=.001$, $\eta^2 = .48$, with an observed power of 1.00. For cues, $F(1, 157)=5.87$, $p=.017$, $\eta^2 = .04$, with an observed power of .67. As shown in Table 1, students who practiced with constructed-response questions (M=3.90, SD=.74) reported higher self-efficacy than those who practiced with multiple-choice questions (M=2.75, SD=.46). The provision of cues during the practice also significantly increased students’ self-efficacy with students who received cues (M=3.42, SD=.84) reporting higher self-efficacy beliefs than those who did not (M=3.21, SD=.83). There was no interaction between response modes and cues on students’ self-efficacy beliefs, $F(1, 157)=.09$, $p=.766$, $\eta^2 = .01$, with an observed power of .06.

In regard to perceived cognitive load, there was a main effect for response modes, $F(1, 157)=178.25$, $p=.001$, $\eta^2 = .54$, with an observed power of 1.00. Table 1 shows that students who practiced with multiple-choice
questions perceived higher cognitive load \( (M=5.66, \ SD=.91) \) than those with constructed-response questions \( (M=3.42, \ SD=1.22) \). However, no main effect was found about the cues, \( F(1, 157)=1.78, \ p=.185, \ \eta^2 = .01 \), with an observed power of .26. The result suggested that the presence or absence of the cues did not make a difference on students’ perceived cognitive load. There was no interaction between response modes and cues on students’ perceived cognitive load, \( F(1, 157)=.09, \ p=.766, \ \eta^2 = .01 \), with an observed power of .06.

**DISCUSSION AND IMPLICATIONS**

The purpose of this study was to examine the effects of different response modes for practicing questions and the presence or absence of cues on students’ performance in language recall and recognition tasks, their self-efficacy beliefs and perceived cognitive load. In language recall and recognition tasks, students who practiced with constructed-response questions performed better than those who practiced with multiple-choice questions. This finding is consistent with the numerous studies that have attested to the effectiveness of constructed-response questions (Clariana, 2003; Yun et al., 2008). The finding suggests that constructed-response questions had similar effects on younger learners.

While few studies have explored the possible impact of practice questions’ response modes and the provision of cues on learners’ self-efficacy, our study suggested that students who practiced with constructed-response questions developed higher self-efficacy beliefs than those who practiced with multiple-choice questions. This finding adds to our knowledge that constructed-response questions might have helped to increase the students’ confidence in learning the materials. The high self-efficacy might have led to better and more appropriate control of cognitive strategies that ultimately contributed to the better learning outcomes (Delclos & Harrington, 1991; Zimmerman, 1995).

Furthermore, our study also examined how different response modes and the availability of cues affected learners’ perceived cognitive load. Our findings suggested that students who practiced with multiple-choice questions reported a significantly higher cognitive load than those who practiced with constructed-response questions. This was somewhat unexpected, as we originally postulated that constructed-response questions would incur heavier cognitive load when compared with multiple-choice questions. We suspect that part of the reason could be the timing for administering the cognitive load questionnaire in this study, which was after the students took the post-test and learned how they had performed in the test. This might have influ-
enced how the students responded to the cognitive load questionnaire. For those students who practiced with multiple-choice questions, they might report higher cognitive load since they had to answer constructed-response questions in the posttest and they might think that they did not do well in the test. Based on the findings, we reasoned that the cognitive load questionnaire would be better given during the learning process, which might lead to different findings.

Based on the study findings, web-based constructed-response questions appear to establish a platform that stimulates more sophisticated knowledge of spatial and semantic properties, allows for better performance in recalling or recognizing vocabulary, and finally, improves vocabulary recall and recognition. The web-based learning environment that utilizes constructed-response questions also helps students to organize their vocabulary words into a meaningful structure rather than having to engage in rote memorization or simple trial-and-error. Using such questions for practice may better help students to retain and recall the words they have learned, and further enhance their self-efficacy beliefs toward learning English vocabulary words. In addition, constructed-response questions can be viewed as germane cognitive load that helped the students to expand their cognitive schema for processing important information. When students utilize their cognitive abilities with constructed-response questions, extraneous cognitive load is therefore diminished.

Regarding the second factor in our study – the cues, our findings indicated that the cues improved students’ recall and recognition performance and increased their self-efficacy toward learning the materials. On the other hand, the presence or absence of cues did not seem to make a difference on students’ perceived cognitive load. Two reasons may help to explain the finding. First, it could be that the timing for the cognitive load questionnaire did not accurately measure the students’ perceived cognitive load. Secondly, it was possible that some students who were given the cues did not actually make use of them. In other words, they might have answered questions without seeking help from the cues.

The current study contributes to our understanding of the impact of different practice questions and cues on students’ language recall and recognition, perceived cognitive load, and self-efficacy in web-based learning. However, there are several questions that future research should address. More research should focus on how response modes interact with cues to affect learning outcomes and perceived cognitive load. Future studies should better design cues to work with different response modes in order to increase the likelihood for students to seek help from cues. This all needs to be re-examined from the perspective of the cognitive load theory, as the
cognitive load associated with performing interactive functions could interfere with the capacity needed to process new information (Pollock, Chandler, & Sweller, 2002). These research foci can help us to gain more insights into the effectiveness of web-based learning with multiple modalities.

As web-based learning is increasingly used in language education, it is important to adopt research-based guidelines in the design of web-based language learning. This study offers two practical implications for designing language instruction for young learners. First, even though multiple-choice questions may be technically more convenient, web-based learning should make use of constructed response questions, because this type of questions not only promotes young learners’ vocabulary acquisition, but also boosts their self-efficacy which is an important factor influencing language learning outcomes. Today there are products (e.g., Hot Potatoes software) available on the market that teachers can use to create constructed-response questions. For similar reasons, web-based language instruction should encourage learners to make use of cues when answering questions. For example, certain incentives can be built into the learning materials so that learners are more motivated to seek help from provided cues.

References


