

# The role of electronic pocket dictionaries as an English learning tool among Chinese students

Hua-Li Jian,\* Frode Eika Sandnes,† Kris M. Y. Law,‡ Yo-Ping Huang§ & Yueh-Min Huang¶

\*Department of Foreign Languages and Literature, National Cheng Kung University, Tainan, Taiwan

†Faculty of Engineering, Oslo University College, Oslo, Norway

‡Department of Industrial and Systems Engineering, The Hong Kong Polytechnic University, Hunghom, Kowloon, Hong Kong

§Department of Electrical Engineering, National Taipei, University of Technology, Taipei, Taiwan

¶Department of Engineering Science, National Cheng Kung University, Tainan, Taiwan 701

## Abstract

This study addressed the role of electronic pocket dictionaries as a language learning tool among university students in Hong Kong and Taiwan. The target groups included engineering and humanities students at both undergraduate and graduate level. Speed of reference was found to be the main motivator for using an electronic pocket dictionary. Next, the functionality used was found to be connected to the language proficiency of the learner. Finally, multimedia content was ranked least important. The results of this study have implications for the design of electronic dictionaries and for the teaching of second languages with electronic dictionaries. In particular, device developers should focus on improving the accessing speed and pay less attention to multimedia functionality. Educators should ensure that the device functionality matches the language proficiency level of the students.

## Keywords

electronic dictionary, human-computer interface, mobile learning, second language learning.

## Introduction

The electronic pocket dictionary is a typical South East Asian phenomenon and it is especially popular in Taiwan (Liu 2007), Hong Kong (Lan 2005), Korea (Park 2006), and Japan (Tono 2001). Electronic pocket dictionaries are sold in most consumer electronic shops and are frequently seen in classrooms. With a few exceptions (Tang 1997), electronic pocket dictionaries are uncommon in classrooms in most other parts of the world, such as Europe, Africa, and America. Electronic pocket dictionaries can be purchased in these regions as well, but these dictionaries are usually targeted at tourists and the lexical content is limited. These electronic pocket dictionaries cover many languages instead of focusing on one language in depth.

A typical electronic dictionary is battery operated, lightweight, and portable. It is usually foldable with a full keyboard in the main unit and a display in the lid. The dictionaries usually provide English to Chinese (or Japanese or Korean) entries, English to English entries, and Chinese (or Japanese or Korean) to English entries. Most dictionaries can produce audible pronunciations of both the Chinese and English words. Current high-end dictionaries are equipped with backlit colour and touch sensitive displays. These models consume more power, but can display language instruction videos and multimedia language training games.

One apparent advantage of an electronic dictionary over a printed one is the ease with which entries can be found. It takes time and practice to develop efficient printed dictionary referencing skills. One study of international students in England found that in every fifth attempt about half of the students using printed dictionaries failed to find dictionary entries (Nesi & Haill 2002).

Accepted: 3 July 2009

Correspondence: Frode Eika Sandnes, Faculty of Engineering, Oslo University College, P.O. Box 4. St. Olavs Plass, N-0130 Oslo, Norway.  
Email: frodes@hio.no

In recent years, many dictionary resources have become available on the Internet and these online dictionaries have grown in popularity throughout the world. However, these dictionaries require an Internet connection and a device powerful enough to render web pages. Smaller and cheaper Internet-enabled general purpose computers are emerging that may one day replace the special purpose electronic pocket dictionary. Experimental learning paradigms that exploit the convenience of handheld devices for collaborative vocabulary learning and related experience sharing are proposed (Ogata & Yano 2004). Still, electronic pocket dictionaries are more ubiquitous. Mobile phones are often equipped with dictionaries, but it is cumbersome to input text on numeric keypads compared to pocket dictionaries with full QWERTY keyboards (Sandnes & Aubert 2007).

This study attempts to uncover factors that motivate students to use electronic pocket dictionaries and hence, explain the popularity of electronic pocket dictionaries in South East Asia. Understanding students' self-initiated use of electronic pocket dictionaries can both help improve the usability of pocket dictionaries and improve second language teaching.

## Background

The acquisition of vocabulary is believed to be an essential part of second language learning (Summers 1988). Limited understanding of vocabulary usage among second language learners may lead to students adopting plagiarism practices in paraphrasing and summarizing tasks (Jian *et al.* 2008). Vocabulary learning is found to be strengthened for learners who check dictionaries for words they have been exposed to during reading and listening activities (Lupescu & Day 1993; Knight 1994; Hulstijn *et al.* 1996). Learners are found to be more successful in using dictionaries for reading tasks compared to production tasks, because production requires more than conceptual information, including the understanding of idioms, grammar, collocations, synonyms, and lexical phrases (Summers 1988). Furthermore, students have been found to learn new vocabulary by themselves by the means of a dictionary, although they need training on how to use dictionaries (Gonzalez 1999).

Views differ regarding the use of monolingual dictionaries versus bilingual dictionaries. Language teachers have traditionally embraced monolingual dictionaries

(Guillota & Kenning 1994) as the reading of entries is itself a language learning activity. Furthermore, voices critical of bilingual dictionaries emphasize that bilingual dictionaries give a false sense of a one-to-one mapping between the words in two languages. Another argument is that bilingual dictionaries are more quickly outdated than their monolingual counterparts (Carter & McCarthy 1988). However, monolingual dictionaries have also been criticized for being too difficult for beginners as they require the students to have a minimal level of language proficiency. In addition, students may not understand the meaning of a word in a specific context or cultural setting (Amritavalli 1999).

## Electronic dictionaries

Initially, researchers were sceptical of the usefulness of electronic pocket dictionaries. One argument was that electronic dictionaries cause confusion and frustration because they provide erroneous contents (Koren 1997; Weschler & Pitts 2000). The electronic dictionary technology has improved since its infancy. Still, functions such as pronunciation are often synthetic and unclear, and the lexical content is incomplete (Liu 2007). However, Yonally and Gilfert pointed out that the speed of reference is an asset that reduces the stress and anxiety among Japanese ESL (English as a Second Language) students allowing them to focus on learning (Yonally & Gilfert 1995). They also mentioned the novelty and fun in using an electronic dictionary and the admiration from peers.

Results show that electronic dictionaries can have a positive effect on learning. For instance, a study addressing children's use of an electronic story book showed an effect on learning for a *read-with-dictionary* task over a *read-only* task (Korat & Shamir 2006). Liou found evidence that the ability of a student to understand the entry in a dictionary is related to the student's academic performance (Liou 2000). However, academically strong learners were more likely to skip entries unknown to them and not bother to look these up and hence, miss the opportunity to learn these terms.

Tono studied the printed dictionary referencing skills needed by Japanese ESL-learners and how these skills can be taught (Tono 2001). Furthermore, a study of electronic pocket dictionary use among Korean college students revealed that guidance on use has a significant impact on students' positive attitude towards the use of

electronic pocket dictionaries (Park 2006). It has also been pointed out that the lack of dictionary skills among beginner and intermediate second language learners may prevent them from finding the meaning of culturally dependent and domain specific words and phrases. McAlpine and Myles suggested that an online hyper-linked phrase-based dictionary may be better suited for beginners, because online dictionaries do not have the same space and linear search limitations as printed dictionaries (McAlpine & Myles 2003).

### Characteristics of electronic pocket dictionary use

A study involving first year Korean university students from a range of disciplines showed that 96% of the students use bilingual dictionaries (Kent 2001). However, only 37% of the students had access to an electronic dictionary. The dictionaries are mostly used when reading (69%) and are least used when listening or speaking. Furthermore, English-to-Korean was the most frequently used reference. More than half of the respondents thought audio pronunciation was the most important aspect of an electronic dictionary. This was followed by the amount of vocabulary and example sentences. Other characteristics such as price and portability were less important. Still, weight and thickness were reported by nearly half of the subjects as the most important problems associated with electronic dictionaries. Illustrations and portability were reported as the two most beneficial characteristics of electronic dictionaries. Similar results have been found among university ESL students in Taiwan (Liu 2007). The Taiwanese students in Liu's study indicated that a large vocabulary is the most important characteristic of an electronic pocket dictionary. Moreover, they indicated that limited content was a major shortcoming of electronic pocket dictionaries. Two-thirds of the students agreed that printed dictionaries have better quality content than electronic pocket dictionaries.

### Research questions

This study sets out to uncover factors that motivate students' use of electronic pocket dictionaries and to assess their implications for language teachers and technology developers. The study is focused around three hypotheses:

Hypothesis 1: Pocket e-dictionaries are perceived as more efficient to use than paper-based dictionaries.

Hypothesis 1 is based on claims that students generally lack dictionary referencing skills (Nesi & Haill 2002). The lack of skills results in students' taking longer and requiring more effort to consult paper dictionaries, while it is a common belief that pocket e-dictionaries allow students to quickly find the desired dictionary entries (Yonally & Gilfert 1995). However, this belief relies on the assumption that students have the necessary computer skills to operate the electronic pocket dictionary.

Hypothesis 2: The learners' perceived electronic pocket dictionary needs are linked to the language proficiency level of the learner.

According to hypothesis 2, the level of the learner, coarsely divided into beginner, intermediate, or advanced, influences how the electronic pocket dictionary is used. The connection between dictionary needs and language proficiency level is consistent with common practices in conventional ESL-teaching, where different pedagogical contents, methods, and focus are applied to language learners at different levels. For instance, beginners focus on reading, while intermediate and advanced learners emphasize writing (Summers 1988).

Hypothesis 3: Pocket e-dictionary multimedia content is perceived as important by language learners.

Recent technology enables the addition of multimedia content to low-cost handheld devices. Device manufacturers often tout multimedia capabilities in their marketing. A key question is therefore, is it beneficial to add multimedia content to electronic pocket dictionaries? Little is written on this topic in the research literature. Hypothesis 3 is therefore rooted in the somewhat conflicting views on the general effectiveness of multimedia. Some educators believe that multimedia promotes learning (Lin & Chen 2006; Tsou *et al.* 2006) while others are more critical of the effectiveness of multimedia (Jones 1991; Murray & Barnes 1998). Multimedia in this context includes interactive language learning games, video, and audio lessons. Illustrations are not considered multimedia content in this study.

## Method

### Participants

Participants were drawn from the National Cheng Kung University, Tatung University, National Taipei

University of Science and Technology and Hong Kong City University. Hong Kong and Taiwan are areas of widespread electronic pocket dictionary use (Lan 2005; Liu 2007). The participants are native speakers of Taiwanese, Mandarin, or Cantonese with moderate English proficiency. They commonly use electronic pocket dictionaries, are pursuing higher education, and are relatively homogeneous culturally (Watkins 2000; Sandnes *et al.* 2006). Classes were sampled at random which gives a representative cross-section of students enrolled in the participating departments.

A total of 195 questionnaires were collected, of which 193 were used. Table 1 summarizes the participants' demographics. The respondents included 104 engineering students, of which 66 were undergraduates and 38 were graduate students, together with 88 humanities students, of which 68 were undergraduate and 20 were graduate students. Clearly, the engineering group was male dominated with only 12 undergraduate and 6 graduate female students; while the humanities group was female dominated with only 18 undergraduate and 2 graduate male students. Gender was not used as a factor in this study because of the gender imbalance in the sample.

Humanities students had a better average in English exam scores than the engineering students ( $t = 8.3$ ,  $P < 0.001$ ,  $df = 109$ ). Note that several types of English exam scores were reported and these statistics must therefore be interpreted with caution. Finally, a majority (79.3%) of the students owned an electronic pocket dictionary.

Table 1. Participant demographics.

	Engineering		Humanities	
	UG	PG	UG	PG
Total	66.0	38.0	68.0	20.0
Females	12.0	6.0	50.0	18.0
Age (mean)	20.4	29.5	18.9	27.0
Age (SD)	3.6	6.7	1.1	3.2
With dictionary (%)	86.4	78.9	79.4	60.0
Mean English exam score	38.3	43.9	68.0	55.5
SD	26.8	29.8	31.1	33.8
Hours of study per week	5.8	5.7	6.1	5.6
SD	2.7	3.3	3.2	3.0

UG, undergraduate; PG, postgraduate; SD, standard deviation.

## Materials

A questionnaire was designed comprising two parts. The first part of the questionnaire was completed by all the respondents and addressed general issues related to dictionary use. The second part of the questionnaire was only completed by respondents who reported using an electronic dictionary regularly. The first section of the questionnaire asked for demographic information including age, gender, subject area of study, level of study, and English entrance exam scores. Moreover, five five-point Likert-style questions were provided to acquire a self-assessment of students' overall English writing, reading, listening, and speaking skills.

The remaining questions involved pair-wise ranking of issues related to dictionary use designed to address the three hypotheses. A pair-wise ranking methodology usually addresses a set of issues (Seip *et al.* 2006). For example, one could establish the preferred ranking of books, the Web, and magazines. To accomplish this, each item pair is matched, e.g. 'what is best: book or the Web, book or magazine, or the Web or magazine?' Each pair was presented on a separate line in a table and each item was assigned a checkbox. The subject ticked the preferred alternative for each pair of items. If a subject could not decide between two alternatives the subjects could tick both alternatives. To rank  $n$  issues, a total of  $n(n - 1)/2$  items are needed. Note that the item pairs were presented in random order, and each item was organized such that each item appeared approximately the same number of times on the left and the right side.

The initial questionnaire was constructed in English and was discussed among the authors. It was later translated into traditional Chinese characters by a teaching assistant and was checked by the Taiwanese authors who also applied final editing. A pilot was run on a test subject, which resulted in a few minor changes to the questionnaire. Figure 1 shows an example of pair-wise ranking from the questionnaire.

## Procedure

The questionnaires were distributed in class and the students were given 30 min to complete the questionnaire. A response rate of 100% was therefore achieved.

For each pair of alternatives below, indicate what is the most important when you buy an electronic dictionary.

<input type="checkbox"/> Low price	or	<input type="checkbox"/> Technical features
<input type="checkbox"/> Size	or	<input type="checkbox"/> Low price
<input type="checkbox"/> Appearance	or	<input type="checkbox"/> Technical features
<input type="checkbox"/> Appearance	or	<input type="checkbox"/> Size
<input type="checkbox"/> Games	or	<input type="checkbox"/> Technical features
<input type="checkbox"/> Size	or	<input type="checkbox"/> Games
<input type="checkbox"/> Technical features	or	<input type="checkbox"/> Size
<input type="checkbox"/> Lexical information	or	<input type="checkbox"/> Appearance
<input type="checkbox"/> Lexical information	or	<input type="checkbox"/> Games
<input type="checkbox"/> Technical features	or	<input type="checkbox"/> Lexical information
<input type="checkbox"/> Low price	or	<input type="checkbox"/> Games
<input type="checkbox"/> Size	or	<input type="checkbox"/> Lexical information
<input type="checkbox"/> Appearance	or	<input type="checkbox"/> Games
<input type="checkbox"/> Low price	or	<input type="checkbox"/> Lexical information
<input type="checkbox"/> Low price	or	<input type="checkbox"/> Appearance

Fig 1 An example of pair-wise ranking (translated from Chinese).

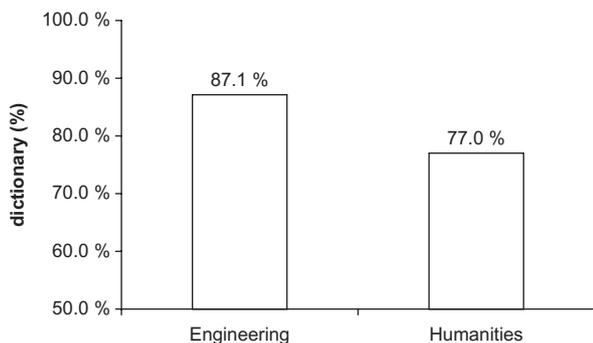


Fig 2 Distribution of students with and without electronic dictionaries among engineering and humanities students.

**Analysis**

The pair-wise analyses were conducted using a pair-wise ranking analysis spreadsheet. Details on the pair-wise statistical computations can be found in (Seip *et al.* 2006). The ranking statistics listed herein include the normalized ranking coefficients for each item, the rank of each item, agreement among the respondents,  $\chi^2$ -statistics, degrees of freedom, and *P*-value.

**Results**

**Printed versus electronic dictionary**

Figure 2 shows the proportion of students who owned electronic pocket dictionaries. Among the engineering students 97.1% owned electronic dictionaries while only 77.0% of the humanities students owned electronic dictionaries. A  $\chi^2$ -test revealed that these groups are independent ( $\chi^2(1, n = 188) = 4.3; P < 0.04$ ). Although

Table 2. Ranking of dictionary types according to students with and without electronic pocket dictionaries.

Dictionary	With		Without	
	Mean	Rank	Mean	Rank
Printed ( $w_1$ )	0.15	4	0.27	1
E-pocket ( $w_2$ )	0.29	1	0.17	4
cellphone/PDA ( $w_3$ )	0.12	5	0.12	5
SW/CD-ROM ( $w_4$ )	0.21	3	0.21	3
Web-based ( $w_5$ )	0.24	2	0.23	2
Agreement	0.14		0.13	
$\chi^2$ (df = 10)	232.69		51.73	
<i>P</i>	<0.01		<0.01	

The table lists the normalized ranking coefficients, rank, agreement among the respondents,  $\chi^2$ -statistics, degrees of freedom, and *P*-value.

the ratio of students who did not have electronic pocket dictionaries is relatively small, the results indicate that humanities students were more likely to manage without the aid of electronic dictionaries. Furthermore, a higher ratio of undergraduate students owned electronic pocket dictionaries (82.8%) than graduate students (72.4%) for both disciplines. A  $\chi^2$ -test revealed that these distributions are independent ( $\chi^2(1, n = 192) = 24.9; P < 0.001$ ).

To assess whether the use of electronic pocket dictionaries was the result of attitude or chance, the rankings of dictionary types for the students with and without electronic pocket dictionaries were compared (see Table 2). The ranking results for the two groups were similar apart from two items. The students with electronic dictionaries ranked electronic dictionaries as their first choice ( $w_2 = 0.29$ , rank 1/5) and printed dictionaries second last (4th) place ( $w_1 = 0.15$ , rank 4/5), while students without electronic pocket dictionaries ranked printed dictionaries first choice ( $w_1 = 0.27$ , rank 1/5) and electronic dictionaries second last ( $w_2 = 0.17$ , rank 4/5). Dictionary ownership was consistent with the expressed dictionary preferences.

To test whether the different dictionary preferences were related to different English skills, the reported English scores of the two groups were compared. The students who reported using an electronic pocket dictionary had a mean exam score of 60.3% [standard deviation (SD) = 25.1], while the students who did not have an electronic dictionary had a mean exam score of

77.2% (SD = 21.1). The two groups are significantly different ( $t = 3.3$ ,  $P < 0.003$ ,  $df = 33$ ). Clearly, learners without electronic dictionaries had better exam results, indicating that their level of English allowed them to operate without this tool. Students with weaker language skills were more dependent on the electronic pocket dictionary. Note that some students left this item blank and the analysis is therefore only based on the questionnaires with this item completed. Students may have left this item blank if they did not remember their scores, or if they were ashamed of their scores. However, this should not affect the analysis as forgetful students would represent a random subsample. Students who are ashamed of their scores would bias the mean towards the high end. However, it is likely that students from both groups were ashamed of their scores. A comparison of the two groups is therefore valid.

To further verify the relationship between electronic dictionary use and language proficiency, the self-assessed language skills including overall abilities, reading, writing listening, and speaking abilities were compared for the two groups. The mean combined score for the students with dictionaries was 3.0 (SD = 0.6) on a scale from 1 to 5, while the mean combined score for the students without pocket dictionaries was 3.2 (SD = 0.5). The two groups are significantly different ( $t = 2.8$ ,  $P < 0.006$ ,  $df = 251$ ). Clearly, the students who reported not using an electronic pocket dictionary had a higher self-assessed language proficiency than students who relied on electronic pocket dictionaries. The connection between language proficiency and electronic pocket dictionary use can also help explain the popularity of electronic pocket dictionaries among students in South East Asia. The official TOEFL (Test of English as a Foreign Language) English proficiency scores for 2007 show that students in most south-east Asian countries scored lower (mean total 75.6) than students in Europe (mean total 88.4) (ETS 2008).

The ranking of difficulties associated with electronic pocket dictionaries gives some clues to the different perceptions among students with and without dictionaries. Table 3 shows that students without electronic dictionaries viewed electronic pocket dictionaries as having too little lexical content ( $w_4 = 0.24$ , rank 1/6), while electronic pocket dictionary users viewed lack of lexical content as a minor issue ( $w_4 = 0.17$ , rank 4/6). On the contrary, electronic dictionary users indicated limited

**Table 3.** Ranking of perceived difficulties using electronic pocket dictionaries according to students with and without electronic pocket dictionaries.

	With		Without	
	Mean	Rank	Mean	Rank
Difficult to use ( $w_1$ )	0.06	6	0.07	6
Expensive ( $w_2$ )	0.19	3	0.17	3
Easily lost ( $w_3$ )	0.13	5	0.14	5
Little content ( $w_4$ )	0.17	4	0.24	1
Battery life ( $w_5$ )	0.25	1	0.23	2
No bookmarks ( $w_6$ )	0.19	2	0.15	4
Agreement	0.19		0.19	
$\chi^2$ (df = 15)	450.46		106.67	
$P$	<0.01		<0.01	

The table lists the normalized ranking coefficients, rank, agreement among the respondents,  $\chi^2$ -statistics, degrees of freedom, and  $P$ -value.

battery power ( $w_5 = 0.25$ , rank 1/6) as the largest drawback with electronic pocket dictionaries.

#### Motivation for use

Table 4 shows how the respondents ranked factors motivating them to use an electronic pocket dictionary. Factors included ease of use ( $w_1$ ), speed of use ( $w_2$ ), small size and light weight ( $w_3$ ), peer pressure ( $w_4$ ), fun ( $w_5$ ), the ability to hear pronunciation ( $w_6$ ), and space for concordance ( $w_7$ ). The results are consistent across the four student groups. All groups cited the speed of electronic dictionaries compared to printed dictionaries as the most important motivator for use ( $w_2 = 0.21 - 0.24$ , rank 1/7). Peer pressure ( $w_4 = 0.05 - 0.07$ , rank 6/7) and fun ( $w_5 = 0.04 - 0.06$ , rank 7/7) were the least important motivators.

Small differences between the student groups were also observed. For instance, undergraduate engineering students ranked small size and light weight as second more important ( $w_3 = 0.18$ , rank 2/7), while these were ranked in third place by the engineering graduate students ( $w_3 = 0.16 - 0.18$ , rank 3/7). Undergraduate humanities students instead ranked the ability to listen to pronunciation as second more important ( $w_6 = 0.19 - 0.20$ , rank 2/7). Humanities graduate students ranked ease of use in second place ( $w_1 = 0.17 - 0.06$ , rank 2/7) and space for concordance in third place ( $w_7 = 0.16$ , rank 3/7).

Table 4. Ranking of motivating factors for using electronic pocket dictionaries.

Motivation for e-dictionary	Engineering				Humanities			
	UG		PG		UG		PG	
	Mean	Rank	Mean	Rank	Mean	Rank	Mean	Rank
Easy to use ( $w_1$ )	0.17	3	0.14	5	0.16	4	0.17	2
Speed of use ( $w_2$ )	0.23	1	0.21	1	0.24	1	0.24	1
Size and weight ( $w_3$ )	0.18	2	0.16	3	0.18	3	0.16	4
Peer pressure ( $w_4$ )	0.07	6	0.08	6	0.05	6	0.06	6
Fun ( $w_5$ )	0.06	7	0.06	7	0.04	7	0.04	7
Pronunciation ( $w_6$ )	0.17	3	0.20	2	0.19	2	0.16	4
Concordance ( $w_7$ )	0.14	5	0.15	4	0.14	5	0.16	3
Agreement	0.27		0.20		0.34		0.36	
$\chi^2$ (df = 21)	384.85		172.95		502.85		163.20	
$P$	<0.01		<0.01		<0.01		<0.01	

UG, undergraduate; PG, postgraduate.

The table lists the normalized ranking coefficients, rank, agreement among the respondents,  $\chi^2$ -statistics, degrees of freedom, and  $P$ -value.

The main difference between the groups is that engineering graduate students placed less emphasis on usability while this factor was more important among humanities graduate students. One explanation for this difference is that engineering students are typically more used to working with machines and technology. Engineers are used to solving problems and making things and are therefore more likely to be tolerant of poor usability; while humanities students are less tolerant of poor usability. Engineering undergraduate students ranked portability more important and humanities graduate students preferred room for a concordance. The humanities students' higher ranking of concordance is consistent with the stronger emphasis on detailed lexical information required for their studies.

To further identify factors that motivate electronic pocket dictionary use, we asked the participants to rank electronic pocket dictionary characteristics, including price ( $w_1$ ), lexical contents ( $w_2$ ), physical appearance of the device ( $w_3$ ), availability of games ( $w_4$ ), availability of technical features ( $w_5$ ), and physical size ( $w_6$ ). The results, shown in Table 5, are relatively consistent across the groups with only minor variations. All groups, except undergraduate engineering students, preferred an electronic pocket dictionary to contain more lexical information ( $w_2 = 0.25 - 0.28$ , rank 1/6), while the engineering undergraduates preferred technical features ( $w_5 = 0.26$ , rank 1/6). The preference for

lexical content is consistent with previous studies (Kent 2001; Liu 2007); however, engineering undergraduates' preference for extra functions over lexical information signals their technical curiosity and playfulness. All groups denoted the availability of games as the least important characteristic ( $w_4 = 0.01 - 0.06$ , rank 6/6) and appearance of the device as the second least important characteristic ( $w_3 = 0.10 - 0.12$ , rank 5/6). Size and price were of medium importance. Undergraduate students preferred low price ( $w_1 = 0.15 - 0.19$ , rank 3/6) to small size ( $w_6 = 0.14 - 0.15$ , rank 4/6), while graduate students preferred small size ( $w_6 = 0.16 - 0.21$ , rank 3/6) over low price ( $w_1 = 0.16 - 0.20$ , rank 4/6).

### Functionality

Table 6 lists the students' ranking of electronic pocket dictionary functionality, namely English to Chinese translation ( $w_1$ ), Chinese to English translation ( $w_2$ ), spelling and word definition ( $w_3$ ), thesaurus, grammar usage, and examples of usage ( $w_4$ ), multimedia language lessons ( $w_5$ ), phrase book and idioms ( $w_6$ ), and word pronunciation ( $w_7$ ). The results reveal that all undergraduate students preferred the English to Chinese reference ( $w_1 = 0.16 - 0.17$ , rank 1/8), while graduates preferred grammar usage and examples of usage ( $w_5 = 0.16 - 0.18$ , rank 1/8). Moreover, all the groups ranked phrasebook and idioms as the second more

Table 5. Ranking of electronic pocket dictionary characteristics.

Characteristics	Engineering				Humanities			
	UG		PG		UG		PG	
	Mean	Rank	Mean	Rank	Mean	Rank	Mean	Rank
Price ( $w_1$ )	0.19	3	0.20	4	0.15	3	0.16	4
Contents ( $w_2$ )	0.25	2	0.25	1	0.28	1	0.28	1
Appearance ( $w_3$ )	0.10	5	0.11	5	0.11	5	0.12	5
Games ( $w_4$ )	0.06	6	0.01	6	0.03	6	0.01	6
Features ( $w_5$ )	0.26	1	0.22	2	0.27	2	0.27	2
Size ( $w_6$ )	0.14	4	0.21	3	0.15	4	0.16	3
Agreement	0.31		0.42		0.44		0.50	
$\chi^2$ (df = 15)	313.85		247.74		460.69		158.15	
$P$	<0.01		<0.01		<0.01		<0.01	

UG, undergraduate; PG, postgraduate.

The table lists the normalized ranking coefficients, rank, agreement among the respondents,  $\chi^2$ -statistics, degrees of freedom and  $P$ -value.

important function ( $w_7 = 0.15 - 0.17$ , rank 2/8). Finally, all groups ranked multimedia lessons as the least important function ( $w_6 = 0.06 - 0.07$ , rank 8/8). Spelling and listening to pronunciation were also ranked low for all groups ( $w_{3,8} = 0.08 - 0.13$ , rank 5/8–7/8). It is interesting to note that the Chinese to English reference ranked low among all groups. Engineering undergraduates were most in favour of the Chinese–English dictionary ( $w_2 = 0.12$ , rank 4/8) and undergraduate humanities

students ranked this function the second least important function ( $w_2 = 0.10$ , rank 7/8).

The functionality requirements of the dictionary may be linked to language proficiency as reading is a more basic skill than writing. Undergraduates seem to focus on reading, while graduates seem to focus more on writing. The preference for functionality that facilitates decoding is also consistent with the literature (Summers 1988; Kent 2001; Liu 2007). Moreover, the different

Table 6. Ranking of electronic pocket dictionary functions.

E-dictionary functions	Engineering				Humanities			
	UG		PG		UG		PG	
	Mean	Rank	Mean	Rank	Mean	Rank	Mean	Rank
English–Chinese ( $w_1$ )	0.17	1	0.15	3	0.16	1	0.14	4
Chinese–English ( $w_2$ )	0.12	4	0.12	5	0.10	7	0.12	5
Spelling ( $w_3$ )	0.10	7	0.09	7	0.11	6	0.08	7
Definition ( $w_4$ )	0.12	5	0.14	4	0.14	4	0.17	3
Grammar/usage ( $w_5$ )	0.14	3	0.16	1	0.15	3	0.18	1
Multimedia ( $w_6$ )	0.07	8	0.07	8	0.07	8	0.06	8
Phrases/idioms ( $w_7$ )	0.15	2	0.16	2	0.15	2	0.17	2
Pronunciation ( $w_8$ )	0.12	6	0.12	5	0.13	5	0.08	6
Agreement	0.17		0.15		0.14		0.27	
$\chi^2$ (df = 28)	332.33		181.39		297.85		170.70	
$P$	<0.01		<0.01		<0.01		<0.01	

UG, undergraduate; PG, postgraduate.

The table lists the normalized ranking coefficients, rank, agreement among the respondents,  $\chi^2$ -statistics, degrees of freedom, and  $P$ -value.

preferences for Chinese–English dictionaries among undergraduate engineering and humanities students suggest that undergraduate engineering students were more dependent on the dictionary for encoding. The dependence on the dictionary for encoding may be connected to the undergraduate engineering students' low English proficiency.

## General discussion

### Speed of access

The results in Table 4 show that speed of access was the preferred benefit of the pocket e-dictionary for all the student groups examined. These observations are also consistent with the results in Table 2 where electronic pocket dictionary users ranked paper dictionaries second last, i.e. they preferred electronic pocket dictionaries, web-based dictionaries, and CD-ROM dictionaries over paper dictionaries. All of these dictionaries have full QWERTY keyboard and text can therefore be entered effectively. Cellphones, ranked as the least favourable, usually rely on text input via numeric keypads. These keypads are time-consuming and difficult to use.

Learners who did not use electronic pocket dictionaries expressed similar preferences with the electronic pocket dictionary users, with the difference that paper-based dictionaries were ranked first and electronic pocket dictionaries were ranked fourth. In other words, these students preferred web-based and CD-ROM dictionaries over electronic pocket dictionaries. The preference for web-based and CD-ROM dictionaries is probably connected to the fact that web-based and CD-ROM dictionaries usually are accessed on personal computers with a full-size keyboard, while electronic dictionaries are accessed via miniature keyboards that are harder to use, although easier to use than cellphones. Moreover, the Web and CD-ROMs are usually accessed in computer environments already familiar to the students. In contrast, the operating environments of electronic pocket dictionaries are vendor and product specific. A clue as to why those learners who did not use electronic pocket dictionaries preferred paper-based dictionaries is provided in Table 3, which shows that this group found the quality of content to be the most prominent problem. Hypothesis 1, namely that electronic pocket dictionaries are perceived as faster to use

than paper-based dictionaries, is therefore supported by the results.

### *Pedagogical implications*

Some educators insist on paper-based dictionaries (Koren 1997; Weschler & Pitts 2000). However, if referencing a dictionary is a bottleneck in the language class, then the motivation for study and learning progress may be hindered. If the student is allowed to use an electronic pocket dictionary, the focus and effort can be shifted away from the mechanical and laborious task of referencing the dictionary onto the actual language learning. A beginner might need to look up nearly every word when reading a text. As a student's language skills improve, the reliance on the dictionary decreases since the student does not have to look up as many words and the student therefore may be more accepting of paper-based dictionaries. From a different perspective, practices taught in university should mirror practices used in the workplace. It is likely that web-based dictionaries will gradually replace conventional paper dictionaries because of the speed of access and their availability on the desktop.

Moreover, different policies exist on the use of dictionaries in exams. For instance, in Norway, paper-based dictionaries are allowed in exams. Under such regimes, it makes sense to develop students' paper dictionary skills. However, in Taiwan, no aids are allowed in exams and exams cannot be used as a rationale for paper dictionary training.

### *Technological implications*

The acceptance of hypothesis 1 means that electronic pocket dictionary developers should focus on the speed of access. Current electronic pocket dictionaries are fast to use when the learners know how to spell the query. However, learners may not always know how to spell a word correctly. One promising avenue of development is to employ approximate input strategies that are robust to spelling mistakes. Spell checkers commonly use phonetic matching techniques such as SOUNDEX or Metaphone (Phillips 1990). Text input robust to phonetic variations is consistent with the proposal of phonetic-access dictionaries to help learners (Sobkowiak 1994). Moreover, predictive text input techniques commonly used in mobile text input applications (How & Kan 2005; Sandnes & Aubert 2007) and for physically disabled users (Darragh *et al.* 1990)

may help speed up access. Moreover, key human–computer interaction principles such as communicating on multiple channels, and the preference for recognition over recall realized through illustrations (picture dictionary (Kent 2001)), could be used to assist the learners to quickly recognize and verify the intended entries.

### Level of the learner

Several aspects of the results support hypothesis 2, namely that the electronic pocket dictionary needs are different for language learners at different levels. First, Table 1 shows that the proficiency level of the learner correlates with the percentage of electronic pocket dictionary usage. Postgraduates can be assumed to be more advanced language learners than undergraduates and the results show that undergraduates have a higher percentage of electronic dictionary usage. Moreover, the humanities students can also be assumed to be more advanced language learners than the engineering students. This assumption is also supported by the mean language exam results and self-reported language proficiencies listed in Table 1. Moreover, the engineering students' percentage of electronic pocket dictionary usage is higher than that of the humanities students (see Fig 1).

Second, the results in both Table 3 and Table 5 suggest that more advanced learners preferred lexical contents. Table 3 shows that learners who do not use electronic pocket dictionaries ranked lack of quality content as the largest disadvantage with electronic pocket dictionaries, while electronic pocket dictionary users ranked lack of content in the fourth place (out of six). Moreover, Table 5 shows that the undergraduate engineering students, who are the least advanced learners in this study, were the only group not to rank content as the most important electronic pocket dictionary characteristic.

Third, Table 6 shows that the perceived importance of the English–Chinese dictionary is lower for more advanced learners compared to less advanced learners, as engineering and humanities undergraduate students both ranked the English–Chinese dictionary as the most important, while engineering and humanities postgraduate students ranked the English–Chinese dictionary as the third and fourth more important function, respectively.

### *Pedagogical implications*

Students usually select an electronic pocket dictionary arbitrarily according to personal preferences and not necessarily according to pedagogical rationale. Instead, educators may impose some control upon which models of electronic pocket dictionaries are allowed in class. Such control would ensure that the students use electronic pocket dictionaries suitable for their level of study and activities conducted in class. This approach has long been employed in the teaching of mathematics, physics and engineering where students are allowed to use specific models of electronic pocket calculators appropriate for their level of study (Bitter & Hatfield 1993; Dion *et al.* 2001). The results in Table 3 suggest that price is not a hindrance for acquiring devices and it may not be unreasonable to expect a student to replace their electronic pocket dictionaries as they become more advanced learners.

### *Technological implications*

One implication of hypothesis 2 is that electronic pocket dictionary developers should develop a product portfolio with focus on language specific functionality to fit the needs of the various proficiency levels of learners, perhaps one range of models for beginners, one range for intermediate learners, and one range for advanced learners. Currently, electronic pocket dictionaries are organized into ranges according to technical features such as type of display (colour or monochrome), memory capacity, etc. which are all less important from a language learner's perspective.

### Multimedia

The results in Table 6 suggest that hypothesis 3, i.e. that multimedia is important, should be rejected. All groups ranked multimedia as the least important feature of an electronic pocket dictionary. Interactive language learning games can be classified as multimedia, and the results in Table 5 show that all student groups ranked games as the least important characteristic of an electronic pocket dictionary. The low ranking of games further fuels the rejection of hypothesis 3.

### *Pedagogical implications*

The rejection of hypothesis 3 implies that less focus should be placed on multimedia aspects of electronic pocket dictionaries in the language curriculum. The key

role of electronic pocket dictionaries is to provide a pervasive and fast alternative to paper dictionaries so that language learning activities in and outside the language learning classroom are facilitated. The function of language is to facilitate human-to-human communication in oral or written form and it is best learnt through communication between humans. Multimedia content may provide a valuable substitute when human contact is impractical. However, other multimedia platforms may be more suitable for language learning than electronic pocket dictionaries.

#### *Technological implications*

A consequence of rejecting hypothesis 3 is that electronic pocket developers should discard multimedia content and instead focus on lexical contents and efficient access mechanisms. Moreover, the development of quality multimedia content is expensive, time-consuming, and difficult. Furthermore, the result may not address the learning needs of the learner. It is in everyone's interest to keep the electronic learning devices simple and to eliminate all irrelevant features, functionalities, and content.

#### **Limitations of this study**

The issue of gender was omitted in this study because of the gender imbalance in the observed groups. It is possible that gender is an influential factor. It would therefore be interesting to repeat the experiment on gender balanced groups.

#### **Conclusion**

This study addressed Chinese students' perceptions of electronic pocket dictionary usage. The chief perceived benefit of electronic pocket dictionaries is the speed with which learners can look up entries. Learners' electronic pocket dictionary needs were found to be connected to their level of study. For instance, beginners rely more on the English–Chinese dictionary than more experienced learners do, while the latter favour grammar reference. Finally, the results suggest that multimedia content is not an important aspect of electronic pocket dictionaries. Pedagogical implications of this study are that electronic pocket dictionaries may serve as a constructive catalyst for weaker students who may be discouraged under a paper-based dictionary

regime. Moreover, educators should be conscious about which electronic pocket dictionary models are used by students and that these models fit the learning needs and proficiency level of the students. The technological implications are that electronic pocket dictionary developers should focus on improving the convenience and speed of access and develop explicit dictionary platforms for learners of different proficiency levels. Multimedia and non-language related functionality should be avoided.

#### **Acknowledgement**

The authors are grateful to Pe-Lun Huang for help during preparatory stages of the project and Ida Jahr and Donald Fleming for help with proofreading.

#### **References**

- Amritavalli R. (1999) Dictionaries are unpredictable. *ELT Journal* **53**, 262–269.
- Bitter G.G. & Hatfield M.M. (1993) Integration of the math explorer calculator into the mathematics curriculum: the calculator project report. *Journal of Computers in Mathematics and Science Teaching* **12**, 59–81.
- Carter R. & McCarthy M. (1988) Developments in the teaching of vocabulary. In *Vocabulary and Language Teaching*, (eds R. Carter & M. McCarthy), pp. 39–59. Longman, New York.
- Darragh J.J., Witten I.H. & James M.L. (1990) The reactive keyboard: a predictive typing aid. *Computer* **23**, 41–49.
- Dion G., Harvey A., Jackson C., Klag P., Liu J. & Wright C. (2001) A survey of calculator usage in high schools. *School Science and Mathematics* **101**, 427–438.
- ETS (2008) TOEFL® test and score data summary for TOEFL Internet-based and paper-based tests. *2007 Test Data (Report)*. Educational Testing Service, Princeton, NJ. Available online: [http://www.ets.org/Media/Research/pdf/71943\\_web.pdf](http://www.ets.org/Media/Research/pdf/71943_web.pdf) (last accessed 3 August 2009).
- Gonzalez O. (1999) Building vocabulary: dictionary consultation and the ESL student. *Journal of Adolescent and Adult Literacy* **43**, 264–270.
- Guillota M.-N. & Kenning M.-M. (1994) Electronic monolingual dictionaries as language learning aids: a case study. *Computers & Education* **23**, 63–74.
- How Y. & Kan M.-Y. (2005) Optimizing predictive text entry for short message service on mobile phones. In *Proceedings of HCI International, 2005*, (eds M.J. Smith & G. Salvendy) [CD-ROM]. Lawrence Erlbaum Associates, Inc, Las Vegas, CA.

- Hulstijn J., Hollander M. & Greidanus T. (1996) Incidental vocabulary learning by advanced foreign language students: the influence of marginal glosses, dictionary use, and reoccurrence of unknown words. *The Modern Language Journal* **80**, 327–339.
- Jian H.-L., Sandnes F.E., Huang Y.-P., Cai L. & Law K. (2008) On students' strategy-preferences for managing difficult coursework. *IEEE Transactions on Education* **51**, 157–165.
- Jones F.R. (1991) Mickey-mouse and state-of-the-art: program sophistication and classroom methodology in communicative CALL. *System* **19**, 1–13.
- Kent D. (2001) Korean university freshmen's dictionary use and perceptions regarding dictionaries. *The Korea TESOL Journal* **4**, 73–92.
- Knight S. (1994) Dictionary use while reading: the effects on comprehension and vocabulary acquisition for students of different verbal abilities. *The Modern Language Journal* **78**, 285–299.
- Korat O. & Shamir A. (2006) The educational electronic book as a tool for supporting children's emergent literacy in low versus middle SES groups. *Computers & Education* **50**, 110–124.
- Koren S. (1997) Quality versus convenience: comparison of modern, dictionaries from the researcher's, teacher's and learner's points of view. *TESL-EJ* **2**. Available online: <http://tesl-ej.org/ej07/a2.html> (last accessed 3 August 2009).
- Lan L. (2005) The growing prosperity of on-line dictionaries. *English Today* **21**, 16–21.
- Lin H. & Chen T. (2006) Decreasing cognitive load for novice EFL learners: Effects of question and descriptive advance organizers in facilitating EFL learners' comprehension of an animation-based content lesson. *System* **34**, 416–431.
- Liou H.-C. (2000) The electronic bilingual dictionary as a reading aid to efl learners: research findings and implications. *Computer Assisted Language Learning* **13**, 467–476.
- Liu S. S.-C. (2007) Electronic dictionaries and ESL students. In *Proceedings of International Conference on English Education*. Shih Chien University, Taipei. Available online: [http://www.usc.edu.tw/college/afl/data/%E5%8A%89%E6%B7%91%E7%85%A7%20\(Electronic%20Dictionaries%20And%20ESL%20Students\).pdf](http://www.usc.edu.tw/college/afl/data/%E5%8A%89%E6%B7%91%E7%85%A7%20(Electronic%20Dictionaries%20And%20ESL%20Students).pdf) (last accessed 3 August 2009).
- Lupescu S. & Day R. (1993) Reading dictionaries and vocabulary learning. *Language Learning* **43**, 263–287.
- McAlpine J. & Myles J. (2003) Capturing phraseology in an online dictionary for advanced users of English as a second language: a response to user needs. *System* **31**, 71–84.
- Murray L. & Barnes A. (1998) Beyond the 'wow' factor – Evaluating multimedia language learning software from a pedagogical viewpoint. *System* **26**, 249–259.
- Nesi H. & Hail R. (2002) A study of dictionary use by international students at a British university. *International Journal of Lexicography* **15**, 277–305.
- Ogata H. & Yano Y. (2004) Knowledge awareness for a computer-assisted language learning using handhelds. *International Journal of Continuing Engineering Education and Life Long Learning* **14**, 435–449.
- Park M.-R. (2006) EFL college students' perceptions toward the use of electronic dictionaries. *English Language & Literature Teaching* **12**, 29–54.
- Phillips L. (1990) Hanging on the Metaphone. *Computer Language* **7**, 39.
- Sandnes F.E. & Aubert A. (2007) Bimanual text entry using game controllers: relying on users' spatial familiarity with QWERTY. *Interacting with Computers* **19**, 140–150.
- Sandnes F.E., Huang Y.-P. & Jian H.-L. (2006) Experiences of teaching engineering students in Taiwan from a western perspective. *International Journal of Engineering Education* **22**, 1013–1022.
- Seip K., Cobelas M., Doledec S., Fang J., Smith V. & Vorontsova O. (2006) Preferences for environmental issues among environmentally-concerned citizens in six countries. *Environmental Conservation* **32**, 288–293.
- Sobkowiak W. (1994) Beyond the year 2000: phonetic-access dictionaries (with word-frequency information). *System* **22**, 509–523.
- Summers D. (1988) The role of dictionaries in language learning. In *Vocabulary and Language Teaching*, (eds R. Carter & M. McCarthy), pp. 111–125. Longman, New York.
- Tang G.M. (1997) Pocket electronic dictionaries for second language learning: help or hindrance? *TESL Canada Journal* **15**, 39–57.
- Tono Y. (2001) *Research on Dictionary Use in the Context of Foreign Language Learning: Focus on Reading Comprehension*. Tübingen, Germany: Max Niemeyer Verlag.
- Tsou W., Wang W. & Tzeng Y. (2006) Applying a multimedia storytelling website in foreign language learning. *Computers & Education* **47**, 17–28.
- Watkins D. (2000) Learning and teaching: a cross-cultural perspective. *School Leadership and Management* **20**, 161–173.
- Weschler R. & Pitts C. (2000) An experiment using electronic dictionaries with EFL Students. *The Internet TESL Journal* **6**. Available online: <http://iteslj.org/Articles/Weschler-ElectroDict.html> (last accessed 3 August 2009).
- Yonally D. & Gilfert S. (1995) Electronic dictionaries in the classroom!? Bah, humbug! *The Internet TESL Journal* **1**. Available online: <http://iteslj.org/Articles/Yonally-ElectroDict.html> (last accessed 3 August 2009).

Copyright of *Journal of Computer Assisted Learning* is the property of Blackwell Publishing Limited and its content may not be copied or emailed to multiple sites or posted to a listserv without the copyright holder's express written permission. However, users may print, download, or email articles for individual use.