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ACTIVITY THEORY AND COMPUTER-ASSISTED LEARNING OF ENGLISH VOCABULARY[1]

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Abstract

This paper describes a study that brings together activity theory, computer-assisted language learning, individual differences and classroom vocabulary learning. The context the research is a quantitative study of student on-line reading, word look-ups, and learning outcomes. During this research, the goals of the researchers and the goals of the students in the use of the tool did not fully coincide. A qualitative study explored these differences using class observation, questionnaires, and interview data. Participants included several first language backgrounds, including many Arabic-speaking and Korean-speaking learners. Students' goals and operations divided into two main groups. Some students prefer to read, look-up words using the tool and take notes, while others prefer to consult their teachers while using the tool and take fewer notes. The students' sociocultural background and attitudes to learning affected their use of the tool, but had only marginal effects on immediate vocabulary learning. However, a trend for better learning emerged for those students who looked up many target words as well as non-target words. Implications for teachers and programmers are that students transform the tool due to their short-term goals and not always the long-term objectives that they and their teachers may appear to share.

Key words: activity theory, CALL, vocabulary, learning strategies, robust learning

1.0 INTRODUCTION

This paper brings together activity theory (Leont'ev, 1978, 1981; Lantolf & Appel, 1994), vocabulary acquisition research (Coxhead, 2001; Cobb, 2006; Nation, 2001), individual differences in the use of computer-assisted language learning (CALL) in classroom vocabulary learning. The context is an intensive English program in the USA where studies are being carried out into robust learning (Koedinger & Van Lehn, submitted) within a larger Science of Learning Center (http://www.learnlab.org). The goals of robust learning theory are to discover learning and teaching activities *in vivo* that result in learning which leads to long-term retention, transfer to other contexts, and accelerated future learning in closely related domains.

The CALL reading program is part of set of implicit/explicit vocabulary learning experiments using automatically web-generated texts from an open source of more than 10 million documents REAP (Reader Specific Practice; Brown and Eskenazi, 2004; Collins-Thompson and Callan, 2004). The goal of the research is to investigate the help-seeking behavior of students using an on-line tool and relate this behavior to the learning outcomes for a specific set of academic vocabulary items (Juffs, et al., 2006; Heilman Juffs, & Eskenazi, 2007). In order to investigate whether the intent of the researchers for the use of the tool and the goals of the students for using the tool coincide, a qualitative study of student behavior and attitudes was undertaken in addition to the experimental quantitative study. Activity theory is an appropriate theoretical framework for this research. The paper first introduces activity theory in L2 research and computer-based research. We then describe data collection procedures and explore the behavior of the students in relation to the learning outcomes. We conclude by making some recommendations.

1.1 Activity theory

Sociocultural theory and activity theory constitute an important part of applied linguists' understanding of how students behave in classrooms and engage in language learning tasks (Coughlan and Duff, 1994; Donato & McCormick, 1994; Lantolf & Appel, 1994; Lantolf & Thorne, 2006, Storch, 2004). Activity theory permits the researcher to take a context and analyze it from the point of view of the whole interaction of the learner (subject/agent), the object (goal/objective), and the behavior that gives the learner a specific direction. Crucially, activity theory links the concepts of setting, which is defined as "the sociocultural interpretation or creation that is imposed on the context by participants," (Lantolf and Appel, 1994:17) with motive because, as Lantolf and Appel point out, activity cannot exist without motive. In the context of vocabulary acquisition and learning strategies, Donato and McCormick (1994: 455) note that language-learning *strategies* must be viewed in relation to the objectives and goals that the students have. These goals are part of their own motivation, and not necessarily those of the task assigned by the researcher or the teacher:

> An example of such strategic learning would include guessing words in context simply to save time in completing a reading assignment, rather than to increase second language reading proficiency. This action is strategic only in the sense that it fulfills a goal; whether the goal is genuinely directed at learning or aimed at avoiding engagement in the learning process is rarely considered in discussions of strategy use.

We shall see in the use of the on-line tutor that Donato and McCormick's (1994) theoretical observation on student goals and motives is particularly relevant.

It is also legitimate to focus on how the students transformed the tool as part of our learning experiments and we take it as a given that the quantitative results cannot be interpreted properly without an understanding of the participants' conception of the

activity. The basis of this approach derives from Vygotsky's own approach to experimentation and his concept of how an experiment itself changed behavior; Gillen (2000: 190)[2] notes that in Vygotsky's work:

> … investigations are pursued always with careful consideration of the effect of the experiment itself on the subject. The experiment itself is often the site for a learning activity – a site of development in microcosm – and *the process by which the child sets about the task is the focus of study rather than a measure of achievement for example* … (my italics – AJ)

We agree with Donato (2000: 44), who reminds us that 'classroom language learning tasks are thus best seen as uniquely situated, emergent interactions based on participants' goals and sub goals and not merely task objectives and invariant task procedures'.

Applied linguists are of course not alone in bringing activity theory into the study of learning. Indeed, researchers who focus on computer-based cognitive tutors, of which the REAP system is an example, have also noted that activity theory is important in understanding computer use (Bannon, 1992; 1997; Kuutti, 1996). Bannon (1992, 1997) makes it clear that activity theory helps us to see students as individuals and not as 'a collection of attributes of cognitive processors'. Moreover, studies of a wide range of cognitive tutors have focused on how students 'game' the system when using such tutors, thus revealing that the goals of software/tutor designers do not coincide with end-users (Koedinger and Aleven, submitted).

In this paper, we apply activity theory in the following way, illustrated in Table 1 adapted from Kuutti (1996: 33).

Table 1. Activity theory and tool use in REAP

Activity theory construct	Application to this study
Activity: Motive (need + object)	Need: Pass the TOEFL Communicate with native speakers
↑ ↓ Action - Goal	Object: learn English Use the tool to improve English Understand the texts
↓ ↑ Condition - Operations	Finish the task as soon as possible Specific event in using the tool: click to look up a word, read, ask the teacher questions.

Table 1 shows that an activity consists of a motive, which is defined as a need plus object. ('Object' in this sense is understood as 'objective'.) In this study, the students' need is to pass TOEFL, or get a job in the US, or talk to native speakers. The object is to learn English. Actions that are required for this need and object are using the tool, understanding the texts, or possibly finishing the task as soon as possible (as Donato and McCormick (1994) point out). Finally, operations include the specific micro-events using the tool – clicking on hyperlinks, looking up non target words, reading, asking the teacher questions. Naturally, interaction between the higher order organizing concepts of an activity can interact with those on a lower level. The arrows in Table 1 express this interaction.

Before moving on to our study, we note that recent research into the use of on-line tools to assist learning vocabulary has established some interesting main trends (e.g., Groot, 2000, Nicolova, 2004). First, it is important for the students to *interact* with the materials on-line, either through a workbook (Zapata and Sagarra, 2007) or with some interlocutor

(Smith, 2004). Second, simple highlighting of items helps only some learners – hence drawing attention is not as effective as actually doing something with the words (*pace*, Folse, 2006). Finally, the computer-based activities appear to lead to longer-lasting gains (Zapata & Sagarra, 2007). The reason for this advantage may be is that learners are able to get immediate feedback as they read and answer questions. This activity could lead to deeper processing which is held to lead to longer-term learning outcomes in general (Craik and Lockhardt, 1972) and also specifically for vocabulary learning (Hulstijn and Laufer, 2001). We shall return to this notion of depth of interaction with the tool later in the paper.

1.2 The context of the study

The English Language Institute at the University of Pittsburgh is an intensive English program (IEP) that seeks to prepare students for academic programs taught in English. Thus, one objective of the reading curriculum is mastery of a subset of the academic word list (AWL) (Coxhead, 2000; Nation, 2001). Since the summer of 2005, the reading classes have been using an on-line tutoring system that is designed to help students learn the AWL. The system that the Institute uses a search engine and on-line tutor that finds text passages satisfying very specific lexical constraints (Brown & Eskenazi, 2004; Collins-Thompson & Callan, 2004) <http://reap.cs.cmu.edu/>. The database contains 50,000 documents (after filtering from 10 million). Each document contains about 1000 words. Total words in the database number 50,000,000. (For comparison, the Cambridge and Nottingham Spoken corpus has 5,000,000 words (McCarthy, 2006)).

The on-line system, which finds and selects texts to present to students, hopes to possess a variety of advantages over traditional texts. First, it selects materials from an open-corpus (the Web), thus satisfying a wide range of student interests and classroom needs; second, it has the ability to model an individual's degree of acquisition and fluency for

each word in a constantly-expanding lexicon so as to provide student-specific practice and remediation. Finally, the goal of the tutor is to present the AWL words that the students need to learn in a meaningful context, to create a deeper processing of the new words through understanding the meaning in context.

The development of the instruction was that ELI teachers and researchers first developed a pre-test based on AWL words. Based on each individual's scores on this test, a personal target word list is produced automatically by REAP for each student and stored by the on-line system. The computer software uses that personal list to select texts that contain the words that each particular student needs to learn. Then, the students read texts on line that each contain 2-5 AWL words from their own list. The texts appear in a web interface that shows the student the text with the words highlighted and linked by hypertext to a dictionary definition in English. During reading, the computer tracks all the 'target words' that the student looks up. The students may also click on words that are not on their personal AWL and obtain dictionary definitions for those words if they want to understand the text better; alternatively, they can type the word into a box in the bottom left hand corner of the screen.

The systems records automatically for each student the words that he or she looks up, those words that are 'clicked', and the time spent on each word and text. Immediately after completing a text, students are quizzed on the meaning of their target AWL words using multiple-choice items. Finally, students receive an automatically generated 'question' that checks whether they actually read the text. In some cases, this 'question' is a multiple-choice question that requires the student to choose which one out of four sentences actually occurred in the text. Another method is to present the student with four lists of words that are unrelated. Only one list of words appeared in the text that the students were reading.

The researchers' and teachers' intent is that the students focus mainly on the highlighted words that appear in the texts. However, as Coughlan and Duff (1994: 175) point out, a teacher-assigned task is not the same as an activity: 'An activity … is the process, as well as the outcome, of a task, examined in its sociocultural context'. Observations of student behavior and differences in data collected by the system alerted us that students were using the tool in individual ways. Some students were speeding through texts, others were taking a lot of time on one single text. Some students looked up many words, others did not. Teachers reported that some students asked questions while they used the tool, but others ignored the teacher during the computer laboratory session. We began a pilot study in the spring and summer of 2006 that identified differences among different student groups in the use of the tutor (Pelletreau, 2006). This paper reports on a more in-depth study of student attitudes and behavior in the spring of 2007.

2.0 THE STUDY

2.1 Method

In order to understand the activity of using the REAP tool in its classroom context we developed a set of measures to investigate how the students in Reading 4 (intermediate students who might have a TOEFL score of 450 paper-based, 133, CBT or 45 on the iBT) used the tool. We wanted to investigate the sources of the students' attitudes to reading, how well they learned the vocabulary on their personalized word list, as well as their choices in clicking on highlighted words from the AWL and non-focus words. The data were collected using the following instruments and techniques.

1. Student surveys on vocabulary learning, reading, and language learning goals.

The informal survey questionnaire contained a section with open questions on student goals in learning, attitudes to learning and attitudes to the US. There was also a Likert scale questionnaire section that included statements that they could disagree and

agree with. The statements concerned their attitude to learning vocabulary and reading, as well as statements about their behavior when they encounter unknown words, both while they were using the online reading tool and in general when they were reading.

2. Class observations.

Students were observed in their regular reading classes and in the laboratory sessions using the on-line tutor. The observation instrument was an adapted form of the Communicative Observation of Language Teaching (COLT) (Spada and Fröhlich, 1995). Students were observed 7 times while using the tool and 6 times in their regular reading classes.

3. Student interviews about the tool.

Students were invited to attend 2-3 person discussion sessions about learning vocabulary using the tool and in their regular classes. The interview was guided by a series of open ended questions about the tool. We invited 2-3 students at a time so that they could react to each other. The interviews were recorded and transcribed. There were five focus group discussions in total that included 11 students.

4. Teacher interviews about the students' study habits and goals.

The teachers were invited to a session to discuss their views of the tool and how they believed the students were using the tool. This interview was not recorded but notes were taken on the views expressed by the teachers.

5. REAP Data of computer use and learning outcomes.

REAP system were analyzed. These data include: number of texts read, number of target and non-target words looked up, percent correct on post-reading vocabulary quizzes, percent correct on post-reading 'reading' check.

2.2 Participants

The participants in the classes included 38 students from a variety of language backgrounds. Students were divided into three classes, each with a different teacher. The students consisted of two large groups of Arabic-speaking and Korean-speaking groups. In this paper, we often refer to 'Asian' students as a group, who include the Korean-speaking, Japanese-speaking, Chinese-speaking students from Taiwan and from the People's Republic of China. While one may object to this conflation of Asian learners into one group, they do seem to share several characteristics and so for convenience we refer to them as a group. However, we do recognize that there may be subtle and important differences among these learners. Finally, three teachers were observed both in regular reading classes and when the students were in the Media Center using the tool. The teachers were also interviewed about their opinions of how the students were using the tool and about the tool itself.

3. RESULTS

Data were collected throughout the spring 2007 semester. This section begins with the survey results, and is followed by the interview comments, the teacher comments and an brief discussion of the quantitative data (texts read, words looked up). Then, the next section includes a discussion of the data obtained from the student and teacher interviews and the classroom observations. Finally, we conclude by looking at the learning outcome data.

3.1 Survey results

Twenty-eight of the thirty-eight students who enrolled in the reading classes returned surveys. First, we present results from the questions that required a free written response.

Abbreviated responses to the questions are listed in Appendix I.

3.1.1 Written answers to the question: what are your goals in learning English?

As can be observed from the responses in Appendix I, the goals of the Arabic-speaking students are mainly to study in college or to pass the TOEFL. Five students asserted that they want to study in the US, and others specifically mentioned the TOEFL exam. In contrast, most of the Asian students' goals are more integrative (life-oriented), with 11 out of 16 stating that they want to live in the US or communicate with native speakers or get a job in the US, but only 3 stating a goal that is test or college oriented.

3.1.2 Answer to the questions: What is the best way to learn new words? What is the worst way to learn words?

It is clear from the students' answers that four out of five Arabic-speaking students favor oral interaction for learning new words; they *never* mention *reading* as the best way. In contrast, eleven Asian students mention *reading* or writing as a good way to learn vocabulary, but only 6 mention speaking/oral skills. Overall, the Asian students mention study techniques that they use that involve text (reading and writing, using dictionaries) rather than oral skills (e.g. listening and speaking). In contrast, several Arabic-speaking students mention reading as the *worst* way to learn new words; three Asians do, but usually when it is reading alone, and not with practice in other ways, such as writing down word lists and memorizing. In contrast, the Arabic-speaking students single out memorization and 'just reading' as bad ways to learn words.

The generalization one can take from these comments is that, on the whole, the Arabic-speaking students are more academically oriented in their goals, but less text-oriented in

their study methods than the Asian students. Thus, for the Arabic speaking students, the REAP tool sets up a conflict between the object (pass the TOEFL, get into college) and the actions and goals valued to achieve that object (talk to native speakers, take part in the community). The reverse is true for the Asian students. Hence the Arabic-speakers and the Asian students seem literally at cross-purposes in their object and actions.

3.1.3 Survey Questions using Likert Scale responses

The survey questions that asked students to agree or disagree with statements on a scale of 'strongly disagree' to 'strongly agree', with 'neither agree nor disagree' being the mid point. The choice 'Strongly Disagree' was assigned a score of 1 with 'Strongly Agree' being assigned a score of 5. The Likert scale survey statements were designed to obtain similar information to the open-ended response questions. As tables 2-3 show, Arabic speakers and Asian students think that vocabulary is important for reading, but neither group is convinced that most vocabulary is *learned* through reading.

Table 2. Question: vocabulary relates to reading

Native Language	Mean	SD	N
Arabic	4.00	0.76	8
Korean	4.18	1.40	11
Chinese	4.00	0.82	4
Spanish	4.50	0.71	2
Japanese	2.50	2.12	2
Turkish	2.00	.	1
Total	3.93	1.22	28

Table 3. Question: most vocabulary is learned through reading

Native Language	Mean	SD	N
Arabic	3.50	1.07	8
Korean	3.55	0.69	11
Chinese	3.75	0.50	4
Spanish	3.50	0.71	2
Japanese	2.00	1.41	2
Total	3.44	0.89	27

A disconnect exists between the written comments and the Likert scale comments. Although the Arabic speaking students do not mention reading as a way to learn, if they are asked, they do agree that reading helps learning vocabulary. This difference will be explored further in the discussion. [Note: our two Japanese-speaking learners seem especially negative about the reading and vocabulary link. However, they rate all questions low, so their data may be unreliable.]

Tables 4-6 show how students believe they handle words during reading. Neither group really believes that every word has to be understood, since they average around 2 – disagreeing that every word has to be understood. However, as we shall see in the behavior data, the Asian students look up many more non-target words. The Arabic-speaking students are just as likely as the Korean and Chinese-speaking students to agree that the dictionary must be used, but Table 6 shows that Arabic-speaking students are slightly less inclined to think that memorizing is important.

Table 4. Statement: Every word must be understood during reading

Native Language	Mean	SD	N
Arabic	2.14	0.90	7
Korean	2.73	1.27	11
Chinese	2.00	0.00	4
Spanish	1.50	0.71	2
Japanese	1.50	0.71	2
Total	2.27	1.04	26

Table 5. Statement: A Dictionary must be used during reading

Native Language	Mean	SD	N
Arabic	3.71	1.38	7
Korean	3.27	0.91	11
Chinese	3.50	0.56	4
Spanish	4.00	0.00	2
Japanese	2.00	1.41	2
Total	3.38	1.06	26

Table 6. Statement: Memorizing lists is important

Native Language	Mean	SD	N
Arabic	3.29	0.95	7
Korean	3.91	0.54	11
Chinese	4.00	0.00	4
Spanish	2.00	0.00	2
Japanese	2.00	1.41	2
Total	3.46	0.95	26

Tables 7 and 8 report on the use of context and synonyms and show the Arabic-speaking students are more inclined to agree that they use those strategies of focus on context and thinking of an appropriate synonym to understand new words. In other words, the syntagmatic axis is very important for the Arabic-speaking students, more so than the Korean, Chinese and Japanese-speaking students. The Arabic speakers are more aware that an unknown word may be understood or clarified if they continue reading, rather than halting and checking word meanings in a dictionary.

Table 7. Statement: I focus on context for unknown words

Native Language	Mean	SD	N
Arabic	4.43	0.54	7
Korean	3.73	1.01	11
Chinese	4.00	0.0	4
Spanish	4.50	0.71	2
Japanese	2.50	2.12	2
Total	3.92	0.97	26

Table 8. Statement: I look for a synonym or definition for unknown words in the text

Native Language	Mean	SD	N
Arabic	4.29	0.49	7
Korean	3.36	0.92	11
Chinese	3.75	0.50	4
Spanish	3.00	1.41	2
Japanese	3.00	1.41	2
Total	3.62	0.90	26

3.2 How the students actually used the REAP on-line tool

Recall that the students receive texts that contain highlighted AWL words that are

on their *personal* list of words that they need to learn. In addition, the students can click on *any* other words that are not highlighted in order to understand the passage better or just to check that they understand the word. The numbers of words looked up in REAP relates to the beliefs of the students expressed in the survey. Tables 9 and 10 show that Arabic-speaking students look up fewer non-target words when compared to the Koreans (71.69 vs. 122.64). For the target words, the Arabic-speaking students look up more on the whole (66.15 vs. 50.92) than the Koreans.

Table 9. Non-target look-ups by language.
(Words not on personalized AWL list, not highlighted in the text)

Native Language	Mean	SD	N
Arabic	71.69	55.72	13
Korean	122.64	62.08	14
Chinese	82.50	65.81	6
Spanish	71.00	72.13	2
Japanese	108.50	34.65	2
Turkish	105.00	.	1
Total	94.95	60.57	38

Table 10. Target look-ups by language.
(Words on personalized AWL list, not highlighted in the text)

Native Language	Mean	SD	N
Arabic	66.15	32.80	13
Korean	50.93	25.13	14
Chinese	51.00	23.83	6
Spanish	14.50	7.78	2
Japanese	84.50	3.54	2
Turkish	96.00	.	1
Total	57.18	29.64	38

Excluding all students except the Arabic-speakers and the Korean-speakers, a 2x2 repeated measures ANOVA showed a main effect for Word Type (Non-Target/Target) ($F(1,25) = 12.07$, $p \leq .01$) and a reliable interaction of L1 and Word Type ($F(1,25) = 9.18$,

$p \leq .01$). In other words, the different pattern of the Korean students and the Arabic speaking seems not to be by chance alone.

The number of unique target words actually seen by the students shows that on average the Arabic-speaking students saw slightly more on average (5), although this is not a reliable difference given the large variance for both groups.

Table 11. Target Words Seen

Native Language	Mean	SD	N
Arabic	49.15	21.56	13
Korean	44.64	18.27	14

The program checks the knowledge of the target words immediately after the students have finish reading a text. The Arabic-speaking students and the Korean speaking students performed equally well on these tasks, scoring around 62% and 64% respectively. Finally, where the reading check questions are concerned (student select the list of words that actually occurred in the passage), the Koreans outdid the Arabic speaking students 72% to 54%, but this difference was not statistically reliable ($F(1, 25) = 2.80$, $p= .10$. We might assume, however, that the Korean students were paying more attention to the meaning of the texts overall than the Arabic-speaking students. The on-line reading seems not to be valuable by the Arabic-speaking students and they therefore do not take the task as seriously.

Given the goals of the students from Arabic-speaking countries and Asian countries, one might expect the Arabic-speaking students to focus on text skills, whereas the Asian students might focus on interaction skills in their classes. However, it is well-known in the ESL community, and it is also the experience in the Institute among the

teachers and administrative faculty, that the stated 'official' goals and the study behavior of the students do not seem to coincide (Cobb, 2006). In fact, Arabic-speaking students tend to be more fluent in listening and speaking, whereas the strengths of the Asian students tend to be in grammar, vocabulary and reading.

3.3 Student interview data

The students were also interviewed about their attitudes to the reading classes as a follow-up to the survey data. The students' comments focus on three themes which were the result of open-ended discussion questions: the difference between the on-line tool and classroom vocabulary learning, dictionary use, and their goals.

3.3.1Attitudes to the teacher-led classes versus the computer classes

First, we describe the most common approach that teachers had to vocabulary instruction. In almost all of the observed classes, the teachers used pair/group activities to promote vocabulary acquisition. A common task was to place students in pairs and have them search for vocabulary words in a text and write definitions for them. The teachers assigned texts from the reading class textbook, from the English Language Institute's newspaper, and from outside sources that students brought into the class. The majority of the vocabulary that was taught in the classroom came from the textbook.

Students frequently worked together in pairs or groups to come up with definitions and sentences for the vocabulary words. They used the Longman Dictionary of American English, which was a required textbook, to find definitions. In other cases, the group members worked together in their pairs and groups and tried to come up with the definition without using a dictionary. After the groups had finished, teachers asked students to read the definitions out loud in the class. The teachers wrote the words on the blackboard and elicited definitions from students. In one class, students were asked to

locate the words that that teacher had written on the board within a weekly newsletter. After locating the words, students were asked to write definitions for the words. The teacher answered any questions that the students had.

In all of the reading classes, the teachers used the blackboard to help reinforce the form of the vocabulary words. For this type of activity, the teacher had already written the vocabulary word on the board before the students arrived in the classroom. After giving the students time to find the definition, the teacher elicited not only the definition of the word, but also the grammatical class (noun, verb, adjective). The grammatical class that was written on the board corresponded to the usage in the paragraph that the students read in the class.

The interviewer simply asked if the students thought they saw more words in 50 minutes in the classroom or in 50 minutes in the lab. However, this was not how most of the students interpreted the question. Students thought that the classroom was a more *effective* place to learn new vocabulary words. Almost all of the students, regardless of first language background, reported that they *learned* more words when they were in the classroom in spite of the fact that they actually *saw* more new words in the laboratory. For them, seeing new words was not nearly as important as learning new words, and they made it known that they actually learned more words in the classroom because of the teacher's support. The following quotes are taken from the student interviews.

> Korean: I can see more in 50 minutes in the lab. But the point is, should I remember them. I should remember the words. But, if the teacher says some new words, I can first recognize the word, and I learn the definition, and I using the word. By using the word, I learn that word. But in the lab, I can see 1000 words, but that does not mean that I understand that word.

Arabic: I think in the lab. I don't have to know all the words, but... eh... here in class, the teacher chooses the important words. But, in the lab, maybe I loose my time or waste my time with words that are not important or not necessary to understand the topic.

Japanese: I think I see more words in 50 minutes with the online reading system, but I can't remember... Class is meaningful.

Arabic: I disagree. Before I said the teacher, uh... the teacher help me so I don't understand the words or question, so it is more helpful, so when I saw the teacher, the face, I can more understand. So it is useful the 50 minutes in my class.

Korean: I think I see more than class because just we reading article, reading the article in lab. But, in the class, we discussing some question or discussing some about article. So I see word more than in the lab.

In general, when students were asked how the on-line reading system compared with the lessons in their regular classrooms, the students responded that they enjoyed the classroom vocabulary lessons more than learning vocabulary from the REAP sessions. Students explained that they enjoyed the classroom because they could be engaged in the classroom through interactions with their teachers and their peers. In contrast, students did not like the REAP program because it lacked a 'human' element and did not engage students in the same way as in the classroom. The students also reported that they got discouraged when using the program because they encountered large numbers of words that they did not know and the documents were not interesting to them.

Chinese Student:

> I prefer to learn by a real person. She'll say with the more commonly used words. In the lab, the words are not commonly used English words, because that's written English not spoken English. I don't need to read about disease of the heart or chemistry term. I don't need to learn this words because I'm not going to using in the common life. It's a little bit difficult to remember these word. It's not intellectual. It's better to learn with a real person.

Arabic Student:

> A: I think in the lab it's more serious and in the class it's kind of fun. And the teacher gives us examples from our lives... simple examples... and sometimes students give examples.

It is important to note here that the Arabic-speaking students on the whole are academically oriented, and some of the Chinese students are as well. Once again, within the framework of activity theory, the tool (the on-line system) transforms their *actions* to the point where they are not compatible with their *objectives* (learn English to pass the TOEFL). They have an 'ideal' goal of studying an academic subject in English, but this object does not come through in their goals and operations because they do not realize that they have to go beyond 'everyday words' to the more high register academic words. The setting, in Lantolf and Appel's (1994) terms is therefore transformed by these students despite their formal objectives in learning English.

Another element that made the program 'impractical' for students was the lack of a pronunciation component. One of the goals that students have for learning new words is the goal of using the new words to interact with native speakers more effectively. Even within a class that focused primarily on reading, the students still thought that learning the correct pronunciation of a word was a very important goal. This is one case in which

the capabilities of the REAP program were not in line with the goals of the students. This deficiency may have influenced the students' motivation towards the task since learning vocabulary without the pronunciation was a secondary goal.

> [Asian] That was disadvantage. If you had some systems that you could give pronunciation… it would help to make the system better.
>
> [Arabic] I didn't think about that. I didn't know that was not there. In reading, we don't need the pronunciation, but in conversation, we do need it. So someone might need the pronunciation in the dictionary.
>
> Arabic: I have example here... a word that we talked today... parameter. I pronounced the first time –paraméter. I think it's something related to meters or long distance, so its parámeter, its big difference. I have a lot of different pronounce... poverty. But when I pronounced for the first time...powverty (wrong pronunciation).

The students' responses were not entirely unfavorable towards the program. One student mentioned that he liked the program because he could learn on his own, without disrupting the class with questions. Additionally, students thought that REAP would help prepare them for the TOEFL exam. One student said, "The advantages is it looks like the ...um... TOEFL, reading TOEFL... because there's a topic and there's questions about the vocabs and the comprehension." Students also liked the program because it focused on teaching them the words that they needed to learn and helped enhance their reading abilities. A Taiwanese female said, 'I think it cultivates reading skills and give you or make you get used to read more fluent...lot of new word.' An Arabic male said, 'I think advantages, the first one is we can choose what's the vocabulary we don't know. New

vocabulary will show in the reading.' [sic]. Finally, students liked the program because it gave them an opportunity to read something that they had not read before. These generally positive reactions to the tool are reported on in Appendix II. After each reading the students are asked to rate the readings for difficulty and interest. These surveys show an overall positive rating for the texts.

Hence, although the students know that the on-line reading program will help them, for this group of students, the tool leads them to actions and operations that do not help in achieving their stated objective in language learning. Their operations do help them in the transformed objective of finishing the task with the computer.

3.3.2. Dictionary Usage

Overall, students thought that the online dictionary was very helpful in learning new words. They said that it saved time because they did not have to look up the words in the Longman dictionary. They also liked having the dictionary because it gave them the part of speech of the word in question. Nonetheless, one of the problems that students had with the online dictionary was in matching the definitions with the usage that they encountered in the readings. In addition, sometimes the students encountered a word in the definition that they did not know. In these cases, the student would have to look up another word in order to understand the definition of the previous word that they looked up.

Most of the interviewees made reference to trying to understand the word from the context of the sentence prior to using the dictionary. Several of the interviewees also reported that they tried to decide on the grammatical category (noun, verb, etc.) of a word based on the word's location in a sentence. In general, students wanted to understand words without relying on the dictionary. However, when they did not know a word or

they could not guess the meaning from context, they used the dictionary. Here we can see that autonomous comprehension is a likely goal that these students bring to the task. They use the online dictionary (a tool) and then ask their teachers if they cannot discover the meaning independently.

After looking up a word in the dictionary, students asked the teacher about words or meanings that they still had questions about. The majority of the questions pertained to meaning in context, but students also asked about pronunciation. The word *façade*[1] is one example of a word for which a student wanted to hear the correct pronunciation. Other examples include the pronunciations of the words *ultimate, threaten,* and *scheme*. In regards to questions about the meanings of words, one student asked about the word *concentrated*, as in a 'concentrated beverage'. The student knew one meaning of the word – to focus on something – but did not know what the word meant when used in this context. In addition, students asked about words in idiomatic expressions when they did not understand what they meant in the context. One particular student encountered the phrase "she blew it" in one of the readings. The student asked the teacher about the use of the word *blew* in this phrase. The teacher explained that it was an idiomatic expression and that it meant that the person had really messed up.

3.3.3 'Goals' of the Tutor

As was explained in the introduction, 'the goal of the tutor is to present the AWL words that the students need to learn in a meaningful context, to create a deeper processing of the new words through understanding the meaning in context.' The observation data suggests that the students' and the teachers' perception of this goal was vague, even though the curriculum supervisors had carefully explained the goal of using the program. According to one teacher, neither the teacher nor the students knew what the

[1]This word has an uncommon symbol that students will not recognize.

goal of the program was when they were using it. Teachers also reported that they thought the program was a waste of time. These attitudes were reflected in the classroom observations and student interviews in the current study. The researcher noticed that some students were able to read many (3-5) documents during one class session, while others would spend the entire class reading one document. Were these students much poorer readers? This may be true, but other factors were encountered in the student interviews and observations that provide alternate explanations for the difference in the rate that students read through the documents. The differences can be explained in terms of Activity Theory.

Activity Theory suggests that learners direct their actions and operations in accordance with their goals. The students in the current study exhibited a variety of different goal-directed actions. One of the actions was to use the online dictionary "in excess" by looking up 50-60 words in the process of reading one document. In the student interviews, students reported that it was very important to understand every word in the document in order to understand the author's argument in the paragraph. For these students, looking up every word was an important goal in learning English. The texts were 1000 words long; if the original text was longer than 1000 words, the program automatically inserts a STOP READING HERE sign. However, some students read beyond "STOP READING HERE" bar. In one case, the student was asked why he was reading beyond the "STOP READING HERE" bar. The student responded by saying that he wanted to find out the rest of the story. In this case, the student's goal was to finish reading a document because he became interested in the story, not to focus on his personal AWL.

On the other hand, some students think that they should skim the documents as fast as they can to see the focus words. These students read many documents during one

session and spent little time looking up words in the online dictionary. One Asian student reported the following during one of the interviews: (This same student also thought that taking time to write down words was a 'waste of time'.)

Asian: Yea, but, I think this [REAP] is not for reading, I think this is just for vocabulary. Because they don't have any comprehension questions, like what this article's main idea or… what this phrase mean… I don't need to understand the whole article, I just need the vocabulary I don't know.

A question about writing down new words elicited a range of responses. Several of the responses are listed below. Some Asian students thought that writing down words would assist in memorization. On the other hand, an Arab student and the other Asian student said that they did not think it was very helpful. The Arab student said that it was not important to write down new words because he was not tested on them.

Arabic: I think when nobody asks us about these words, we'll lose it. I just keep it in my head…

It is important to note that this student is not thinking about his or her needs, but about a future 'test'. Hence, one of the unstated goals/objectives is to be able to pass a language test that is part of the program, not future learning.

An Asian student said that it was not important to write down the new words because it slowed down the time.

Asian: Actually, I didn't write down the word, because this makes me stop the reading. I just want to read and just click the words and then answer the question…That see what I did.

We see here that students have very different goals and actions in mind when they write down or refrain from writing down new words. The first Asian student writes down words because she wants to remember them the next time she sees them. The Arabic student thinks that it is important to write down words only if the words were later part of an assessment in class, and thus fails to see how it might help in his more abstract 'object' of learning English. Furthermore, this learner relies on his internal memory in order to learn new words, but recognizes that his strategy is largely an ineffective means for learning new words. Last of all, the second Asian student doesn't write down words because she is focused on reading the documents and not on learning individual vocabulary words.

3.3.4 Summary of interview data

In general, students believe that that they learn vocabulary more effectively within the classroom. Even though students believe that they see more words while using REAP, they do not necessarily focus on learning them. Although the tool did accommodate the object that students brought to the task in their statements about learning, in practice the tool transformed their operations and goals into a task completion exercise unrelated to their ultimate objective. Speeding through the tutor was an issue when the question of how learning words in the lab compared to their learning words in the regular reading class. One student's words epitomizes this observation:

When I in the lab, I feel like I take a test. I just want to do it as fast as possible. I don't know the words, I clicke and I forget about them. .. In … classroom, .. more relaxed. It's more effective.

During the interviews, most of the interviewees agreed with one another regarding effective and ineffective ways to learn English vocabulary both in the standard classroom and in the REAP classroom. These findings suggest that although students may differ considerably in terms of their goals and operations during the task, they share similar attitudes towards classroom and CALL vocabulary learning. Furthermore, when a particular language-learning task such as REAP fails to conform to student's goal-directed expectations, students approach the activity with less than favorable attitudes. These attitudes are likely to influence the amount of vocabulary that students can acquire during a particular language-learning task. In the current study, learners preferred to learn vocabulary within the classroom setting as opposed to learning vocabulary from the REAP system; this preference resulted in operations with the on-line system that were not conducive to deeper processing and learning even though they knew that the tool has been designed to select words specifically for them as individuals. It seems that they want to rely on the teacher to create interactive learning contexts for them, and will cheerfully pass up the opportunity that the tool offers for self-created, or autonomous, interactivity for their own learning. Put another way, the autonomous CALL path is more lonely and less attractive that the jointly constructed path of companionable learning in the classroom.

3.4 The teachers' view

During the first semester or so that REAP was used, the teachers viewed the tool with suspicion and wondered what the students were getting out of the laboratory sessions. In part, this was because they saw that the students were not paying attention to them as

teachers. Furthermore, the teachers were uncertain about their own role during the computer-based tutor classes. One teacher conducted her own small survey, and found that 50% found the tool helpful, whereas the other 50% thought it was boring or too hard. Another teacher was concerned that the computer was not interactive enough, and that the vocabulary knowledge being acquired was just 'passive knowledge'.

They also noted that some students had 'cracked' the system and were not reading anything, instead these students were just looking up highlighted words, and finishing the comprehension questions. The teachers also observed that the students who were strongest in proficiency tended to be those who liked to use the tutor the most.

Hence the teachers, although informed of the goals of the program, were not sufficiently invested in its success in class. Clearly, more work must be done to integrate teachers into the goals and power of the tool for individual student learning.

3.5 A comment on quantitative learning outcomes

As Gillen (2000) noted, it is legitimate to look just at the behavior of the students in an 'experiment'. We are, however, ultimately interested in the question of learning outcomes for our students. We therefore analyzed the learning of target words using the REAP system. Interestingly, of the 9 Arabic speakers who took the post-test and the 10 Korean speakers who took the post-test, on words that they had seen on REAP, they scored an average of 46% and 44% respectively. Hence, the differing strategies did not have different effects on the test scores in the cloze recognition test.

A second test was a test of definitions, in which the students had to match words and definitions. In this test, the Arabic speakers (n=9) scored an average of 44% compared to the Korean speakers (n=10) who scored an average of 66%. This difference approached

significance ($F(1, 17) = 3.06$, $p = .098$).

These results, along with the success of the Korean students in the comprehension check questions, suggest that the speed of processing that the Arabic-speaking students engaged in, and the consequent failure to understand target words in context because they did not look up as many *non* target words, may lead to less robust learning. The results also confirm previous research with on line tools discussed in the introduction, namely that learners who interact with the tool and process more deeply will have better retention in the long-term.

4. CONCLUSION

Activity theory is crucial in understanding how the students used the vocabulary learning tool. Without knowing the goals and beliefs of these individuals, how they bring agency to the task along with those beliefs, it would not have been possible to understand the different behavior of the Arabic-speaking group and the Korean-speaking group at the level of operations: skimming quickly versus clicking on many words. These results show that the Arabic-speaking students and the Asian students bring different ideas and practices into the language-learning laboratory. The Arabic-speaking learners construct the reading activity and vocabulary task as an exercise to get through, not a reading to learn vocabulary activity. This is because they do not value reading as an aid in attaining their object. The Asian students construct the task as a micro level vocabulary task rather than a reading task. Neither group construed the task in the same way as the researchers. Both groups saw the tool as incompatible with their object, which led to inefficient operations.

The on-line tutor is seen by the Arabic-speaking students as less valuable for words not

on their target list, since they see reading as being an activity that is less important to them for learning new words. As a result, they look up fewer words that are incidental to their Academic Word list words, and are more likely to guess from context and use the syntactic environment for their learning rather than a definition supplied by an on-line dictionary. In contrast, the Asian students focus much more on bottom-up micro understanding of each word, even if that word is not on their focus list.

Hence, as predicted by an activity theoretic view of vocabulary strategies (Donato and McCormick, 1994), the learners build their own task with the computer. In addition, as Gillen (2000) pointed out, it is important to see the experiment itself as a way of seeing how the students approach the task and in this way we can learn how students interpret the task we gave them. This is not to say that the students do not learn; however, they learned things in a way that was not predicted by the researchers or the tool. The implication is that before investing in high technological solutions to individual learning needs, we must be clearer about the way learners transform tools based on their attitudes and beliefs.

The differences also shed light on findings by Fender (2003). He showed that Japanese-speaking students were better at word recognition than Arabic-speaking students who were better at syntactic integration and parsing. If the kinds of learning attitudes and behaviors that we observed as part of this study can be generalized, it is clear that the bottom up approach and the top down approach that these students take is based in part on *attitudes* as well as text processing that derives from automatic L1 processing routines. Thus, teachers and curriculum/materials designers need to develop fine-grained instructional strategies that work to enhance the strengths of the two groups.

Teachers and program coordinators also need to develop tasks that work to enhance the

strengths of the two groups. Clearly, both groups continue to struggle with their target words because one groups skims over the context, and the other group gets bogged down in irrelevant details of non-target words. In the ELI at Pitt, we are finding that the Arabic-speaking students in particular need to focus more on bottom-up skills in language learning. One of the first steps in this process will be to actually convince them that text-based, as well as orally-based learning, will benefit them. For the Asian students, we will need to encourage them to let go of the detailed bottom up strategies.

While these conclusions are not new, this study has focused very specifically on on-line attitudes and behavior. It supports findings in Hulstijn and Laufer (2001) that need, search, and evaluation by learners affect vocabulary learning. They found that simply reading is not a task that requires sufficient involvement and without involvement learning is a less likely outcome. We have shown that the same issues that classroom teachers face with these learners in other teacher fronted classes arise in the use of a cognitive tutor. The logical next step is to adapt the tutor to promote involvement by supplying help at strategic points. In addition, programmers and teachers need to develop more interactive reading and processing activities during on-line work.

For now, we have decided that the tutor should also probably not be used for a whole class period without some teacher interaction or a related output activity. For example, the tool has a powerful back-end review function which the teacher can check words that the students are looking up. In-class use of this function, where the teacher reviews words frequently looked-up by class members with the whole class, may enhance the face-validity of the tool. Programmers need to think about what is so attractive to the students in the communal classroom setting and create interfaces that permit the student to feel less isolated in his or her learning. Language learning technology is not alone in facing this issue. Indeed, the tuning of the provision of on- and off-line help is currently of

central interest to specialists in cognitive tutors (Aleven et al. 2006; Koedinger and Aleven, submitted), and CALL should be able to partner and learn from researchers in other domains of knowledge that may be more well-defined than language learning.

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Appendix I Free response answers to questions by language background.

(These answers have been abbreviated from their original form).

1. What are your goals in learning English and how are you trying to achieve those goals?

Arabic-Speaking students

Study in the US 5
Improve skills
Practice TOEFL
To improve my English; to contact native speakers besides the ELI
To get the TOEFL so I can continue my studies to get the master.

Asian students (Korea, Japan, China, and Taiwan)

Teach my children
Improve English talk with native speakers
Go to college
Speak English with native speakers
Speak with native speakers
Communicating with native speakers
Speak well like native speaker
To understand movies
Want to live in America
Go to college; know US culture
Want to get a job in this country
To go to university
Getting a good score on TOEIC
Get job
Speak English fluently, communicate with English speakers
To get a better job.

Hispanic
Read and write correctly
To master English; to go to college

Turkish (1 student)
To do business

2. What is the best way to learn new words in English?

Arabic-speaking
Having conversations with native speakers (3 students listed this method)
Use it
To know and listen how to use them. The more examples I hear, the faster words I gain
To write them and try to use them in my life
From classes, speaking with native people, and watching TV.

Asia
Using a small notebook and just reading once or twice a day
Study concentratedly then use actually.
Using cards for new words
Reading
Reading
Read books; watch moves
To read many books
Reading adverstisements on the bus
Look at the word's definition, Chinese definition, example sentences
I think read a lot and think about examples
Write words again and again

Spend time in the English using environment
Use speak or hear the words
Watching movies
From conversations. It's the most easy way to remember new words.
Use it when you talk
By using words in conversation.

Hispanic
Watching TV speaking with native speakers
Practising!

Turkish
Reading books would be a solution

3. What is the worst way to learn new words in English.

Arabic-speaking
Reading boring article
Not from native speaker
Studying it in institute
Living with your family
Just listen to it
To give list and not discuss them after
The worst way is just read them
To memorize words only

Asia
Just memorize without practice
Don't review it
One way. Only reading writing to do one thing.
Just see one time without using. (Reading in the computer lab).
Watching violent programs
Doing nothing
Study only grammar
Don't use the words after you memorized it
Living with family
Just read them
Skipping, not repeating
Just write down
From reading. It takes too long time.
Just look at it.
Just memorizing

Hispanic
Learn without live the language
Not practicing!

Turkish
Reading dictionary

4. How should vocabulary be taught to students in the ELI?

Arabic-speaking students

By giving example for each word.
--
Ask the students some oral question have the new words in the question.
Using them. For example, when you study new vocabulary words, you have use in speaking class when you do your speech. That will help not to forget them.
Choose the most important ones, which we can use everyday.

You should advice them to read more.
I think ELI reading program is good enough.

Asian students
Give examples of how to use it
To memorize them and spelling
Providing some articles which have many useful and efficient words in.
We can find new words in interesting articles, or books.
The way that now studying in the ELI, understanding the meaning of words in the reading is very useful.

Give the vocabulary and ask students make sentences.
Giving a lot of easy examples
I would like to learn joyfully. For example, the teachers uses games, puzzle.

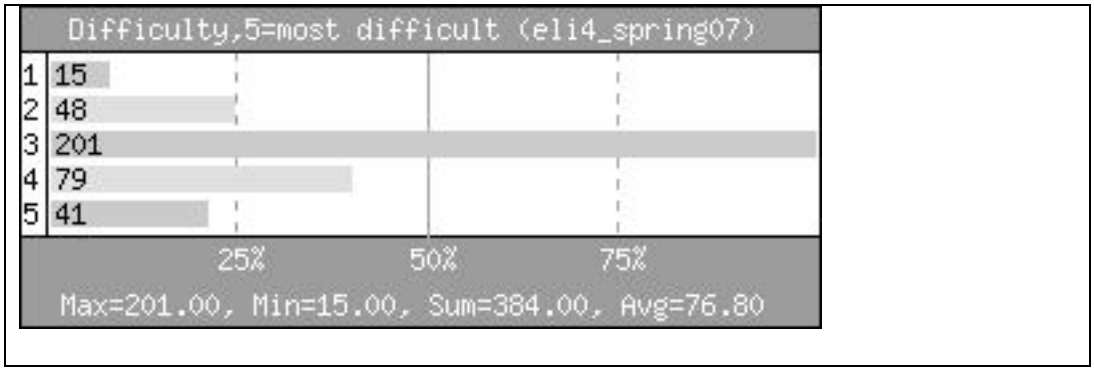
Explain vocabulary.
Use short movie or short live dialogh.
Give a piece of paper that is written in vocabulary to students. (It's not in the textbook but others).
With examples and use a lot (not just one day).
Make us keep using it.

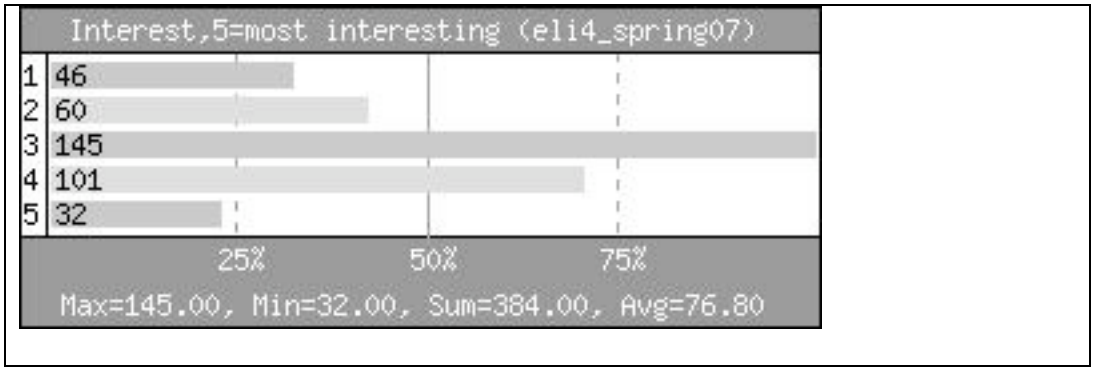
I think it need to be taught to students how to use the words and what situations words fit well.
How to use the vocabulary.
In my opinion, it's depend on what the student looking for. What is the most interesting for them.

Hispanic
Practice the words
Dialogs, debates, movies, etc.

Turkish
Some games might be useful.

Appendix 2. Measure of student opinion of text difficulty and interest.





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