ABSTRACT
As mobile dictionaries have become popular L2 learning and referencing tools, this paper primarily focused on four Chinese EFL learners’ incidental and intentional L2 vocabulary learning process and progress with the assistance of a mobile dictionary. The study has two learning stages: the incidental stage and the intentional stage, employing a quasi-experimental design to collect both quantitative and qualitative data. At the incidental learning stage, all participants were asked to complete: (1) vocabulary tests; (2) a reading comprehension task with a bilingualised mobile dictionary; (3) a self-report questionnaire; and (4) a semi-structured interview. At the intentional learning stage, a word list and an audio recording of word pronunciation were distributed to the participants. In the ensuing 14 days, participants took charge of their vocabulary learning, using the word list on their smartphones. They completed the self-report questionnaire to report their daily mobile-assisted vocabulary learning and attended the final vocabulary test. The findings show that mobile dictionaries could benefit learners’ incidental vocabulary learning, but subject to their dictionary use. In the self-directed intentional vocabulary learning, participants were more active as a result of great performance in the final vocabulary test.

Author Keywords
Incidental and intentional L2 vocabulary learning, MALL, mobile dictionary, EFL learners

INTRODUCTION
Vocabulary knowledge is central to communicative competence and second language acquisition (Schmitt, 2000). However, many scholars like Oxford (1990) perceive vocabulary knowledge as the most sizable and unmanageable aspect of language learning. Unlike syntax and phonology, clear vocabulary rules do not exist for learners to follow in developing their vocabulary knowledge (Alqahtani, 2015).

In China, enlarging vocabulary is one of the primary tasks for Chinese EFL learners. As the explicit and intentional classroom-based vocabulary teaching approaches are dominated, Chinese teachers and students mainly depend on textbooks and classroom activities (Ma, 2009), accustomed to teaching and learning vocabulary by rote learning methods. Although this type of approach may be beneficial for students’ adaptation to the Chinese exam-oriented education system, many students are bored with mechanically remembering words and feel frustrated (Wu, 2018).

The burgeoning development of mobile technologies allows teachers and students to access various learning resources anywhere and at any time (Pachler, Bachmair, & Cook, 2010). Most Chinese EFL learners are equipped with touch-screen smartphones and have experiences in using MALL (mobile assisted language learning) resources (Yu, Zhu, Yang, & Chen, 2018). As one of the most commonly-used MALL applications, mobile dictionary enables learners to look up words across different learning contexts, offering affordances for EFL learners’ L2 vocabulary acquisition. Nevertheless, many learners are still deficient in using the technologies (Conole & Pérez-Paredes, 2017). As more attention should be given to students’ use strategies in their informal mobile learning (Miller & Wu, 2018), this study particularly focuses on four Chinese EFL learners’ use and the effectiveness of mobile dictionary both in the incidental and intentional vocabulary learning settings, aiming to offer some insights in vocabulary teaching and learning across different contexts.

SECOND LANGUAGE VOCABULARY ACQUISITION
According to Henriksen (1999), vocabulary knowledge can be generally categorised into receptive and productive knowledge. Receptive vocabulary knowledge only requires learners to recognise the form and understand the word meaning in context. At a higher level, productive vocabulary knowledge refers to the ability to correctly and appropriately use the word. Nation (2001) elucidates three key aspects of vocabulary knowledge: form, meaning and use, from the receptive and productive dimensions. Form refers to two types: (1) spoken form (word pronunciation) and (2) written form (word spelling). The meaning of a word is understood as an association of the concept of the word and the thing that people want to express in their mind. At a higher level, word use contains the grammatical functions of the word, collocations and any constraints on its use. As there is not a clear boundary between word form, meaning and use, we need to understand vocabulary knowledge in an interactive and holistic way.
Vocabulary learning can occur both intentionally and incidentally. According to Hulstijn (2003), intentional vocabulary learning refers to a process to memorise words and related grammar rules via different ways, while incidental learning is defined as a process to learn vocabulary without an intention (Laufer & Hulstijn, 2001). In this case, the learner’s main learning object is to do something else, such as completing the meaning-focused communicative activities (Ma, 2009). On the one side, previous studies have verified the effectiveness of incidental vocabulary learning (e.g. Day, Omura, & Hiramatsu, 1991). On the other side, some scholars criticise the retention rate of incidental vocabulary learning. They highlight the importance of explicit and intentional vocabulary teaching and learning (e.g. Rott, 2007), especially word occurrence frequencies in vocabulary retention (e.g. Teng, 2016).

**MOBILE-ASSISTED LANGUAGE LEARNING (MALL), MOBILE-ASSISTED VOCABULARY LEARNING (MAVL) AND MOBILE DICTIONARY**

Differing from computer-assisted language learning (CALL), MALL provides learners with new learning ways, emphasising the continuity and spontaneity of information access and interaction across the border between formal and informal language learning settings (Kukulska-Hulme, 2009). As Kukulska-Hulme and Shield (2008) summarise, MALL studies can be generally categorised into (1) content-related studies that focus more on the advance of learning activity types and materials in formal language learning settings, and (2) design-related studies that mainly addresses the development of authentic learning materials and interactive activities for mobile devices. Mobile dictionary, as a type of MALL application, could be developed and applied in the classroom. It is also a kind of self-direct referencing and learning tool that learners can use beyond the classroom.

Previous studies have demonstrated the advantages of MALL resources in vocabulary learning. Firstly, the development of technology contributes to the appearance and popularity of multimodal MALL applications. Language learners who are exposed to the multimodal MALL resources performed better in word retention (Joseph & Uther, 2009). As most mobile dictionaries have multimodal inputs (e.g. texts, images and pronunciation), learners can read the textual information of the word and conceptualise the word via images for better understanding. Apart from serving as a referencing tool, this type of dictionary can also be used as a learning tool for different aspects of language learning. Secondly, the personalised functions featured in MALL offer learners more freedom, encouraging learners to take charge of their study at their own pace based on their learning aims and preferences (Selwyn, 2011). For example, the “search history” and “notebook” functions in the majority of mobile dictionaries give users affordances to review the words they have looked up.

However, the effects of the affordances of MALL applications (including mobile dictionaries) largely depend on learners’ use, i.e. how they self-regulate their language learning process. As Ormrod (2012) points out, not all learners qualify as self-study regulators when they use mobile devices. They may be unaware of some affordances or be distracted by the notifications of text messages, incoming calls and other mobile applications (Kuznekoff & Titsworth, 2013). As mobile devices are more closely related to learners’ daily life rather than their academic study (Lai & Zheng, 2018), the disparity between their personal uses and learning uses of mobile devices should be noticed (Stockwell, 2007). Besides, some problems of MALL applications like system crashes, errors and long loading time (Chen, 2011) may negatively affect users’ experience and discourage them from using the applications.

Particularly focusing on mobile-assisted vocabulary learning (MAVL), the latest systematic review by Lin and Lin (2019) summarises that there are two predominant research foci in MAVL – learning vocabulary via (1) short message services (SMS) and multimedia message service (MMS) and (2) mobile applications – from the behaviourist, cognitivist, situated learning theory and (social) constructivist perspectives. This systematic review also reminds us that very few previous studies focused on mobile dictionaries in learners’ L2 vocabulary learning both in the intentional and incidental contexts.

**VOCABULARY LEARNING STRATEGIES (VLS) AND LEARNER’S DICTIONARY USE**

Vocabulary learning strategies (VLS) have been defined from different perspectives. Drawing on the work of Oxford (1990) and O’Malley and Chamot (1990), VLS can be categorised into direct VLS and indirect VLS. Using a dictionary, the focus of this study, is a commonly-used direct VLS. Nation (2001) summarises four steps learners look up unknown words in a dictionary, including (1) getting information from the context where the word is situated; (2) looking up the dictionary and finding the dictionary entry; (3) choose the most suitable information; and (4) apply the information to the context and decide whether it is in accordance with the reference needs. As a cognitive strategy (O’Malley & Chamot, 1990), using dictionary is not easy, which involves different skills such as language skills, searching and selecting skills, problem-solving skills, and information processing skills (Tono, 2011). Results from Tono (2011)’s study show that, even with the support of mobile dictionary, more than 30% of the participants failed to identify the exact meaning of the word in the specific context, which to some extent reflects the provision of the dictionary does not mean its correct and effective use.

In China, EFL learners use dictionary in various ways. Shi and Chen (2005) find that non-English major students prefer to read Chinese definitions when using bilingualised dictionaries. Nevertheless, results from Yu’s (2013) study contradicts this finding, reporting that more than a third of her English-major participants tended to read the English definition of the target word first. Besides, many learners only read the first definition (Shi & Chen, 2005). There is, however, no confirmed conclusion: according to Yu’s (2013) research, over 78.72% of the participants (74 students) normally read all entries, then select the most suitable entry for the context. Moreover, Yu (2013) reports that Chinese students also preferred to look up the meaning of unknown words, followed by pronunciation. Other aspects of vocabulary knowledge, such as collocations,
idioms, pragmatic and cultural information, synonyms and antonyms, were often ignored. However, few previous studies have probed Chinese EFL learners’ mobile dictionary use experience and the effectiveness of mobile dictionary in vocabulary learning.

**RESEARCH QUESTIONS**

In order to better understand mobile dictionary in EFL learners L2 vocabulary learning, the study aims to answer two research questions: (1) How do Chinese EFL learners use the mobile dictionary in the incidental and intentional English vocabulary learning contexts? (2) In what ways, if any, can mobile dictionary benefit Chinese EFL learners’ incidental and intentional English vocabulary learning?

**METHODOLOGY**

**Research Design**

The study applied a multiple-case design (Cohen et al., 2013) to explore how four Chinese EFL learners use the mobile dictionary to incidentally and intentionally learn English vocabulary. A multiple-case study design was adopted here as it “provides a unique example of real people in real situations, enabling readers to understand ideas more clearly than simply by presenting them with abstract theories or principles” (Cohen et al., 2013, p. 253), and it further improves the generalizability compared with single-case design.

We invited four Chinese EFL learners (Lucy, Harry, Maggie and Frank) who were all first-year undergraduates with around ten years’ English learning experience at a Chinese university. Lucy and Frank are studying English linguistics, and Harry and Maggie major in natural science. According to their Oxford Placement Test score, they are all at the Common European Framework for Reference (CEFR) B2 level.

Figure 1 illustrates the whole data collection process. There are two main stages: (1) incidental vocabulary learning stage and (2) intentional vocabulary learning stage. Before the incidental learning stage, the four participants were asked to attend the pre-vocabulary test. Then they were given two reading passages with 20 reading comprehension questions. During reading, they were allowed to use the bilingualised mobile dictionary (Longman Dictionary of Contemporary English) on their mobile phone. After that, an unexpected immediate post-vocabulary test for assessing their short-term vocabulary retention and the self-report questionnaire for investigating their dictionary use were distributed. After a two-week interval, they attended the delayed post-vocabulary test designed for examining their long-term vocabulary retention. At the intentional learning stage, the learners were given a word list that contains everything in the word entries with an audio recording of correct word pronunciation. In the following 14 days, they used the word list to learn the 14 words by themselves, and the researcher gave some instructions and help when needed. They completed the self-report questionnaire every day to report their learning, and a vocabulary test was conducted at the end of the study. All tests and questionnaires were conducted on Qualtrics (https://cambridge.eu.qualtrics.com).

**Figure 1. Data collection process**

**Data Collection**

The two readings were selected from Cambridge English: Proficiency (CPE) with 20 matching questions. The two articles, entitled *Is the Internet changing our lives?* and *Photography: A historical background*, are closely related to participants’ daily life. Although there was no time restriction for participants to finish the reading tasks in order to keep the “naturalness” of reading conditions (Ding, 2015), participants were advised to finish the task within one hour. The two readings were with more than 92% of the words are K-3 words and 95% are K-5 words, which were suitable but sufficiently challenging for learner’s incidental vocabulary learning. Drawing on the VocabProfie (http://www.lextutor.ca/vp/comp/) section of the

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1 Lucy, Harry, Maggie and Franks are pseudonyms of the four participants.

2 The Oxford Placement Test was conducted before the formal data collection to test participants’ English language proficiency. This test includes: (1) a use of English test with approximately 30 questions and (2) a listening test with about 15 questions, which usually takes 30 to 40 minutes.
With regard to the vocabulary tests, all of the four tests include: (1) a spelling recognition test, (2) a Vocabulary Knowledge Scale (VKS)-based (Wesche & Paribakht, 1996) meaning, use and part of speech (POS) test, and (3) a pronunciation (PRON) test. The main structure of the tests was similar, but the question order was changed to avoid the carryover effect from the previous test (Chen, 2011). The small differences between the tests include: (1) There were 14 extra words at the K-5 level or above included in the pre-test as distractors; (2) There was an extra question asking participants whether they have learnt the word during the two-week interval in the delayed post-test. Besides, two self-report questionnaires were designed to collect self-report data, asking a participant to report whether they looked up the target word and what aspect they focused on. The semi-structured interviews mainly explored the reason why they paid more attention to certain words/aspects.

### Data Analysis

Descriptive analysis was applied to analyse the quantitative data in the self-report questionnaires and the scores in the pre- and post-vocabulary tests. Qualitatively, MAXQDA Plus was used to analyse all data from the interviews. We used the thematic analysis method for “identifying, analysing and reporting patterns within data” (Braun & Clarke, 2006, p.6). Based on the six stages in the thematic analysis (O’Leary, 2014), the first author checked all the transcripts, coded and separated them into themes by using the open-coding method (Rivas, 2012). The second author reviewed and defined the themes and examined the initial results. Finally, we double checked the integrity and accuracy of the information, themes and results.

### FINDINGS

#### Incidental Vocabulary Learning

**Learner’s Use of the Mobile Dictionary**

Using data from the self-report questionnaires, Table 1 summarises participants’ mobile dictionary use in reading. Maggie and Frank looked up almost all target words (13 and 14 words). Both of them preferred to consult word spelling (13) and meaning (11 and 14), and they were keen on looking at just one definition, especially the first definition. Their attention to word meaning in two languages was slightly different: Maggie paid attention to the Chinese translations of six target words and five in both Chinese and English, but Frank only read the Chinese translations. Besides, Frank did not look up and read any other information, while Maggie read eight example sentences, 11 POS, and 12 word pronunciation.

On the contrary, the other two participants — Lucy and Harry — seldom used the mobile dictionary. Lucy did not look up any of the 14 target words, and Harry consulted only two words. Despite a reading comprehension task, Harry did not pay any attention to word meanings and example sentences, which are assumed to be crucial for reading comprehension.

![Table 1. Learners’ mobile dictionary use in reading](http://www.lextutor.ca)

<table>
<thead>
<tr>
<th>Student name</th>
<th>Look up</th>
<th>Spelling</th>
<th>Meaning</th>
<th>e.g.</th>
<th>POS</th>
<th>PRON</th>
<th>Other aspects</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td></td>
<td></td>
<td>yes/no</td>
<td>No. of meaning(s)</td>
<td>first</td>
<td>EN/CN</td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td>1 2 3  &gt;3</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Maggie</td>
<td>13</td>
<td>13</td>
<td>11</td>
<td>10</td>
<td>0</td>
<td>10</td>
<td>8</td>
</tr>
<tr>
<td>Frank</td>
<td>14</td>
<td>13</td>
<td>14</td>
<td>12</td>
<td>0</td>
<td>2</td>
<td>11</td>
</tr>
<tr>
<td>Harry</td>
<td>2</td>
<td>0</td>
<td>0</td>
<td>0</td>
<td>0</td>
<td>0</td>
<td>0</td>
</tr>
<tr>
<td>Lucy</td>
<td>0</td>
<td>0</td>
<td>0</td>
<td>0</td>
<td>0</td>
<td>0</td>
<td>0</td>
</tr>
</tbody>
</table>

Their responses from the semi-structured interview can be understood to interpret their dictionary use behaviours:

- **Maggie**: A mobile dictionary serves as a **learning** tool.

Maggie was used to looking up all the unknown words in the dictionary, especially word meanings. In the interview, she explained that her focus was word definition. She prioritised Chinese translations (L1), which were more useful for her quick understanding of the word. Apart from that, she underscored the importance of word spelling, example sentences, POS, and pronunciation, perceiving these aspects were quite beneficial to acquire a word. In other words, she looked up words in the dictionary not just to understand the word meaning in the text but to acquire the word comprehensively.

- **Frank**: A mobile dictionary serves as a **referencing** tool.

Although Frank looked up all the 14 target words, he paid the most attention to the word spelling and meaning (particularly the first meaning). As he supposed, the first definition is the most commonly used definition of the word and likely to fit the reading context. Regarding Chinese translation, Frank had a reason similar to Maggie’s, attributing his preference to his familiarity with Chinese. Looking at the word spelling, as he described, could help him establish an association between the word form and meaning. Because reading everything in the word entry was time-consuming, he usually ignored other information when doing reading comprehension exercises.
c. Harry: A mobile dictionary serves as a supplementary tool.

Harry preferred to directly guess word meaning from the reading. He talked about his guessing strategy in the interview, perceiving that sometimes it was not necessary to know the exact meaning of the word. Alternatively, getting a general sense of the word from the context was enough to complete the reading comprehension questions. A mobile dictionary was just a supplementary tool for him when he needed extra information.

d. Lucy: A mobile dictionary is an interrupter.

Similar to Harry, Lucy showed a preference for guessing the word meaning from the reading context. She was confident in her guessing ability and complained that looking up words in the dictionary usually interrupted her reading. She elucidated that as reading tasks were usually paper-based, she needed to move her eyes to her mobile phone, type the word, find the suitable word meaning and get back to the reading. She sometimes forgot what she had read after using the mobile dictionary, so she had to reread the previous sentences, which was time-consuming and caused cognitive burdens.

The Effectiveness of the Mobile Dictionary in a Learner’s Incidental Vocabulary Learning

a. Short-term vocabulary retention

Table 2 presents four participants’ pre- and immediate post-vocabulary test scores as well as their short-term retention. Maggie, who fully used the mobile dictionary when reading, performed the best in the immediate post-test and made great progress in all three aspects (score diff = 60 for spelling, score diff = 72 for meaning and use, score diff = 20 for pronunciation). In comparison, Frank, who focused on the word spelling and (the first) meaning, greatly improved spelling but made small progress in meaning and use (score diff = 49) and pronunciation (score diff = 3). On the contrary, no significant progress could be found in Harry’s and Lucy’s vocabulary test scores, although Harry made some progress in spelling (score diff = 30) and pronunciation (score diff = 7). Arguably, the results indicate that the active and effective use of a mobile dictionary benefits incidental vocabulary learning in the short term.

<table>
<thead>
<tr>
<th>Student</th>
<th>Pre-test score</th>
<th>Immediate post-test score</th>
<th>Short-term retention</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>Spelling</td>
<td>Meaning &amp; use</td>
<td>PRON</td>
</tr>
<tr>
<td>Maggie</td>
<td>24</td>
<td>39</td>
<td>62</td>
</tr>
<tr>
<td>Frank</td>
<td>24</td>
<td>21</td>
<td>75</td>
</tr>
<tr>
<td>Harry</td>
<td>36</td>
<td>14</td>
<td>63</td>
</tr>
<tr>
<td>Lucy</td>
<td>54</td>
<td>17</td>
<td>76</td>
</tr>
</tbody>
</table>

Table 2. Learners’ pre- and immediate post-test score and short-term retention

b. Long-term vocabulary retention

Participants were asked to report whether they had learnt the 14 target words before answering the questions in the delayed post-test. The results were refined and presented in Table 3. In general, students’ delayed post-test scores are lower than what they achieved in the immediate post-test, demonstrating that their incidental vocabulary retention weakened as time went by. Comparatively, Maggie and Frank still performed better in the delayed post-test than Harry and Lucy, evidencing better long-term retention, especially in spelling as well as meaning and use. Thus, the results may reflect that using mobile dictionary can benefit their long-term vocabulary retention, but the effects also depend on how much and how effectively the learners use the mobile dictionary.

<table>
<thead>
<tr>
<th>Student name</th>
<th>Pre-test score</th>
<th>Delayed post-test score</th>
<th>Long-term retention</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>Spelling</td>
<td>Meaning &amp; use</td>
<td>PRON</td>
</tr>
<tr>
<td>Maggie</td>
<td>24</td>
<td>39</td>
<td>62</td>
</tr>
<tr>
<td>Frank</td>
<td>24</td>
<td>21</td>
<td>75</td>
</tr>
<tr>
<td>Harry</td>
<td>36</td>
<td>14</td>
<td>63</td>
</tr>
<tr>
<td>Lucy</td>
<td>54</td>
<td>17</td>
<td>76</td>
</tr>
</tbody>
</table>

Table 3. Learners’ pre- and immediate post-test score & long-term retention

Intentional Vocabulary Learning

The everyday self-report questionnaire was used to track participants’ intentional vocabulary learning process. Table 4 offers a brief overview of their 14-day intentional vocabulary learning, which reflects that participants were quite active and able to schedule their daily vocabulary learning at their own pace. They preferred to study in the evening and studied an average of 64 minutes to 78 minutes per day.

<table>
<thead>
<tr>
<th>Name</th>
<th>Study days</th>
<th>Morning</th>
<th>Afternoon</th>
<th>Evening</th>
<th>Average study length (per day)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Maggie</td>
<td>14</td>
<td>3</td>
<td>3</td>
<td>8</td>
<td>68 min</td>
</tr>
</tbody>
</table>

8
Table 4. Overview of learner’s 14-day intentional learning process

Table 5. Learners’ intentional learning progress

DISCUSSION

Using a Mobile Dictionary is More Effective than Guessing.

The effectiveness of a dictionary (especially a paper dictionary) in incidental vocabulary learning was researched and empirically verified by some scholars, including Luppescu and Day (1993) and Knight (1994). The present study echoes the previous findings that looking up words in a dictionary is beneficial for a learner’s vocabulary retention. In addition, we further reported that the two learners who were keen on using the mobile dictionary (Maggie and Frank) outperformed the other two learners who preferred to guess the word meaning (Harry and Lucy). The involvement load hypothesis, proposed by Laufer and Hulstijn (2001), may provide some theoretical underpinnings into this finding. The hypothesis informs some determining factors in incidental vocabulary learning from the motivational dimension to the cognitive dimension. They argued that retention of words when processed and acquired incidentally is conditional, highlighting three factors — need, search, and evaluation — as main components of involvements. The need component, from a motivational perspective, refers to a learner’s motivation to achieve. Search is an attempt to find the form of the L2 word to represent a concept or find the meaning of the word. Evaluation involves a process of making comparisons between words and word meanings to find the most suitable word/word meaning in a specific context.

In practice, Laufer and Hulstijn (2001) verified their assumption that words processed and acquired with higher involvement load could be retained better. According to Laufer and Hulstijn (2001), need is moderate when it is imposed by external factors (e.g. teachers and tasks, marked as +). It becomes stronger when learners themselves are willing to use the dictionary (marked as ++). The involvement of evaluation depends on whether there is a need to compare different meanings of a word (marked as +), and whether there is a productive task (e.g. making sentences, marked as ++). Table 6 summarises the possible involvement index of using dictionary and guessing in this study, indicating higher involvement load in using dictionary. In this study, the cases of Maggie and Frank justified the active use of a mobile dictionary with more cognitive involvement load could contribute to their better word retention.

Self-Directed Intentional Vocabulary Learning is Beneficial.

Findings in this study show that all our four participants’ vocabulary retention was weakened after the two-week interval, indicating that short exposure to the word may result in shallow processing and word retention both in a short and long

<table>
<thead>
<tr>
<th>Strategy</th>
<th>Need</th>
<th>Search</th>
<th>Evaluation</th>
<th>Involvement index</th>
</tr>
</thead>
<tbody>
<tr>
<td>Using dictionary</td>
<td>+ (imposed by the reading task)</td>
<td>+</td>
<td>- (without comparison) + (with comparison but without productive output) ++ (with comparison and productive output)</td>
<td>2-5</td>
</tr>
<tr>
<td></td>
<td>++ (imposed by the learners)</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Guessing</td>
<td>+ (imposed by the reading task)</td>
<td>-</td>
<td>-</td>
<td>1-2</td>
</tr>
<tr>
<td></td>
<td>++ (imposed by the learners)</td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

Table 6. The involvement load index of using dictionary and guessing

3 In this table, a minus (-) marks an absence of an involvement factor; a plus (+) marks that the factor is present but only in its moderate version; a double plus (++) marks the strong version of an involvement factor (Laufer & Hulstijn, 2001).
term. Many scholars such as Webb (2007) emphasised the importance of repetition, arguing that increasing the number of exposures to target words is beneficial for word retention. Craik and Lockhart (1972), from a cognitive perspective, underscored the importance of in-depth processing. As they proposed, information is mainly processed in three ways at two levels: (1) **structural** processing, to encode the physical qualities of the word at a shallow level; (2) **phonemic** processing, to encode the sound of the word at a shallow level; and (3) **semantic** processing, to encode the word meaning and its associated knowledge (e.g. word use, synonyms) at a deep level. The **semantic** processing, as they proposed, is of great importance in the process of storing vocabulary knowledge in the long-term memory.

With the provision of rich vocabulary knowledge information and learners’ active involvement, the effectiveness of the 14-day self-directed intentional vocabulary learning confirmed that vocabulary retention is affected by the quantity of exposure as well as the quality of the learner’s attention and use (Laufer & Hulstijn, 2001). The rich and numerous associations with the learner’s previous knowledge also benefit his or her acquisition of new knowledge. In this study, results indicate the intentional learning with rich and enormous exposure to the word can stimulate learners’ **semantic** processing, which is useful for their vocabulary retention. In the realm of pedagogy, when teachers implement intentional vocabulary teaching, it is recommended that they provide learners with rich, high-quality, constructive vocabulary learning materials and more exposure so learners can become familiar with, understand, and acquire the word.

**CONCLUSIONS AND FUTURE RESEARCH**

To conclude, this study explored four Chinese EFL learners’ vocabulary learning across contexts, aiming to examine learners’ use of a mobile dictionary in reading, as well as the effectiveness of a mobile dictionary in both incidental and intentional learning settings. At the incidental learning stage, results show that Maggie and Frank, who preferred to use the mobile dictionary, made more significant progress than the other two participants (Harry and Lucy). In particular, Maggie, who made the most effective use of the dictionary and regarded the dictionary as a learning tool, showed the greatest progress. At the intentional learning stage, all of the learners improved, and the gap between the two who preferred the mobile dictionary (Maggie and Frank) and the two who preferred to use context (Harry and Lucy) was narrowed. This study verified the benefits of a mobile dictionary in a learner’s self-directed incidental and intentional vocabulary learning, but the effectiveness may be largely subject to whether and how learners use the dictionary. Theoretically, the results to some extent corroborate involvement load hypothesis (Laufer & Hulstijn, 2001) and depth of processing (Craik & Lockhart, 1972). Nevertheless, as a study with quite a small sample size, this study is just a point of departure for determining the usefulness of a mobile dictionary in L2 vocabulary learning. We call for more research to further explore this topic with a larger group of learners and a longer intentional vocabulary treatment. As it seems that Maggie and Frank entered a bottleneck period at the end of the intentional learning stage, more efforts on how to break through the bottleneck are needed. Pedagogically, teachers are suggested to put more emphasis on how to efficiently and effectively implement incidental and intentional vocabulary learning both inside and outside the classroom. Governments and universities should consider more about how to provide teachers, especially those in less developed areas, with adequate digital multimodal resources and training to help them use technology in different teaching contexts (Zhang, 2019). As self-regulation plays a definitive role in non-formal self-directed L2 vocabulary acquisition, learners should make endeavour to develop their vocabulary learning strategies via technological and pedagogical support for different language learning purposes.

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