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Clicking Behaviour with Computer Textual Glosses and Vocabulary Knowledge

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***Abstract*—Framed within the interaction approach (Mackey, 2012) in second language acquisition, this study investigates if learner-computer interactions can facilitate vocabulary development. Chapelle (2003) considers human-computer interactions as one form of interaction besides the well-documented conversational interaction and the interactions that take place inside the language learner's mind. Specifically, the study looks at students' interactions with a computer-aided textual gloss and if the use of such glosses are able to aid the students in their vocabulary development. The purpose of the study is to explore and describe how English as a second language learners use a computer-aided vocabulary gloss in an online reading text to develop their vocabulary knowledge. To track the vocabulary development of the students, tests measuring vocabulary knowledge were designed to evaluate the students' recognition and productive vocabulary knowledge. Using descriptive statistics together with ANOVA, and correlation measures to analyse data, it was revealed that there were no significant differences in the students' clicking behaviour and their proficiency levels. Furthermore, it was found out that with more clicks on the glosses, students were able to maintain their vocabulary knowledge after three weeks. The findings seem to auger well for using computer textual glosses for vocabulary development in a second language context.**

***Index Terms*—learner-computer interactions, vocabulary development, computer-aided textual gloss, recognition and productive vocabulary knowledge**

I. Introduction

There is wide acceptance that the interaction approach is facilitative for language learning. Mackey (2012) writes that "it is not currently claimed to be sufficient for second language learning but it provides a useful perspective on language learning" (p. 4). Presently, interaction is said to be facilitative for second language learning. The question that arises now is how interaction affects L2 learning. There has been substantial research on the interaction and learning (Hatch, 1978 & Long, 1983) which focused on face-to-face or conversational interactions. Apart from this kind of interactions, Ellis (1999) extended interaction to mean interactions that go on within the learners mind in dealing with language learning. With the current computer technology and its related area of computer assisted language learning (CALL), Chapelle (2003) has extended the realm of interaction to include human-computer interactions.

In human-computer interactions, a ubiquitous feature that most web-users are accustomed to when interacting with a computer is clicking. Therefore, a major factor in any online interface is the act of clicking of the mouse and in computer interaction literature this is commonly referred to as clicking behaviour. The act of clicking usually leads to further engagement with the icons, images or the links in the interface. Clicking in this study is defined as the clicking of the computer mouse to initiate interactions with a textual gloss. This is the similar definition given by Chapelle (2003, p.58). It indicates that the learner is aware that some form of modified input is available in this case, it is the glosses that form the modified input and the clicking denotes that the learners intend to obtain this input.

Nation and Meara (2002) comment that for first language vocabulary learning, a lot of input is derived from reading and listening. They continue that for this type of learning can also occur amongst non-native speakers though certain conditions need to be in place. The conditions are firstly, the unknown vocabulary has to be in small amounts; secondly, there is a lot of input and; thirdly, there is more deliberate attention to the unknown words (pp. 40-41). These conditions are set up in this study where a small number of unknown words are presented to the students, while the condition of deliberate attention is created when these words are glossed with their meanings in different type and language combinations. However, the condition for a large input cannot be met in this study because of research constraints.

Research has shown that the relationship between reading, comprehension and vocabulary is a complex and tangled one (Eskey, 2005). In other words, vocabulary load is seen as a strong indicator of text difficulty. Haynes and Baker (1993) concludes that the main reason that L2 learners find it difficult to comprehend text is because of their lack of

vocabulary and not because they lack reading comprehension strategies. This suggests that the threshold for reading comprehension is to a large extent, lexical. Second language learners not only differ in the amount of knowledge of and exposure to the target language but they are also affected by cross-language factors. Read (as cited in Yusuf, Sim & Awab, 2014) makes the observation that second language learners realize that their insufficient vocabulary impedes their communication in the target language as vocabulary carry the meaning of what they comprehend and wish to express in their communication. Hence, Read points out that vocabulary is a prime element of the language for students to learn as compared to other aspects of the language.

It is documented that vocabulary plays a critical role in reading and conversely reading also lends itself to vocabulary acquisition. Vocabulary knowledge is complex and wide. It has also been "… defined differently by different researchers" (Laufer & Goldstein, 2004, p. 400). According to Nation (2001), it involves knowing its form, meaning and use. Some researchers (Faerch, Haastrup, & Phillipson, 1984; Palmberg, 1987) have looked upon vocabulary knowledge as a continuum comprising several layers. To them, the first layer can be considered as superficial familiarity of the words. Knowing vocabulary in this study refers to *know* a word and its meaning at two levels – recognition and production. One of the most common distinction of vocabulary knowledge is recognition and productive knowledge (Schmitt, 2010, p. 80). Vocabulary knowledge can also be identified as recognition and productive knowledge. Recognition knowledge is sometimes termed as passive knowledge and it is used in listening and reading. Conversely, productive knowledge is also termed as active knowledge used for writing and speaking (Nation as cited Yusuf et al., 2014).

The current study focused attention on the aspect of form and meaning of words. Learning in this instance is in the form of meaning-focused input, where the input in the online reading text. It operationalised vocabulary knowledge development as the students' knowledge of the target words, as measured in specifically developed recognition and productive vocabulary knowledge tests.

II. Methodology

A. Procedure

The students were first stratified into low, medium and high proficiency level based on their English results of the SPM examinations. Next, they were randomized into the four different gloss conditions: Word Bahasa Melayu, Sentence Bahasa Melayu, Word English and Sentence English. The students were placed in a computer laboratory where they accessed the online text in which the unfamiliar words were glossed. After reading the text, the recognition and productive vocabulary knowledge tests were administered. After three weeks the students were given the same recognition and productive vocabulary knowledge tests in class

B. Participants

A total of 99 diploma students whose ages range from 18 to 19 years old from a Malaysian public university took part in this research. They were from 4 intact ESL classes in the university. They were initially stratified into three proficiency levels: low, mid and high based on their English results in a national examination, *Sijil Pelajaran Malaysia* (SPM). Next these students were randomised into 4 different gloss conditions: L1 word Bahasa Melayu (WBM), L2 word English (WEN), L1 sentence Bahasa Melayu (SBM) and L2 sentence English (SEN).

C. Materials

This study adapted a text titled "Scary Night" that was previously used by Yoshi (2006) in his study on glosses and vocabulary knowledge. In the text thirteen words which were deemed unfamiliar to the students were then glossed in both the students' L1, Bahasa Melayu and L2, English. The unfamiliarity of the words was judged by two instructors teaching English at the university. Then glosses were created at word and sentence levels, that is, the meaning of the words were given at word level and in context as in sentence definitions. The glosses and tracking were developed using Hypertext Pre-processor (PHP) and MYSQL tools.

To measure the effect of the interactions on vocabulary acquisition, vocabulary tests were designed and administered to the students. These tests measured the students' recognition and production vocabulary knowledge of the students at set intervals, namely, immediately after experiment and post experiment. The glosses (word and sentence/L1 and L2) were the independent variables in the study, while the outcome was measured by the students' vocabulary knowledge (recognition and production) test scores which formed the dependent variables. The other moderating variables are the students' proficiency and their language developmental levels.

Data for the study were collected at two levels. The first was data which was related to the interaction of the students of different proficiency levels with the glosses. It has to be declared here that the data for the clicking behaviour of students was used in a previous study "Students' proficiency and textual computer gloss use in facilitating vocabulary knowledge" published in *English Language Teaching*, Vo.7, No.11, 2014 by the same authors. In that study, clicking behaviour was related to proficiency levels to facilitate vocabulary knowledge. The focus of the previous study was the use of glosses in the teaching of vocabulary and the clicking behavior. In this current study, the data were used to provide a framework of clicking behaviour before deeper analysis of their interactions with specific type of glosses.

With a built-in tracking device in the online reading text, clicking behaviour of the students was documented. It contained information such as the type of gloss clicked and the language of the gloss. At another level, data were in the form of vocabulary test scores. Two tests were developed for the study. One was to measure the recognition vocabulary knowledge of the students. It was a multiple-choice question format with four options. The productive vocabulary knowledge was measured by a gap-filling test where students filled in the gaps of sentences with the correct words. The purpose of the tests was to show evidence of vocabulary acquisition from the interaction of the students with the glosses.

D. Research Questions

1. What is the clicking behaviour of the learners of different language proficiency levels in the different gloss conditions?
2. What is the relationship between the clicking behaviour of the students on the different types of vocabulary knowledge?
3. Is the vocabulary knowledge maintained after three weeks?

III. Results & Analysis

A. Number of Clicks and Proficiency Levels

A one-way analysis of Variance (ANOVA) was conducted to find out if there were differences between the total number of clicks in different proficiency levels. The dependent variable was the total number of clicks and the independent variable was the proficiency levels. Tuckey post-hoc multiple comparisons will be undertaken if significant results were obtained in order to determine the differences between the gloss conditions.

Checks for normality and homogeneity of variance of the dependent variable were carried out. There was no marked deviation from the two assumptions for the different proficiency levels. Table I depicts the mean and standard deviation of the number of clicks at different proficiency levels while Table II shows the ANOVA results.

TABLE I.
MEAN AND STANDARD DEVIATION FOR NUMBER OF CLICKS AND PROFICIENCY LEVEL.

	N	Mean	Std. Deviation	Std. Error
LOW	30	10.2333	7.01566	1.28088
MID	39	11.6923	6.32103	1.01218
HIGH	30	9.5667	5.27638	.96333
Total	99	10.6061	6.25613	.62876

The results show that the mid proficiency group had the most number of clicks (M=11.70, SD= 6.3)and high proficiency level had the least number of clicks(M=9.57, SD=5.28). Nonetheless, the differences are not statistically significant. The results are presented in Figure I.

Both ANOVA and post-hoc comparisons revealed that in low proficiency level there was no statistically significant difference between different proficiency levels in the number of clicks. F (2, 96) =1.0 56 P-value=0.352. Therefore this means that the clicking behavior of the students in the different proficiency levels is almost similar.

TABLE II.
ANOVA FOR CLICKS AT DIFFERENT PROFICIENCY LEVELS

	df	Mean Square	F	Sig.
Between Groups	2	41.298	1.056	.352
Within Groups	96	39.094		
Total	98			

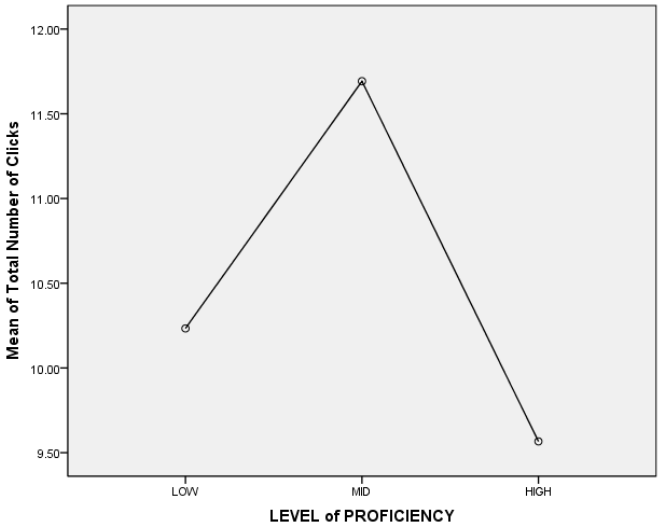

Figure I. Mean number of clicks and levels of proficiency

B. Effect of Gloss Conditions on Clicking Behavior

A one-way analysis of Variance (ANOVA) was carried out to find out if there were differences between total number of clicks in the 4 gloss conditions. Checks for normality and homogeneity of variance of the dependent variable were undertaken and revealed that the two assumptions were met for all proficiency levels. Table III shows the mean and standard deviation for all tests in four gloss conditions for total number of clicks. Figure III depicts the number of clicks and gloss conditions.

TABLE III.
MEAN AND STANDARD DEVIATION FOR THE NUMBER OF CLICKS IN EACH GLOSS CONDITION

	N	Mean	Std. Deviation
Word BM	22	13.4091	4.90538
S-BM	23	12.2609	7.05960
Word En	24	8.4583	5.80089
S-En	30	9.0000	5.97697
Total	99	10.6061	6.25613

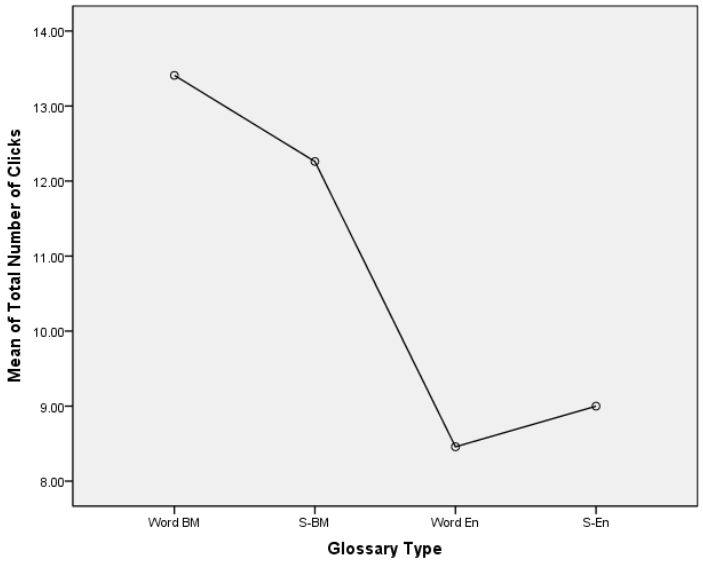

Figure II. The total number of clicks and gloss types

Figure II shows that students in the word-Bahasa Melayu gloss had clicked most on the glosses. This followed by the sentence-Bahasa Melayu gloss. The least clicked glosses were the word-English glosses.

TABLE IV.
ANOVA FOR NUMBER OF CLICKS AT FOUR GLOSS CONDITIONS

	df	Mean Square	F	Sig.
Between Groups	3	141.308	3.935	.011
Within Groups	95	35.913		
Total	98			

The results of one way ANOVA for the vocabulary knowledge test are presented in Table IV. The ANOVA test revealed that there was a statistically significant difference in the mean total click numbers of the four gloss conditions F (3, 26) =3.93, p=0.011.

The Tukey HSD post-hoc multiple comparisons (Table V) show a statistically significant difference in the following pairs:

Word–BM gloss (M=13.40, SD =4.90) and Sentence-English gloss (M= 9.00, SD = 5.97) with a mean difference (MD =4.4) and the p-value of 0.31

Word–BM gloss (M=13.40, SD =4.90) and Word-English gloss (M= 8.45, SD = 5.80) with a large mean difference (MD =4.95) and the p-value of 0.04

TABLE V.
TUKEY POST-HOC COMPARISONS RESULTS

	(I) Glossary Type	(J) Glossary Type	Mean Difference (I-J)	Std. Error	Sig.
Tukey HSD	Word BM	S-BM	1.14822	1.78713	.918
		Word -En	4.95076*	1.76883	.031
		S-En	4.40909*	1.68211	.049

C. Correlation between Number of Clicks and Recognition and Productive Vocabulary Knowledge Test Scores

In order to investigate the relationship between clicking behavior of students and their recognition and productive vocabulary knowledge test scores, Pearson Product-Moment Correlation Coefficient was used. Preliminary analyses were carried out and showed that the assumptions of normality and linearity were not compromised.

TABLE VI.
PEARSON'S CORRELATION COEFFICIENTS OF NUMBER OF CLICKS AND TYPE OF VOCABULARY KNOWLEDGE

		VOCABULARY PRODUCTION TEST 2	WORD RECOGNITION TEST2
Total Number of Clicks	Pearson Correlation	+0.260**	+0.302**
	P-value	.009	.002

As shown in Table VI, the highest linear relationship was found to exist between number of clicks and word recognition test 2 (delayed test) scores (r = .302, p < .001). The positive correlation coefficient of 0.302 indicates that the score for word recognition test increases by increasing the number of clicks. In addition, there existed a weak positive correlation between word production test scores and number of clicks (r = .260, p = 0.009).

As a result, it would seem logical to say that the scores of different tests are more likely to increase when the number of clicks increases. This seems to suggest that the more clicks that the students make, the likelihood of them enhancing their vocabulary knowledge increases.

In other words, the more interactions the students make with the textual glosses, the more they gain on vocabulary knowledge. It also appeared that the interactions with the glosses can be maintained over time, in the case of this study, it was within three weeks. This is because the delayed vocabulary tests were conducted three weeks after the experiment with the glosses.

IV. DISCUSSION & CONCLUSIONS

From the aspect of proficiency level, there were no significant differences clicking behaviour and students' proficiency levels. Closer inspection of the data however revealed that the high proficiency learners clicked the least on the target words, while mid proficiency learners clicked the most. The low proficiency learners were moderate in their clicking behaviour.

In the literature of computer clicking, Murphy (1999) categorises web-users as "surfers" and "searchers". He defines the "surfer" as one who clicks from link to link mainly for amusement and it can be inferred that a "surfer" is one who clicks without any direction or purpose. On the other hand, there is the "searcher" who is focused in seeking specific information. What this means is that a "searcher's" clicking behaviour is purposeful.

Both these traits were possibly manifested in the study where mid proficiency students had the tendency for "surfer" clicking behaviour, while high proficiency students displayed more purposeful clicking behaviour.

What can be seen from the clicking behaviour of the learners in this study seems similar to clicking behaviour in other studies. For instance, Hulstijn, Hollander and Greidanus (1996) observed that advanced L2 learners when reading for comprehension did not interrupt their reading process by looking-up unknown words. They presumed that the concern of such readers were for comprehension and did not use their time and mental effort to look-up the meaning of

unknown words. Again the same phenomenon was seen in a study by Hulstijn, (1993) who found that learners with greater vocabulary knowledge generally looked-up fewer words than learners who had less vocabulary knowledge. The same situation probably existed in this study. The learners with higher proficiency level clicked less on the target words as compared to the low and mid proficiency level learners. If this kind of logic rules, then it would make sense that low proficiency learners would have clicked on more words if compared to the higher levels.

In this study, however, an anomaly seems to have occurred where the mid proficiency learners had clicked the most. What could have occurred with this group of learners is what Robb (1999, p. 98) terms as "click happy behaviour". The mid proficiency students in this study may have displayed surfers' characteristics as described by Murphy, (1999). Therefore, the learners of mid proficiency level clicked on the words more compared to the other learners given the ease and convenience of looking-up the target words. The words were clicked as the students were aware of them and the glosses attended to. After clicking the glossed words, the students may have processed the words, thus making the form-meaning link (Van Patten, 2012). What has probably transpired was that the targeted words were clicked by these students because the words were made visually salient. Hence, saliency which was created by highlighting the words in the text may have triggered the students to click on them. This may have resulted in students being able to develop their vocabulary knowledge.

The data on the clicking behaviour of the learners in the study suggest that clicking behaviour did not vary much between the different gloss conditions and proficiency levels. However, from closer inspection of the data, it was observed that learners in the word BM gloss condition had clicked most on the target words, followed by the learners in the sentence BM gloss condition. The lowest number of clicks was made by learners in the word English gloss condition. Therefore, this would suggest that word BM can be considered useful for the students. Next, it was also seen that sentence BM gloss was clicked on frequently. Thus, this suggests that Bahasa Melayu or the students' L1 appear to be mostly likely preferred type of language of the gloss for these students. At the other end of the scale, it was seen that students in the word English condition had clicked the least. What can be speculated here is that the students probably felt that such glosses may not be of much use to them; hence they clicked the least on such glosses.

The data also showed that vocabulary knowledge was able to be maintained three weeks after the interactions of the glosses. In particular, it was seen that recognition vocabulary knowledge was better maintained when compared to productive vocabulary knowledge. This may mean that computer textual gloss may benefit students in retaining vocabulary knowledge. The researchers are however cautiously optimistic of this pattern as a period of three weeks is not a long period of time. In future studies, the delayed vocabulary tests should be held after a longer period of three weeks before claims of robust vocabulary retention can be made.

In relation to maintaining vocabulary knowledge what has been found out was dissimilar to what has been reported in Watanabe's (1997) research where it showed that words which have been previously learnt would fade away if there was no reviewing process. Schmitt (2010) also made a similar claim where vocabulary attrition is a common occurrence in learning, more so for vocabulary. Hence, it did seem that this situation may not have been played out in this present study. The students' vocabulary knowledge was retained after three weeks of the gloss use. What could have transpired in this study is that the more clicks made on the glosses, there was the possibility that vocabulary knowledge can be sustained. Therefore, this researcher concurs with Pimsleur (1967) and Cheng and Good's (2009) view that new vocabulary items have to be reinforced by frequent reviews after they have been presented in order for the items to be retained over time.

The discussion next is on the implications of the study to pedagogy. It appears that textual type of computer glosses as used in this study can promote vocabulary learning in the short term (Yusuf et al., 2014). Perhaps, for more long-term learning and retention, direct vocabulary teaching may have to be carried out even though Parry (as cited in Yusuf et al., 2014) believes that direct vocabulary teaching for low frequency words is a time-consuming task. Therefore, it would seem that textual glosses and direct teaching may aid students more efficiently in the vocabulary learning process.

From the perspective of gloss conditions, the results from this study indicated that students maintained their recognition vocabulary better in the word-Bahasa Melayu gloss condition compared to other gloss conditions. From the research, albeit cautiously, the researchers sum up that interactions with glosses in word and sentence level in Bahasa Melayu or learners' L1 may benefit the learners' vocabulary knowledge. Nonetheless, for stronger long–term vocabulary gains more vocabulary learning tasks have to be created to induce the elements of noticing, interaction and processing. These are required to maintain and develop the initial vocabulary knowledge gained (Yusuf et al., 2014).

Picking up the point of look-up behaviour, the researchers suggest that when dealing with CALL, teachers should also guide students on their look-up behaviour. For instance, teachers should encourage students to develop more "searcher" kind of look-up behaviour instead of "click-happy" or "surfer" kind of look-up. It would be useful for teachers to inculcate a more "searcher" type of look-up behaviour when dealing when computer aids such as glosses. Although, the study did not show any significant difference between clicking behaviour and proficiency levels, closer observation of the results do suggest that there may be an inherent pattern linking these two variables of look-up behaviour and proficiency.

Pedagogically, it is also proposed that if computer textual-glossing in an online reading context is used to teach vocabulary, it is best for teachers to be explicit in their instructions whether the lesson is for reading comprehension or

vocabulary learning. This would in a way direct the students for the learning activity ahead and their attention can be channeled appropriately – either reading for meaning or form.

Finally, this study has shown that students of different proficiency levels did not differ significantly in their clicking behaviour. It was also documented that vocabulary knowledge may be related to clicking behaviour; more clicks allowed for retention of recognition vocabulary knowledge followed by productive vocabulary knowledge. This may mean that computer textual glosses in Bahasa Melayu and English can be utilized to develop students' vocabulary knowledge.

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