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ABSTRACT

A study investigated the instructional usefulness of HANGMAN, a computerized vocabulary development game, for university students of English as a Second Language. In the ten microcomputers available to students, the regular version of the game was replaced with a modified version in which all student key-strokes were recorded automatically. Subjects were anonymous, most likely first-year university students. Data from 790 problems in 100 student sessions were analyzed for use of linguistic-competency-based (CB) and non-competency-based (NCB) strategies for solving the vocabulary puzzles presented. CB strategies included solving a puzzle with no hints; using hints with the result of a correct answer; and in some cases, use of a hint or "See Solution" to avoid hanging. NCB strategies included use of "See Solution" rather than persevering; abuse of hints; and patterned key-presses. Analysis indicates students used CB strategies to solve about half the words presented to them, while ESL instructors, viewed as "ideal" learners, used CB strategies to solve 92% of the problems presented to them. The students' manner of doing the problems was distinctive, with NCB strategies used at a much higher rate among this group. Recommendations are made for improving the program's instructional effectiveness. (MSE)

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ABSTRACT

HANGMAN is a vocabulary game with some appeal, especially when implemented on a microcomputer. For this reason, versions of this game are often found in CALL (computer-assisted language learning) labs, especially to attract computer-novice language learners. Are students who play this game learning vocabulary or wasting their time with puzzle-solving behavior irrelevant to the immediate task of language learning?

The present study takes advantage of a computer implementation of HANGMAN to definitively address this question. HANGMAN was installed as one of several text manipulation options available to students who switched on any one of ten computers in the Student Resource Centre at Sultan Qaboos University in Oman. The computers were configured to unobtrusively preserve on disk all key-presses of students playing HANGMAN on a self-access basis for the period of a month.

Thus data were gathered revealing exactly what these students did when playing HANGMAN. This paper examines the strategies they employed in doing so, with respect to whether these strategies are likely to promote language learning. Insights from this study will guide developers in decisions regarding implementations of this and similar language puzzle games.

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I. INTRODUCTION

Every teacher has some reaction to HANGMAN; many consider it a waste of time, merely something cute you can do with computers, but something suggested more by the medium itself than by pedagogical considerations; in other words, just the kind of CALL (computer-assisted language learning) implementation that should be scrupulously avoided.

However, HANGMAN is an easy program for teachers to install and for students to use. It's mildly challenging, it has drama, and it can draw first-time users back into the lab to see what else is available there. As such, HANGMAN may serve a purpose as an appealing and useful introduction to CALL for computer-naive students.

But otherwise, is the program doing language learners any good? No definitive research has to date shed any light on this question one way or the other. This study is therefore the first of its kind to address whether language learners benefit from playing HANGMAN.

I.1. WHY HANGMAN?

HANGMAN is one of a battery of computer-based text manipulation programs available to Arab university students in the Student Resource Centre (SRC) in the Language Centre at Sultan Qaboos University (SQU) in Oman. As described in Stevens (In Press, 1988, and 1987), the programs, collectively known as Text Tanglers (Stevens and Millmore, 1987), all feed off ASCII versions of texts the students are studying in courses they take

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elsewhere at the university simultaneously with Language Centre ones. Thus one aspect of the rationale behind use of such programs is the authenticity they bring to the learning process (Stevens, 1990); another is that students can select the game format that appeals to them as a vehicle for approaching the texts they are studying (Stevens, 1984).

Because the texts students study in other courses are available to them with the text manipulation programs, it is conceivable that the students could recall contexts for the words displayed with HANGMAN. However, it is more probable that our students are not that systematic in their choice of texts, in which case they would not be contextualizing the words. Still, the processes that come into play when students solve a HANGMAN puzzle must be at least partially based in linguistic competence.

The exact mechanism by which humans are able to solve HANGMAN puzzles can be no better understood than are its perceptual and cognitive components. A perceptual component, for example, is suggested by the ability to complete patterns. Gestalt psychologists refer to completion of visual patterns as "closure" (see Shiffman, 1982:273-275), but the concept as well as the word itself have been borrowed in language teaching as the familiar "cloze" format (Klein-Braley, 1983; Meyer, 1986). A cognitive element is plausibly demonstrated by McClelland, Rumelhart, and Hinton (1986), whose parallel distributed processing model postulates that in seeking to discern letters in a disguised or degraded word, hypotheses regarding what letters can occur in certain positions interact, selectively strengthening some hypotheses while weakening others to extinction, resulting in solution.

The hypotheses themselves by which a word is elucidated are based in linguistic competence. Toward this end, McClelland, Rumelhart, and Hinton (1986:24):

> "imagine that the perceiver possesses, in addition to detectors for familiar words, sets of detectors for regular subword units such as familiar letter clusters, or that they use abstract rules, specifying which classes of letters can go with which others in different contexts."

Thus in HANGMAN, elucidation of a word utilizes, among other processes, competence regarding orthographical conventions of the language. Figure 1 (reproduced from McClelland, Rumelhart, and Hinton, 1986:8) illustrates that we are able to resolve ambiguous letters by considering constraints imposed by surrounding letters. Similarly, HANGMAN puzzles are solved as each letter newly revealed narrows down what is possible in the letter positions still hidden.

Place Figure 1 about here.

Similarly, orthographic competence is illustrated in an experiment by Burnett and Miller (1982), in which the authors configured a computer to reveal a hidden sentence as subjects guessed successive letters, one at a time starting from the left. Figure 2 shows a sample run from that experiment, whose results shed light on the nature of constraints operating on letters in English words; for example, it was difficult to guess the J following the I in what is actually the name of a Dutch river, IJessl, because this combination of letters never occurs in English.

Figure 2

The	large	duck	quacked	and	jumped	into	the	IJessl	River.
	fid	pom	w	l	w			lnotte	O
	des	ta	s		s			ssivea	L
	pok	si	i		e			wojmi	m
	g p	he	t		l			pvuno	t
	s n	k	b		m			yrajs	y
	m	r	l		r			rl r	
	a	i	f		d			tb h	
	w	b	c		c			bm	
	c		m		p			dg	

I.2. IMPLEMENTATION OF HANGMAN IN THE SRC AT SQU

The ten IBM XT computers in the SRC at SQU are normally configured so that they run the text manipulation programs from their hard disks when students do nothing but turn them on. For the duration of this study, the HANGMAN program normally found in this battery of programs was replaced by a special version which was identical to the original except that it recorded all student key-presses made while running the HANGMAN program. Since the identity of individuals was never recorded, neither students nor teachers were made aware of the program's installation. In this way, the program was able to unobtrusively record spontaneous, wholly natural, and unforced student interactions with the HANGMAN program.

When working HANGMAN, the subjects encountered the solution screen shown in Figure 3. The series of question marks in the upper left show how many letters the target word has. The alphabet in the middle of the screen indicates what letters have already been chosen and, more importantly, which letters remain as choices, a diminishing subset of which should be plausible choices the further the game progresses. The screen also indicates the name of the text file in use (relevant in case the student is aware of what text is being used and is familiar with the contents of that file), and a score which increases with each correct letter typed (even if that correct letter has already been typed).

Place Figure 3 about here.

Once students start typing letters, their correct guesses replace the question marks in the hidden word at the top of the screen, and their incorrect ones cause first a scaffold and then a man to be constructed in low resolution graphics in the lower right corner of the screen. After 12 incorrect guesses, the man is hanged with an "aargh."

The bottom of the screen shows options activated by function keys (these are consistent throughout our battery of text manipulation programs). The two that are relevant to this experiment are F5, the See Solution option, and F8 to see a Hint. The former causes the program to reveal the hidden word and fetch another; the latter divulges the first unsolved letter from the left and suggests the student type it next. Students can request a hint and then continue working on the same word, but if they activate See Solution they effectively give up on that word. Still a third option, F9, causes the game to be terminated.

Pressing F1 causes display of the Help screen, shown in Figure 4. Our data show that 34% of student sessions (47 out of 138 counted) included a look at the Help screen (during ongoing data entry, this figure hovered at roughly a third no matter

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where we were in the database). If the students had read and comprehended this screen once they had looked at it (not a foregone assumption) they would have found useful hints about using the program; e.g. a suggestion that they type vowels first. The fact that students almost never followed this advice suggests that a Help screen is not the best way to suggest strategy, nor possibly to convey instructions or information, to students.

Figure 4

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HANGMAN HELP SCREEN

At the top of the screen, question marks [??????] hide the
letters in the mystery word.  You try to discover the word by
guessing one letter at a time.

Each CORRECT letter is put into the word, like so: [??e??e]
Each WRONG letter brings the man at the bottom of the screen
nearer and  n e a r e r  to D E A T H !! (so guess carefully)
--------------------------------------------------------------
HINTS: (1) Each word in English has at least one VOWEL in it.
           The vowels are:  A E I O and U.
       (2) The most common letter in English is E.
       (3) Remember, HANGMAN uses words from the text YOU
           have chosen.
--------------------------------------------------------------
Don't forget the function keys on the left of the keyboard:

F1   Gives you this HELP page again
F4   Turns the SOUND on or off
F5   Lets you see the SOLUTION, but this wipes out your score
F8   Gives you a HINT, but costs you 30 points
F9   Lets you stop, or QUIT, this game.

Press any key to continue.
```

II. SUBJECTS

Although, as has been mentioned, the identities of subjects for this study were not recorded, they were most likely to have been Arab first-year university arts, science, or education students, either male or female. They most likely used HANGMAN and the other text manipulation programs either during scheduled class times or during evening hours when the SRC was open for self-access.

Student performance with HANGMAN was compared with that of a group of 'ideal' language learners; i.e. a group of language teachers. Accordingly, instructors of ESL working at the Language Centre at SQU were asked to play at HANGMAN. Told only that the computer would record their moves, they complied without being aware in advance of the nature of the experiment. Their informal feedback (when given, as none was solicited) focused on improvements to the program itself, reconfirming in those cases that they did not suspect the true aim of the experiment.

Two groups of instructors were used: one comprised the native English-speaking members of an Arabic course who were able to draw words from a database of Arabic materials transcribed into Roman alphabet; the other simply used words from the same database of texts in English that was available to the students. These two groupings were established in the event there might be differences between subjects working as native or non-native speakers of a language. Thus we compared two NNS groups: Arabic students working in English with English speakers working in Arabic (transliterated); and the former group with native English speakers working in their own language and with the same text base available to the students.

III. PROCEDURE

Once the program was installed, it was simply left in place to collect data automatically for a period of time. The data were then analyzed to determine what strategies subjects used when working HANGMAN. These strategies were in turn categorized

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as being either competency-based (CB) or non-competency-based strategies (NCB), and the frequency of each determined.

Any body of interaction with HANGMAN starting with logon and ending with exit from the game was considered to be a "session". The data were divided in this manner in hopes of isolating transactions particular to different students (or groups of students if they happened to be working in groups). There was no way of telling whether two or more sessions represented in the student database happened to be the work of the same subject or subjects, but if it happened at all, this should not have seriously affected the outcome of the results reported here, since the large number of sessions studied would dilute any such effects. (Teacher subjects in the study were identified; hence each teacher session represents the work of a unique subject.)

Each session comprised a varying number of "problems"; that is, mystery words for the subjects to identify in the course of the game. All data from students' logging on and off again without attempting a problem were ignored as being not sufficiently robust for our study. However if work was attempted on even one problem, this constituted a session. The number of problems per session ranged in this study from 1 to 45 for students and from 4 to 30 for teachers, with 7.9 being the average number of problems per session for students, 7.3 being that for teachers working in English, and 13.9 that for teachers working in transcribed Arabic.

Data were collected from over 150 student sessions (which number could grow indefinitely simply by leaving the system in place); however, only that accruing from the first 100 robust sessions examined were analyzed in the present study. The number was limited because a point is reached where the trend begins firmly to emerge, and further data collection yields increasingly fewer insights. In this study, a computer-based spreadsheet computed an ongoing analysis as each item of data was entered, and it could thus be seen that the data were quite consistent; that is, the results obtained after entering data from 25 sessions were much the same as those from 50, and so on. Thus the data were considered to have settled into a definitive pattern well before examination of a hundred separate sessions (but a hundred sessions were examined in order to establish that fact, and for ease in visualizing percentages).

Before analysis could take place, the various strategies used by those playing HANGMAN had to be identified, and these in turn had to be characterized as being either CB strategies or NCB ones. Once it was established whether each problem in the data base had been solved using CB or NCB strategies, the instances of each were tallied and presented as a percentage of the whole. Non-parametric measures were then used to investigate any differences in the groups in solving those problems.

Thus the primary results of the experiment were identification of CB and NCB strategies, and examination of relative use of these strategies by the student and ideal learner groups. There were two null hypothesis: $H\emptyset_1$ was that there would be no differences in strategies used between the student and ideal learner groups, and $H\emptyset_2$ predicted no such differences between the NS and NNS ideal learner groups.

IV. COMPETENCY-BASED VS. NON-COMPETENCY-BASED STRATEGIES

By a CB strategy is meant the employment of a strategy in solving a HANGMAN puzzle evidencing application of the kind of linguistic competence illustrated earlier; for example, on exposing a number of letters, making plausible choices for the remaining ones.

In the event that non-plausible choices are made for remaining letters, such moves would be characterized as NCB behaviors; e.g. typing 'z' and 'x' when these could not possibly be the missing letters, or typing 'zxcvb' in rapid succession simply because these are adjacent to each other on the keyboard.

In order distinguish CB vs. NCB strategies, it is necessary to take into account where the student is in the game. HANGMAN games have two phases: opening and end-game. At the start, there are no clues except how many letters a word contains. There is little a student can do in an opening (except start with hints or vowels) to avoid sheer guessing. But once a few tokens have been exposed, the range of possible alternatives is narrowed down, and the student is in the end-game phase. It is how the student plays the end-game that indicates whether he or she is employing CB or NCB strategies.

IV.1. OPENING GAMBITS

An often used opening gambit is to start with random or patterned key-presses (one student favored 'lea'). This strategy is likely to expose a few letters, but will also inefficiently squander chances. While not necessarily based on linguistic competence, this might work as an opening gambit until a few letters have emerged, at which point a CB strategy can be used.

A more productive opening in HANGMAN is to start off with vowels. This is a CB strategy because it indicates an awareness of the fact that there must be at least one vowel in any English word. Anyone typing five vowels has a better than one-in-five chance of success with his or her first five moves.

Another productive strategy is to start with a hint. By exposing one letter, or perhaps even two, players increase their chances of success with the remaining letters. When hints served as spring-boards for CB interactions, their use (at any point in the game except at the very end) was counted in this study as a CB strategy if fewer than half the letters in the word were exposed in this way.

IV.2. END-GAME

Once sufficient tokens are exposed, the distinction between CB and NCB behaviors becomes more obvious. Players employing the former will not "guess" at the solution, but will attempt letters complying with orthographic conventions of the language; according to results of this study, they should succeed in excess of 90% of the time. Conversely, players employing NCB strategies at this stage tend to press contiguous or clustered keys, and in so doing to repeat letters already judged incorrect.

IV.3. CHARACTERIZING STUDENT MOVES AS EITHER CB OR NCB

In order to determine whether a subject had applied CB or NCB strategies when attempting a solution to any given problem, the outcome of that attempt was characterized according to one of the following patterns.

IV.3.i. COMPETENCY-BASED STRATEGIES

Correct, no hints used -

Solving a problem correctly without asking for a hint was considered evidence of systematic application of linguistic knowledge toward achieving a solution, particularly if correct solutions dominated the session. However, it is also possible to achieve a correct solution by striking keys at random, or using a NCB strategy. In this case, correct solutions are likely to be interspersed with hangings during the session, alerting the researcher to search for one of the NCB patterns described below.

Correct, used hints -

Use of hints was not considered to preclude use of CB strategies to solve a problem. Although overuse of hints would suggest that the learner was using the computer to solve the puzzle for him or her, judicious use of hints to arrive at a solution can be a CB strategy, and is one to be encouraged. In judging whether use of hints was reasonable or not, it was decided that use of hints to solve half the letters in the word or fewer counted as a CB strategy, unless a hint was used to resolve the last remaining letter.

Use of Hint or See Solution to avoid hanging -

Use of Hint or See Solution was considered reasonable when these facilities were invoked to avoid imminent hanging in cases where CB strategies had been predominant up to then.

Unavoidably hanged -

Being hanged did not necessarily suggest use of NCB strategies; on the contrary, it is possible to use a linguistically-based strategy and still be hanged. As noted above, numerous hangings might suggest predominant use of NCB strategies; but if use of no known NCB strategy could be discerned, then use of a CB strategy was assumed.

IV.3.ii. NON-COMPETENCY-BASED STRATEGIES

See Solution -

When a student chose the option of See Solution rather than persevering with the problem, this was considered to be a NCB strategy, except when used to avoid imminent hanging, as noted above. Although not considered to be a CB behavior, it is possible that some students used See Solution to get an idea of what words were likely to come up. On the other hand, some sessions were nothing but a series of See Solutions, in one case a total of 31 times, with no attempt at then working any of the problems.

Abuse of hints -

Another NCB strategy was for students to use hints to arrive at more than half the letters in a given problem or to use the hint option to arrive at the last letter in a problem when there was no pressure; i.e. danger of hanging.

Patterned key-presses -

A variety of key-press patterns were identified as evidencing NCB behavior. These are described below.

Clustered keys - Many students simply typed adjacent or clustered keys (or in some cases, their names) in attempts to solve problems. This would be acceptable as an opening gambit, to reveal sufficient amounts of the word so that the rest could be resolved through linguistic competence; but some students used this strategy throughout, rather than abandon it once parts of the word were revealed. The researcher tested all suspicious cases by removing a keyboard to a work table and physically recreating student sessions.

<u>Alphabet</u> - Some students typed the alphabet. A limited version of this would be acceptable as an opening, but if it continued until hanging, it was counted as a NCB.

<u>Suicide</u> - This refers to instances where students brought the problem to conclusion by repeating the same wrong key press. Some suicides could have been due to inadvertently "leaning" on single keys; others may have been purposely invoked in order to see the man hang, or perhaps in response to a sudden urge to simply end it all.

V. RESULTS

The 100 students whose sessions were analyzed in this study attempted 790 problems, each of which was characterized according to the strategy patterns identified and described above. All CB interactions were then summed and this number expressed as a percent against the total number of words attempted. For our student subject population, that percent was 57.09% (Table 1). In other words, the students in our survey used CB strategies to solve little more than half of the words presented to them.

The same was done for the ESL instructors used in our survey. Sums of all CB solutions were tallied out of the 111 words attempted for the instructors working with the Arabic texts (see Table 2), and again for the 51 words attempted by the instructors working the English texts (Table 3). The CB interactions totaled about 92% in each case. In other words, the "ideal" language learners in our survey used CB strategies to solve about 92% of the problems presented to them.

Because subjects attempted different numbers of problems in individual sessions, non-parametric measures were used to verify

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what the percentages suggest: that the behavior of the student and ideal learner groups was significantly different. A chi square analysis for the 2 x 2 table of values yielded $X^2 = 49.73$ for the students vs. instructors working with Arabic texts, and $X^2 = 24.395$ for the students vs. instructors working in English. Both these figures are off the tables even at alpha $< .001$, which convincingly rejects the null hypothesis that either of the instructor groups might have performed equally to the students.

As a check on the fact that the sample sizes were different for the groups compared (8 instructors working in Arabic and 7 in English vs. 100 student subjects), another non-parametric test, the Mann-Whitney U, was used to compare the two instructor groups individually against the student groups, and in both cases, significant differences were again found. These differences were most pronounced with the instructors working in their native language vs. the students working in their foreign one ($Z = 2.780$; $p < 0.01$); however, with the instructors and students both working in foreign languages (Arabic and English respectively) the probability of difference between the two groups was still greater than 0.05 at $Z = 2.022$.

A further 2 x 2 chi square test established that the instructors used essentially the same strategies whether working HANGMAN in English or in transcribed Arabic; the comparison produced almost zero difference at $X^2 = .003$; $p > 0.95$. Thus the hypothesis HO_2 that the two instructor groups were essentially the same, whether working as NS or NNS, is well supported.

These results are vulnerable only to the extent that sample sizes varied and that there was no control over the number of attempts made per subject in each session; however, the measures chosen are appropriate to these particular cases. Accordingly, we can reject $H0_1$ and assume that our students performed far beneath the ideal. Simply put, it appears that our students working HANGMAN could be relied on to be engaged in CB strategies only about 57% of the time, as opposed to the 92% that we might reasonably expect from mature language learners approaching the same task as a serious linguistic exercise.

VI. DISCUSSION AND LIMITATIONS

A glance at the tables reveal striking differences in student and ideal learner behaviors, especially in use of NCB strategies for solving the problems. Although students proportionally got only half as many problems right as did instructors, it was the manner of their getting them wrong that most distinguished the two groups. Students, for example, used See Solution to give up on problems over 13% of the time as opposed to about 4% of the time for instructors (combined). Students used hints to avoid solving problems themselves almost 10% of the time as opposed to just one instance in the instructor database. Students were still using clustered key-presses at end-game almost 14% of the time vs. only 2.5% for teachers. And the data indicated 40 student suicides vs. none for either instructor group.

One is tempted to ask at this point why these differences occurred. At the risk of indulging in sheer speculation, it seems that the students frequently regarded HANGMAN more as a distraction than as a serious language-learning activity.

Crucial to data analysis in the present study was an ability to distinguish, when a student was close to finishing a word yet made several incorrect attempts, if he or she was closely considering each attempt, or just pressing keys at random. The fact that the researcher never actually observed the subjects as they produced the data for the survey enhances the integrity of the data because the effect of observation on the behavior of the subjects was not a factor in this study. On the other hand, lack of over-the-shoulder observation precludes clues that might otherwise have explained certain behaviors evidenced in the data. Although all the data fell into the strategy patterns noted above, there may have been alternate explanations for their occurrence.

As has been noted, some means of getting some letters into play is a necessary opening strategy in HANGMAN, while linguistic competence should be used to resolve the end game. However, as HANGMAN was implemented in this study, it was possible that a quickly typed series of random key-strokes as an opening gambit might bring on one of two accidental effects. First, it might lead to inadvertent solution of the problem, in which case the subject would be credited with having employed a CB strategy when a NCB strategy was in fact used. More likely, it might precipitate hanging.

In the latter event though the student would be correctly caught using a NCB strategy, it is possible that the subject intended those key-presses to be opening moves, but the computer went on processing the input even after a pause in data entry, resulting in hanging. This could have happened because, in this version of HANGMAN, all key-strokes were buffered for processing as soon as the program could get to them. Indeed this may have been responsible for a few apparent suicides, since students occasionally become engrossed in the chaos occurring on their monitors when they fail to remove fingers from keys just pressed.

Another observation was that students sometimes, though not often (just half a dozen instances in the entire database), ran up the score by repeating letters known to be correct; e.g. by simply by holding down the key in question. Because such behavior neither contributed to nor detracted from the solution of any problem, it had no effect on the study, and could easily have been obviated by not buffering key-strokes and by checking letters for prior use in a problem. However, such behavior could also have been encouraged by our scoring scheme, since holding down a correct-letter key would have the effect of causing the score to increase for as long as the key was held down. Although this is not a topic addressed in this study, the impact of scoring on student behavior with CALL is a valid area for future inquiry.

These idiosyncrasies probably wouldn't have greatly effected "ideal" learners because it is normal for computer users who wish to competently work a program to speedily adapt to its peculiarities. However, there may be ways to improve data collection so as to better determine what is going on while still collecting data unobtrusively. One improvement would be to record the exact time of each key-stroke; this would show if such key-presses were rapid or each thought out. Another possibility would be to interview individual students, though this would require a means of identifying them. If one advantage to research in computer labs with stand-alone PC's is that students feel free to use them unmonitored, then this latter option, while revelatory in its own right, could change the character of the data collected.

A final observation in this study was of a deterioration of concentration during long sessions, where students initially making competent decisions would lapse into the NCB behaviors noted above. Conversely, students working HANGMAN for the very first time were not sure at the outset how to work the program. Therefore, it may be that there is an optimum window for CALL data collection between the time the student understands how to work the program and the time he or she has tired of it. Future studies might take this into account, or seek to establish an optimal attention span for different types of CALL activities.

VII. IMPLICATIONS FOR IMPLEMENTING HANGMAN

As a result of this study, suggestions can be made for future implementations of HANGMAN and similar programs. Two have already been mentioned: first, some way besides a help screen should be found for conveying information and suggesting strategy; and second, the program should not buffer key-presses.

Having identified certain NCB behaviors, it becomes possible to program a computer to detect them. Specifically, a sophisticated HANGMAN program should test student key-presses for alphabetical input, contiguous and clustered key-strokes, and repeated letters - and then warn students off using such counterproductive strategies at inappropriate junctures.

Conversely, a sophisticated HANGMAN program would encourage CB behaviors. For example, there might be prompts or function keys to suggest to students productive ways of opening the game. Accordingly, the student might be asked "How do you wish to start?" and choices should include: (1) automatic entry of all vowels and (2) with a HINT. Furthermore, the program should keep track of hints in such a way that it is clear to students that judicious use is allowed; abuse is not. For example, revelation through hints of up to half the letters in a word could be permitted; beyond that (or some other figure) hints might be disallowed.

VII. CONCLUSION

The purpose of this paper has been to resolve the question of whether HANGMAN is a waste of time or a valid and viable means of practicing vocabulary. The answer is some of both. The study has shown that one body of students was caught wasting almost half its time with the game, but the study also provides a breakdown of how this time was wasted and suggests improvements to HANGMAN accordingly. As with any item of courseware, the question is not whether the program is effective, but: what is it about the program that determines its effectiveness? The contribution of the present survey has been in shedding light on this question in hopes of providing insights applicable to improvements to computer-based implementations of HANGMAN and to CALL programming in general.

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TABLES

Key to Abbreviations in Tables

OK no hint = Solving a problem correctly without hints
OK w/hint = Solving a problem correctly, using hints judiciously
Ht/no hng = Requesting SOLUTION or HINT only to avoid imminent hangin
Unav/h = Being unavoidably hanged, without detectable NCB behavior

See soln = Seeing the SOLUTION before solving the problem
Ht abuse = Abusing the HINT option
End Clus = Typing clustered or contiguous keys when nearing solution
Alphabet = Typing the alphabet when nearing solution
Suicide = Committing suicide by holding one key down

Table 1

Arab university students attempting 790 words in 100 sessions

Competency-based transactions:

	OK no hint	OK w/hint	Ht/no hng	Unav/h	TOTALS
occurrences	275	102	4	70	451
% of total	34.81	12.91	0.51	8.86	57.09%

Non-competency based transactions:

	See soln	Ht abuse	End clus	Alphabet	Suicide	TOTALS
occurrences	105	78	108	8	40	339
% of total	13.29	9.87	13.67	1.01	5.06	42.91%

Table 2

Instructors working HANGMAN generating words deriving from Romanized transliteration of Arabic scripts, 111 words in 8 sessions

Competency based transactions:

	OK no hint	OK w/hint	Ht/no hng	Unav/h	TOTALS
occurrences	60	32	0	10	102
% of total	54.05	28.83	0.00	9.01	91.89%

Non-competency based transactions:

	See soln	Ht abuse	End clus	Alphabet	Suicide	TOTALS
occurrences	4	1	3	1	0	9
% of total	3.60	0.90	2.70	0.90	0.00	8.11%

Table 3

For instructors working HANGMAN using
the database of words available to students, 51 words in 7 sessions

Competency based transactions:

	OK no hint	OK w/hint	Ht/no hng	Unav/h	TOTALS
occurrences	38	5	0	4.00	47
% of total	74.51	9.80	0.00	7.84	92.16%

Non-competency based transactions:

	See soln	Ht abuse	End clus	Alphabet	Suicide	TOTALS
occurrences	3	0	1	0	0	4
% of total	5.88	0.00	1.96	0.00	0.00	7.84%

Additional Figures

(Figures 2 and 4 are already inserted in the text.)

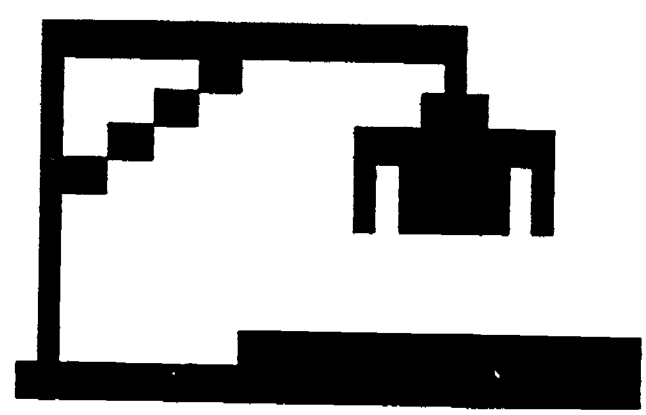
Figure 1

Figure 3

```
HANGMAN 2.2 by  S Millmore & V Stevens 1990          File name: photo.txt
 ?ho?og?a?h?                                       Word  1  of  1  words

Type letter here> w

-----------------------------------------------------------------------------
a b c d e f g h i j k l m n o p q r s t u v w x y z
a b c d e f g h i     l     o           u   w
-----------------------------------------------------------------------------
Correct:      4   Total score:     31
Incorrect:    9   Hints:            0
```



```
F1 = Help    F4 = Sound now on    F5 = See Solution    F8 = Hint    F9 = Qu
```