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Investigating Task-induced Involvement Load and Vocabulary Learning from the Perspective of Metacognition

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ABSTRACT

This study attempted to delineate the relationship between the knowledge and regulation of metacognition, and to show how they interact to mediate the effects of task-induced involvement load on learning vocabulary. A total of 90 tertiary-level students completed a checklist on metacognition. Subsequently, they were assigned to complete three tasks with varying degree of involvement load and to complete certain vocabulary tests. Results showed that both the knowledge and regulation of metacognition are independent constructs, but closely and significantly correlated. The learners were sub-divided into two distinct ability groups (high vs. low) based on the knowledge-of-metacognition checklist, and two distinct ability group (high vs. low) based on the regulation-of-metacognition checklist. Overall, the learners were divided into four groups: (1) low knowledge/ low regulators; (2) low knowledge/high regulators; (3) high knowledge/low regulators; and (4) high knowledge/high regulators. Learners benefited the most by engaging in a task with the highest load of involvement. However, learners with a high level of regulation of metacognition performed well in the three tasks, which suggests a mediating role of learners' regulatory ability. Relevant implications were discussed on how to effectively apply task-induced involvement load into learning new words from the perspective of metacognition.

Keywords: Metacognition, knowledge, regulation, involvement, word learning

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INTRODUCTION

It is widely acknowledged that self-regulated learners often exhibit a high sense of self-efficacy and are cognizant of their strengths and weaknesses, and perform better in academic learning. Self-regulated learning

(SRL), oriented by metacognition, refers to the extent to which learners are engaged in the process of learning motivationally. SRL is determined by employing the parameters associated with personal process, environmental events, and behavioral attributes (Zimmerman & Schunk, 2001). The process of SRL includes: to identify a topic, set reasonable goals to examine the topic, adopt appropriate strategies to be familiar with the topic, and evaluate and modify these strategies as a deeper understanding of subject matter is developed in the learners. Therefore, empowering students to become self-regulated learners is essential, because SRL entails taking control of and evaluating one's own learning and behavior (Ziegler, Stoeger, & Grassinger, 2011). Self-regulated learning is determined by personal processes or environmental and behavioral events in a reciprocal fashion.

The present study concerns the metacognitive aspect of SRL. Metacognition, according to Flavell (1979), refers to an appreciation of the knowledge of an individual's own cognitive system, together with a regulation of relevant knowledge and skills that they require. Metacognition includes two components: knowledge of metacognition and regulation of metacognition. According to Flavell (1979), the knowledge of metacognition includes three types of awareness: declarative knowledge (the factual knowledge about what a learner is and what factors influencing his/her academic success), procedural knowledge (knowledge of completing a task), and conditional knowledge (knowledge about discerning a logic of when to use a strategy or skill to coordinate a process of learning behaviors). The regulation of metacognition entails three skills: planning (an appropriate formulation of detailed plans and strategies and an apt allocation of resources to achieve optimum results of a task), monitoring (contemplating on one's own awareness of task comprehension, execution and performance), and evaluating (appraising the efficiency at which the task was performed). The knowledge and regulation of metacognition might interact with each other and mediate the effects of task-induced involvement load on word learning.

The Involvement Load Hypothesis, initiated by Laufer and Hulstijn (2001), suggests that effective learning of new words is contingent upon the amount of mental effort or involvement while conducting some composite cognitive activities involved in learning these words. Task-induced involvement is regarded as a motivational-cognitive construct, which consists of three dimensions: *need, search*, and *evaluation*. According to Laufer and Hulstijn (2001), *need*, referring to whether the prior knowledge of new words is a necessity to complete a task, is the motivational, non-cognitive dimension of the involvement. *Need* is considered moderate if imposed by the task, and strong if by the learner. *Search* and *evaluation* are categorized as the cognitive dimensions of involvement; their prime focus is on the information processing involved in the learning and remembering of a word form and meaning (e.g., noticing new words and paying attention to them). *Search* is regarded as an attempt that individuals make to determine the meaning of unknown words encountered during a task through a dictionary or by consulting a teacher. *Search* is absent when such an effort is not required, for example, when a text is accompanied by marginal glosses for unknown words. *Evaluation*, while making a decision, refers to the comparison of a new word with already known words, or when deducing a particular meaning of the word among other meanings, or assessing its suitability in a given context. *Evaluation* is moderate when a task requires a learner to recognize differences between words provided in a given context, such as a fill-in-the-blank task, but strong when the task requires a learner to make decisions about the meaning of unknown words and combining them with known words in an original context, such as writing a sentence or composition. A task with a high level of need, search, or evaluation has a higher level of involvement load, and when the involvement load is higher, the task is deemed to be more beneficial for word learning than those with a lower involvement load (Laufer & Hulsijin, 2001; Teng, 2015; Teng & Zhang, 2015).

However, it is still unknown what are the causes of the differences in learners' word learning under the tasks of varying involvement loads. A possible explanation can be deduced from the relationship between knowledge and regulation of metacognition. For example, Schraw (1994) showed that learners with a higher level of knowledge of metacognition performed better than their counterparts with a lower level of knowledge of metacognition. However, the knowledge of metacognition was related to the regulation of cognition only among the high monitors. Overall, these two aspects of metacognition interact with each other to explain variances in the students' learning performance, as well as in the susceptibility to comply with the embedded information in a task. Metacognition is considered essential for the acquisition of knowledge and the appropriate allocation of the cognitive resources and the effective provision of information about its status, deficits, and the current needs of knowledge for a cognitive system (Carvalho & Yuzawa, 2001). Therefore, there is a need to examine how the knowledge and regulation of metacognition interact and mediate the role of involvement load on word learning (Teng, 2017).

RATIONALE FOR THE PRESENT STUDY

Rationale for the present study begins first with the involvement load in a task and self-regulated learning appearing to be two related areas (Fox & Riconscente, 2008). For example, the task-induced involvement load attempts to measure word learning, which is based on student-centered learning. Second, previous studies have shown that knowledge and regulation of metacognition conjointly played a significant role in explaining learners' performance (Teng, 2016), including word learning and confidence judgment (Teng, 2017). Finally, as there is a close link between metacognition and SRL, and considering that learning behavior is a product of self-generated and external sources of influence (Bernacki, Nokes-Malach, & Aleven, 2015), it is assumed that a general metacognitive ability mediates the effects of the task-induced involvement load on word learning.

Two main objectives were addressed in the present study. The first objective was to explore the relationship between the knowledge and regulation of metacognition, which is of great significance in delineating the functions of metacognition and in exploring how it mediates the individuals' cognitive system. The second objective was to assess how these two constructs of metacognition interact and mediate the effects of a task-induced involvement load on the individuals' word learning.

Three hypotheses were tested: First, a high degree of involvement load would lead the learners to perform better in the word learning. Second, participants with a higher level of regulation of metacognition would perform better than those with a lower one. Furthermore, low knowledge/low regulators and high knowledge/low regulators would be more affected than low knowledge/high regulators and high knowledge/high regulators.

METHOD

Research Design

A 2 × 2 × 3 (Knowledge of metacognition: high versus low × Regulation of metacognition: high versus low × Task-induced Involvement: strong, moderate, and low load) factorial design was employed in the present study; and the data were subjected to analysis of variance (ANOVA). Metacognition was varied as a between-subjects factor, and task-induced involvement was varied as a within-participants factor.

Participants

Participants were 90 undergraduate students (20 males and 70 females, between 18 and 20 years old), enrolled in three classes of first-year business English major from a university in China. They were English as a Foreign Language (EFL) students and they had been learning English for six years.

The participants needed to have an adequate level of word knowledge required for reading texts in English. Hence, prior to the commencement of the experiment, the students were tested for their overall receptive vocabulary size through a Vocabulary Levels Test (VLT) (Schmitt, Schmitt, & Clapham, 2001). The participants were expected to have a 3,000-level word knowledge for basic reading and comprehension (Hu & Nation, 2000). All participants met this requirement, as they responded correctly to at least 27 out of 30 items on the test (the cutoff point was 26 out of 30).

Reading Materials and Task Types

The reading materials were three texts, and eight of the target words were selected from each text. The target words were of 9-11 letters. The three tasks differed from one another in terms of the degree of involvement load. Task 1 included reading a text with marginal glosses (Index 1, lowest degree of involvement load). Task 2 required filling in blanks using a given word list which included the target words, some difficult words, and some more frequent words that the participants may already know (Index 2, moderate degree of involvement load). Task 3 required the participants to write a composition with the given words based on reading a text with marginal glosses (Index 3, highest involvement load).

Each task included the same three texts. The text in Task 1 was designed to include glosses for the target words in the margins. The text in Task 2 was designed in a way that the eight target words were replaced by equally-sized fill-in-the-blank spaces. These blanks were required to be filled from a word list following the text. The target words, along with their parts of speech (noun, verb, adjective, adverb) and a brief definition were provided in the word list. The text in Task 3 was designed to include marginal glosses as in Task 1 and the same word list as in Task 2.

Measures

Metacognitive assessment. All participants completed the Metacognitive Awareness Inventory (MAI), which was developed by Schraw and Dennisson (1994). The MAI is a useful tool in assessing metacognitive knowledge and regulation. It includes two subscales. The first subscale was adopted to assess the learners' metacognitive knowledge. The second subscale was for measuring their perceived metacognitive regulation. Both subscales have been shown to be reliable (Händel, Artelt, & Weinert, 2013). The knowledge of metacognition subscale contained 17 items, which mainly measures the learners' declarative, procedural, and conditional knowledge. Cronbach's Alpha for this subscale was 0.75. The regulation of metacognition subscale included 35 items, measuring the participants' awareness of planning, monitoring, evaluating, information management, and debugging strategies. For this scale, Cronbach's Alpha was 0.85.

The scoring system for both subscales was a five-point Likert-type scale ranging from *I totally disagree* (0) to *I totally agree* (4). Following this, the participants were required to evaluate whether each statement in the MAI was applicable to their learning experiences. The sum of all the scores of the ratings for the 17 knowledge items and 35 regulation items indicated the level of metacognition. The possible maximum scores for the knowledge and the regulation of metacognition were 68 and 140 points, respectively.

Measure in vocabulary development. The Vocabulary Knowledge Scale (VKS) developed by Wesche and Paribakht (1996) was adapted in the present study to measure participants' word leaning. Four weeks before the study, VKS was administered to test the prior knowledge of the target words among the participants. The learners were found to have no prior knowledge of the target words. It was presumed that after a four-week break, the learners would not retain the target words into memory. The participants were tested for their command over the target words through the same VKS test.

In terms of the scoring system, a zero point was given if a learner reported that he or she had never seen the target words. A score of one was given if a learner indicated that he or she had seen this word before but did not know the meaning. A score of two was given when a learner provided an acceptable English synonym or a Chinese translation. As there were 24 items in each task, the possible maximum score for each task was 48 points.

The scoring for all the tests was done by three experienced raters who were not teaching the participants. First, two raters were invited independently to score the measures described above. A complete inter-rater agreement was found between MAI and VLT; while in VKS 60 discrepancies out of 2160 responses was found. The inter-agreement rate was 97%. Where there was disagreement between the first two raters, a third rater was then called upon and the final marking was made by majority opinion.

Procedure

The entire study lasted for nine weeks, with two hours per week. The participants completed the pre-test in the first week. No testing or teaching occurred during weeks 2-5 to allow the participants time to reduce their memory of the target words. Then the participants undertook the reading treatment for weeks 6-8. To eliminate the effects of individual differences, the study used a within-subject design, in which all students were exposed to all the texts and target words, and worked on the three tasks at the end of the eighth week. In the ninth week, the participants took a post-test, which tested their word learning.

RESULTS

Metacognitive Assessment and Analysis

The learners were divided into two distinct ability groups based on the responses for the knowledge-of-metacognition checklist. The learners were also assigned into two groups according to their scores on the regulation-of-metacognition checklist. The details are shown in Table 1.

Table 1
Scores of knowledge and regulation of metacognition and related groups

Group	N	Low load		Moderate load		Strong load	
		M	SD	M	SD	M	SD
LK	39	31.61	9.35	34.82	8.89	37.93	9.12
HK	51	35.45	9.12	38.16	8.59	41.23	8.57
LR	39	33.36	4.61	37.13	6.12	41.25	5.78
HR	51	44.85	3.15	45.15	2.59	46.51	1.97
Total	90	36.30	14.13	38.81	11.3	41.73	10.12

Note. LK=Low Knowledge HK=High Knowledge LR=Low Regulation HR=High Regulation

As described in Table 2, the average score for the knowledge-of-metacognition group was 33.21(SD = 5.32). There were 51 participants who scored above the mean score and were included in the high knowledge-of-metacognition group (M = 36.82, SD = 3.81), and 39 participants who scored below the mean score and were placed in the low knowledge-of-metacognition group (M = 27.32, SD = 2.97). Regarding the mean score, a significant difference was found between the high knowledge-of-metacognition-group and the low knowledge-of-metacognition group (t (81) = 11.52, p < .001).

The mean score for the regulation-of-metacognition group was 50.21 (SD = 6.12). Of the participants, 51 were included in the high-regulation group (M = 56.85, SD = 4.81), and 39 in the low-regulation group (M = 44.32, SD = 4.13). The participants in the high-regulation group scored significantly higher than those in the low-regulation group (t (81) =11.89, p <.001).

Following Carvalho and Yuzawa (2001), the present study combined the knowledge-of-metacognition scores with the regulation-of-metacognition scores and divided their participants into four groups: low knowledge/low regulators (LK/LR), low knowledge/high regulators (LK/HR), high knowledge/low regulators (HK/LR), and high knowledge/high regulators (HK/HR). The cell sizes were as follows: There were 17 participants for the LK/LR group, 22 participants for the LK/HR group, 23 participants for HK/LR group, and 28 participants for the HK/HR group.

Relationships between the Knowledge and Regulation of Metacognition

Table 2 summarizes the results of word learning. The means and standard deviations for the word learning are presented according to the groups and the involvement load in each task.

Table 2
General effects of involvement load on word learning

Group	N	M	SD	Group	N	M	SD
KM	90	33.21	5.32	RM	90	50.21	6.12
HKCG	51	36.81	3.81	HRG	51	56.83	4.81
LKCG	39	27.32	2.97	LRG	39	44.32	4.13

Note. KM=Knowledge of metacognition RM=Regulation of metacognition
HKCG=High knowledge-of-metacognition group
LKCG=Low knowledge-of-metacognition group
HRG=High-regulation group
LRG=low-regulation group

As shown in Table 2, the high-knowledge group participants seemed to outperform the low-knowledge group participants in terms of word learning. In a similar vein, the participants with a higher level of regulation of metacognition seemed to outperform those with the lower level of regulation of metacognition.

ANOVA showed that word learning is significantly affected by the knowledge of metacognition (F (2, 89) = 10.04, p < .05). It is evident that the high-knowledge participants were significantly better in learning target words than the low-knowledge participants. Likewise, the effect of the regulation of metacognition was also significant (F (2, 22) = 6.15, p < .001) on word learning. This affirms that the learners in the high-regulation group outperformed their counterparts in the low-regulation group during word learning.

However, the results seem to be influenced by the Knowledge × Regulation of Metacognition interaction. Simple effect analyses indicated that regulation of metacognition significantly affected low-knowledge participants' word learning (F (2, 23) = 7.15, P <.001). Similarly, regulation of metacognition also had a significant effect on high-knowledge participants' word learning (F (2, 73) = 12.31, P <.05). However, knowledge of metacognition did not significantly affect low regulators' word learning (F (2, 10) = 21.89, p =.58). In a similar vein, knowledge of metacognition did not show a significant effect on the high regulators' word learning (F (2, 10) = 20.12, p =.48). High performance in regulation of metacognition seemed to compensate for deficits in the knowledge of metacognition (Table 3).

Table 3
General effects of involvement load on word learning (different ability groups)

Group	N	Low load		Moderate load		Strong load		Total	
		M	SD	M	SD	M	SD	M	SD
LK/LR	17	32.11	12.15	36.81	11.12	41.52	9.12	36.81	5.79
LK/HR	22	44.22	12.79	45.13	11.43	46.31	10.13	45.22	5.81
HK/LR	23	32.31	13.15	37.13	12.89	42.21	9.05	37.18	6.12
HK/HR	28	44.57	12.10	45.81	11.05	47.51	8.79	45.96	4.13
Total	90	38.30	10.58	41.22	11.12	44.36	9.13	41.37	11.59

Effects of Task-induced Involvement Load on word learning

ANOVA revealed that the task-induced involvement load has a significant effect on the word learning performance (F (2, 83) = 8.67, p < .001). This effect was depicted by the Regulation of Metacognition × Involvement Loads interaction (F (2, 146) = 19.75, p = .32). Simple effects and post hoc analyses indicated that task-induced involvement load greatly influenced low regulators (F (2, 83) = 9.28, p < .001). However, no significant effect of involvement load was detected for the high regulators (F (2, 146) =3.15, p = .06). It is evident that low regulators were more likely to significantly increase their word learning efficiency when sufficed with strong involvement load and significantly decrease it when sufficed with low involvement load. However, this variance was not significant among the high regulators. Furthermore, the Knowledge of Metacognition × Involvement Load interaction was not significant. Overall, differences in the effects of task-induced involvement loads emerged as a function of regulation of metacognition, but not knowledge of metacognition.

DISCUSSION AND CONCLUSION

One of the objectives in this study was to measure the relationship between knowledge of metacognition and regulation of metacognition. The findings revealed that both components of metacognition are independent constructs but closely and significantly correlated; this outcome concords with earlier studies (Brown & Kinshuk, 2016; Sperling, Howard, Miller, & Murphy, 2002). The low level of metacognition observed overall in the present study also provided evidence for a significant variance in many constituent aspects among the participants. In line with earlier studies (Carvalho & Yuzawa, 2001; Trainin & Swanson, 2005), this outcome results in a classification of the participants according to their high or low performance in the knowledge and regulation of metacognition.

The findings suggested that learners with higher levels of knowledge of metacognition and effective regulation of that knowledge performed better in word learning. This corroborates with earlier findings that metacognition is a strong predictor of high-quality learning and effective problem-solving (Blankson & Blair, 2016). One possible explanation is that learners with a high sense of metacognition are more likely to manipulate their cognitive skills, and to locate and construct new metacognitive strategies or skills to correct their weakness. Furthermore, students with a wide range of metacognitive skills seem to be able to utilize the appropriate strategies for their learning or modify the existing learning strategies and skills according to their awareness of effectiveness.

An unexpected finding that was not found in the previous studies is that high regulatory competence can compensate for deficits in knowledge of metacognition. However, high levels of knowledge of metacognition does not seem to compensate for low regulatory skills. This is apparently observable in similar word learning results between the LK/HR and HK/HR groups. However, the absence of high regulatory ability has negative effects on word learning results in the LK/LR and HK/LR group. This supports the claim that high regulatory ability, rather than knowledge of metacognition, yields more effective word learning. This is in line with Schraw (1994), but contradicts Carvalho and Yuzawa's (2001) findings that knowledge of metacognition was a strong predictor of learning performance, as the regulation of metacognition. Particular attention needs to be paid in developing learners' regulatory ability in future teaching. Learners with high-regulatory skills set reasonable learning goals, plan accordingly based on their appropriate selection of the strategies and correct allocation of resources. They are more likely to figure out if the selected strategies are working well. They continue when the strategies work well, and make adjustments until the strategies are in tune with their learning goals. Following this, they monitor their learning performance, and evaluate the final product of their learning. Learners with low regulatory skills, in contrast, may not have explicit learning goals, and fail to effectively plan, monitor, and evaluate their learning, and deploy appropriate strategies to the situation (Barbara, Nadia, Chiara, & Cesare, 2014; Cornoldi, Carretti, Drusi, & Tencati, 2015).

In addition, the knowledge and regulation of metacognition mediate the effects of task-induced involvement load on word learning, as suggested by Teng (2017). The findings reveal that word learning is significantly affected by task-induced involvement load. This outcome is also an extension of Keating (2008), who showed that word learning is highest in the sentence writing task (strong load), lower in the reading plus fill-in task (moderate load), and lowest in the reading comprehension task (low load). The results of the present study indicate that the component of a task crucial to word learning is *evaluation*. This suggests that future teaching should include word-focused tasks that require high degrees of *evaluation*. Therefore, it is suggested that, for self-regulated learning to be effective, students need to be able to assess and evaluate their own performance on a learning task.

A different but interesting finding in the present study is that low regulators are especially susceptible to task-induced involvement load. However, high regulators were not significantly affected by the effect of task-induced involvement load. These findings suggest that a consideration of students' regulatory level prior to assigning tasks is important. One possible explanation is that learners with high level of regulatory skills are more efficient in avoiding a distraction, perceiving responsibility for learning, and in drawing up goals, conducting self-reflection, and controlling time. This may help them attain success in word learning regardless of the varying degrees of involvement load in the tasks. As regulation operates through cognitive, motivational, and metacognitive components (Hong, Peng, & Rowell, 2009), this indicates that high regulators possess a higher level of cognitive and a metacognitive awareness, and motivational domain. As the tasks were completed independently, the motivational domain of high regulators may invoke them to value the task and have high self-efficacy for the task. This might strengthen their perseverance in dealing with difficulties, thus compensate for the deficits of low motivational and cognitive levels of the tasks.

The analytical results also suggest that the effects of task-induced involvement load on word learning are mediated by the regulation and not by the knowledge of metacognition. The pattern found for the intensity of the task-induced involvement load from the most to the least affected group was in order of LK/LR > HK/LR > LK/HR > HK/HR, similar to that found by Carvalho and Yuzawa (2001). This could be explained that the knowledge of metacognition relates to the declarative knowledge, which affects learners' knowledge about themselves, tasks, and strategies but not how strategies are appropriately selected, and resources are correctly allocated. In contrast, the task-induced involvement load affects word learning as a function of the regulatory skills of learners, perhaps because a higher level of regulation of metacognition is important while selecting the task information that may help them attain better word learning success, as discussed above.

The limitations of this study include the methodological difficulties of assessing metacognition, which was based on a self-report questionnaire. The self-report questionnaire might not have been sensitive enough to accurately measure the participants' metacognition because the output was based only on the students' recall of their academic routine. For further research, it is essential to adopt multi-method designs, particularly combining multiple concurrent tools to obtain a full and accurate portrayal of students' metacognition.

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