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Computer-Assisted Language Learning as a Predictor of Success in Acquiring English as a Second Language

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This article reports the results of a study of the effectiveness of computer-assisted language learning (CALL) in the acquisition of English as a second language by Arabic- and Spanish-speaking students in an intensive program. The study also examined two student variables—time spent using and attitude toward the CALL lessons—as well as four cognitive/affective characteristics—field independence, ambiguity tolerance, motivational intensity, and English-class anxiety. English proficiency was measured by the TOEFL and an oral test of communicative competence. Results indicated that the use of CALL lessons predicted no variance on the criterion measures beyond what could be predicted by the cognitive/affective variables. In addition, it was found that time spent using and attitude toward CALL were significantly related to field independence and motivational intensity. These results indicate that (a) certain types of learners may be better suited to some CALL materials than other students and (b) it is necessary to consider many learner variables when researching the effectiveness of CALL.

Three questions are often asked about computer-assisted language learning (CALL): Do students like it? Do students use it? Does it work? These questions address practical concerns, yet they are based on two faulty assumptions. First, they assume that students think and act in a uniform manner, even though teachers and researchers alike agree that students differ in their learning styles and strategies. Second, the questions presuppose that CALL is a single method of instruction, whereas it is actually a vehicle for implementing a range of approaches representing a variety of teaching philosophies. These points do not deny the basic

importance of asking questions about the value of CALL; instead, they indicate the need to modify the questions: What kind of students like and use a particular type of CALL? Do those students who use CALL achieve greater success in the second language?

These were the questions posed in the research reported in this article, which sought to (a) characterize students who chose to use CALL when they had the option to do so and (b) discover whether students' use of CALL accounted for variance in end-of-semester ESL performance beyond what could be explained by other variables.

COMPUTER-ASSISTED LANGUAGE LEARNING

To evaluate the effectiveness of CALL, it is important to understand the reason for having students practice ESL on the computer. Computer-assisted instruction (CAI) has evolved around three distinguishable, though interrelated, instructional ideals: individualization, record keeping, and answer judging.

Individualization in CAI refers to the fact that the computer enables students to work alone and at their own pace. Through the use of individualized instruction, poor students can attain additional practice outside of the classroom so that the teacher does not have to slow down the rest of the class. Individualization also allows the teacher to maintain the interest of good students by providing them with advanced materials. Individualized instruction provided by CAI has been used as an adjunct to classroom instruction in some cases and as the sole method of instruction in others (Chapelle & Jamieson, 1983; Otto, 1981; Smith & Sherwood, 1976; Suppes, 1981).

To provide an individualized learning environment, many developers have used a systems approach to design: A learning hierarchy is formulated, and a diagnostic mechanism is used so that either the computer program or the student can decide when the student needs to review (Bunderson, 1970; Dick & Carey, 1978; Tennyson, 1981). The difficulty, however, is in designing a diagnostic mechanism that will enable each student to proceed along a tailor-made path. Although its potential has been demonstrated, individualization has not been achieved at a sophisticated level (Hart, 1981; Kearsley, Hunter, & Seidel, 1983). To provide a student with an ideal learning path through a lesson, the lesson author must have a well-defined understanding of how students learn.

This traditional view of individualization in CAI has recently been seen in a new light. Some educators have proposed that students use the computer as a means of exploring and playing with

material (such as the target language) through group work, games, and student-initiated exchanges (Higgins & Johns, 1983; Underwood, 1984). In such an environment, students create their own learning experiences; therefore, it is difficult for the lesson designer to know what (and if) each student learns from a lesson, particularly in the case of students who have typically been unsuccessful (Steinberg, 1977).

The capability of collecting data and keeping records is a second advantage of CAI. Data on any interaction that occurs between the student and computer can be collected and subsequently analyzed. For example, students' wrong answers in a drill can be collected and analyzed to improve the program's error diagnosis and remediation. Record keeping is also beneficial for providing the student and/or teacher with a profile of the student's mastery of material (Marty, 1981, 1982). Another benefit of record keeping is in the area of research; data can be collected to search for patterns in students' learning.

Some CAI materials have incorporated research findings that indicate students learn better when (a) they have to answer questions (rather than simply read material) and (b) they receive "knowledge of the correct response" (e.g., Anderson, Kulhavy, & Andre, 1971; Sassenrath, 1975). Thus, the third advantage of CAI is embodied in answer judging. Answer judging occurs after students answer a question posed by the computer: The computer informs them whether it is right or wrong. Moreover, if the answer is wrong, the program should provide students with a meaningful explanation as to why the answer is wrong. If the program can recognize and classify students' wrong answers, then it can save this information as student records and provide students with appropriate remedial activities (Hartley, 1974; Marty & Meyers, 1975).

Although the potential of each of these ideals has been demonstrated, their implementation on a large scale remains to be seen. In spite of the limitations of current courseware, a number of studies have been done on attitude and achievement with CAI. This research indicates that CAI is usually a popular method of instruction which is typically as effective as regular classroom instruction and may require less time on task for mastery of the target skills (e.g., Collins, 1978; Freed, 1971; J. A. Kulik, Bangert, & Williams, 1983; J. A. Kulik, C.-L.C. Kulik, & Cohen, 1980; Tsai & Pohl, 1977, 1980; Van Campen, 1981), although there are notable exceptions to this conclusion (Alderman, 1978; Murphy & Appel, 1977).

Attempts to put these ideals into practice in ESL courseware have resulted in lessons that differ from one another in a number of

relevant ways. First, ESL courseware is used to teach skill areas such as reading, writing, listening, and grammar, as well as to provide practice in using the target language by engaging the student in games or problem-solving activities. Lessons also differ with respect to the use of the target language: Some lessons use discrete elements within the language to delimit and simplify the learning task; others incorporate language in a natural context, allowing the student to practice in a more authentic L2 environment. A third difference is the kind of learning objective. Some lessons have very clearly defined objectives (e.g., the student will form the present perfect correctly); others do not (e.g., the student will interact with the program to discover its limitations). Finally, a lesson can be characterized by placing it somewhere along a continuum ranging from machine-controlled to student-controlled. In a machine-controlled lesson, the instructional decisions are made by the program; the student simply follows the program's instructions. A student-controlled program, on the other hand, allows the student much freedom in initiating learning decisions.

METHOD

Subjects

The students enrolled in the Intensive English Institute at the University of Illinois during the Fall 1982 semester were invited to participate in the research by a letter translated into their native languages. Of the 84 students in the Institute, 28 Spanish-speaking and 20 Arabic-speaking students agreed to participate. The subjects ranged in age from 18 to 40 and had TOEFL scores ranging from 430 to 510.

Materials and Procedure

The ESL PLATO courseware is primarily a drill and practice curriculum of lessons in three skill areas: grammar, reading, and listening. Although the content differs, the lessons share many design features.

Grammar is presented in two series of lessons. The first, a series of 20 Remedial Grammar lessons, provides an intensive review of grammatical points for beginning ESL students. These lessons assume a very low vocabulary level, include a simple grammatical generalization, and provide extensive practice of specific grammar points using a wide variety of exercises. A built-in review is provided for items that are missed in each exercise.

The second series, 16 Advanced Grammar Review lessons,

provides extensive reinforcement and practice of a wide range of advanced grammar points. These lessons provide supplementary practice with minimal grammar explanations. Each of the lessons consists of at least four mechanical exercises, including substitution, transformation, question/answer, and fill-in-the-blank drills. Items answered incorrectly in these lessons are also recycled for reinforcement (see also, Stevens, 1983).

The reading lessons are also subdivided into two different series. The lower-level Vocabulary and Culture series consists of 12 lessons that simultaneously introduce and teach real-world vocabulary, familiarize the student with some important aspects of American culture, and check on the student's command of specific grammar points, in accordance with the Remedial Grammar lessons. The lessons portray the main character, Peter Adams, in his dormitory room, at the local post office, at a restaurant, and so on.

The objectives of the higher-level Reading and Comprehension series are to (a) test comprehension of a passage, (b) increase reading speed, (c) increase active and passive vocabulary, and (d) acquaint foreign students with some aspects of American culture and history. The reading passages in each of the eight lessons consist of six or seven paragraphs that are displayed individually. While reading each paragraph, students have the option to ask for definitions of words. If a queried word was anticipated as a troublesome vocabulary item, students are given three synonyms from which to choose; otherwise, they are told that the word is not in PLATO's dictionary. After students have read all of the paragraphs, they first answer multiple-choice comprehension questions about each paragraph, then complete a restatement or paraphrase exercise, and finally type a derivative of a keyword in the correct grammatical context.

The listening lessons are of two different types, Spelling and Dictation, each of which has two levels corresponding with the low and high levels in grammar and reading. The two Spelling series, each of which has 14 lessons, differ only in the level of difficulty of the words. The instructional exercises used in these series elicit both aural recognition and written production from the student. Each lesson consists of three lists of 10 words. Students first see a list of the words. Then they hear a word in isolation, in a sentence, and repeated in isolation. For example: "morning. John reads the newspaper in the morning. Type *morning*." Some spelling errors are anticipated based on contrastive analysis of English and other languages. Incorrectly answered items are recycled at the end of each of the three segments of the lesson.

The Dictation series also has 14 lessons at each of the two levels

of difficulty. Each lesson contains two parts, a list of 10 sentences and a paragraph of 5 sentences. Students touch the screen, which in turn activates a random-access audio device, and they then hear a sentence through their headphones (much like in the Spelling lessons). Students have the option of hearing all or part of the sentence as often as necessary to complete the task, which is to type the sentence. An answer with an error is indicated to students not only by a “wrong” message but also by special symbols that indicate misspellings, inversion, errors in capitalization and punctuation, or extra words. After the correct answer has been entered, students have the option of continuing or of recording their voice and then comparing it to the model, as in a language laboratory.

All of the lessons in the eight series described above have some common design features. The lessons, which do not give students practice with global language use, employ discrete elements of language to present materials which have a clearly defined objective. For example, in the Dictation lessons students hear a sentence such as “The women asked for some instructions,” which they are directed to type. The sentence occurs in the lesson at this point to provide students with practice on past tense and quantifiers. After completing this item correctly, students can go on to the next, which may have nothing to do with what the women did with the instructions—no meaningful context is built. The PLATO lessons are more machine-controlled than learner-controlled. Although students choose from a menu the order in which they will complete the week’s lessons, the lessons themselves provide the learners with very few options.

Variables

To learn what kind of students were CALL users, it was necessary to examine a number of student variables. Affective and cognitive differences among individuals are numerous and multidimensional; however, on the basis of previous research, several variables were isolated for their importance in second language acquisition.

Field independence/dependence. Field independence/dependence (FI/D), a cognitive variable, is defined as “the extent to which a person perceives part of a field as discrete from the surrounding field as a whole, rather than embedded, or . . . the extent to which a person perceives analytically” (Witkin, Moore, Goodenough, & Cox, 1977, p. 7). A field independent (FI) person tends to approach problem solving analytically, while a field dependent (FD) person tends to approach problem solving in a more global way. In the area of intellectual problem solving, a highly FI person is able to detect

patterns and subpatterns, while an FD person tends to get lost in the totality of the stimuli. Consequently, an FI person is at an advantage in problem-solving situations in which isolating and manipulating a critical element are important, such as word problems in mathematics (Witkin et al., 1977). An FD person, on the other hand, is more capable of perceiving the total picture in a situation.

An FI person may have good analytical language skills, such as those needed in many classroom environments, while the FD person would logically be better at acquiring a second language through interaction with native speakers in social situations. However, research supports only the former claim (e.g., Bialystok & Frölich, 1978; Hansen & Stansfield, 1981; Naiman, Fröhlich, & Stern, 1975; Roberts, 1983).

The Group Embedded Figures Test (Oltman, Raskin, & Witkin, 1971), in which subjects are asked to find a given simple figure embedded in each of 18 complex figures, was used to measure FI. One point is given for each item answered correctly so subjects with high scores are considered FI.

Ambiguity tolerance. Ambiguity tolerance (AT) can be defined as a person's ability to function rationally and calmly in a situation in which interpretation of all stimuli is not completely clear. People who have little or no AT perceive ambiguous situations as sources of psychological discomfort or threat (Budner, 1962). These feelings may cause them to resort to black-and-white solutions (Frenkel-Brunswik, 1949) and to refuse to consider any gray aspects of a situation. They may also strive to categorize phenomena rather than order them along a continuum (Levitt, 1953); moreover, they may arrive at premature closure (Frenkel-Brunswik, 1949) or jump to conclusions rather than take time to consider all of the essential elements of an unclear situation. People with little AT may also try to avoid ambiguous situations. Individuals who have a great deal of AT, on the other hand, enjoy being in ambiguous situations and, in fact, seek them out. They are believed to excel in the performance of ambiguous tasks (MacDonald, 1970).

Of course, L2 situations vary with respect to the amount of ambiguity present. Although ambiguity is present in any L2 situation, there is less in a formal language class in which individual elements of language are isolated for study and more in an immersion situation in which the learner has to attend to all language cues simultaneously. Research (Chapelle, 1983; Naiman et al., 1975) supports the claim of a negative relationship between AT and L2 acquisition.

AT was measured by the MAT-50 (Norton, 1975), a 62-item, Likert-type scale which consists of statements concerning work,

philosophy, art, and other topics. Subjects are to indicate agreement or disagreement with these statements on a 7-point scale. An example (Item 30) is given below.

A group meeting functions best with a definite agenda.

YES! YES yes ? no NO NO!

A subject who answers this and similar statements with a “YES!” would get a low total score on the AT test.

Motivational intensity. Motivational intensity (MOT) refers to the strength of a student’s desire to learn the L2, as reflected by the amount of work done for classroom assignments, future plans to make use of the language, and the effort made to acquire the language. The logical and empirically supported hypothesis is that MOT contributes to success in L2 acquisition (e.g., Gardner & Lambert, 1959; Gardner, Smythe, Clement, & Gliksmann, 1976).

MOT for learning English was measured by a subscale of Gardner and Smythe’s (1979) Attitudes and Motivation Test Battery (AMTB), which consists of 10 items, such as the one below (Item 68).

If my teacher wanted me to do an extra assignment, I would:

- a. only do it if the teacher asked me directly.
- b. definitely volunteer.
- c. definitely not volunteer.

Students who choose Alternative b in response to this and similar questions would get the highest score for MOT; students who choose Alternative c would get the lowest score.

English-class anxiety. English-class anxiety (ANX) is the degree to which the student feels uncomfortable and nervous in the L2 classroom. Because research has found anxiety to be both positively (e.g., Chastain, 1975; Kleinmann, 1977) and negatively (e.g., Gardner et al., 1976; Swain & Burnaby, 1976) related to performance in various language situations, a distinction has been proposed between “facilitating” and “debilitating” anxiety (Scovel, 1978). The effects of ANX on L2 acquisition appear to depend on the amount and kind of anxiety that the learner has, as well as on the L2 environment.

ANX was also measured by a portion of the AMTB, which consists of five questions, one of which is given below (Item 18).

I am afraid that the other students in the class will laugh at me when I speak English.

Students are asked to indicate their agreement or disagreement on a 7-point scale ranging from *strongly disagree* to *strongly agree*. A

student who strongly agreed with this and similar questions would get a high score for ANX.

Attitude toward CALL. Students' attitudes toward using the PLATO lessons were assessed through three items on a general student information questionnaire (Chapelle, 1983) which focused on students' past experiences with foreign language study and current preferences in L2 study. An example of the questions used to elicit information is given below (Item 22).

Do you like to do English lessons on PLATO?

- a. Yes, very much.
- b. Yes.
- c. It's OK.
- d. Not really.
- e. No, I hate it.

Time spent using CALL. In addition to the self-report data, a measure of students' actual behavior toward CALL was obtained by tabulating the number of hours each student spent working on PLATO over the course of the semester. Each student in the intensive program is routinely assigned to work 4 hours a week in the PLATO lab. Strictly speaking, however, this lab time is not required because neither lab work nor attendance is calculated as part of the student's grade. Consequently, students who do not care to work on PLATO typically spend fewer than their scheduled hours in the lab or cease to go to the lab at all. On the other hand, those students who like to use CALL visit the lab during their scheduled time as well as during the lab's open hours.

English proficiency. Students' English proficiency was measured at the beginning and the end of the semester by the TOEFL and an oral test of communicative competence (Bachman & Palmer, 1982). The latter, which was developed and validated on the basis of Canale and Swain's (1980) theoretical model of communicative competence, measures three general competence areas: grammatical, pragmatic, and sociolinguistic.

In addition to the tests of English proficiency administered at the beginning and the end of the semester, the subjects were given the tests of FI, AT, ANX, and MOT and the student information questionnaire in the seventh week of the semester. All of these had been translated into their native languages.

Analysis

The data were analyzed using SPSS (Nie, Hull, Jenkins, Steinbrenner, & Bent, 1975) to perform procedures corresponding to the two questions posed in the study. A series of analyses was

done to address the first question, What kind of student likes to use CALL? After the measures were found to have adequate reliabilities (all $> .71$), Pearson product-moment correlations were calculated to determine if students' cognitive/affective characteristics were related to time spent using CALL and attitude toward CALL. Then, a multiple regression analysis was performed to determine if one predictor variable accounted for the variance in time and attitude.

The second part of the analysis focused on the question of whether those students who used PLATO more frequently got higher scores on the end-of-semester criterion measures. The correlations between end-of-semester scores and the predictor variables—beginning-of-semester language measures, student cognitive/affective characteristics, and time spent using CALL—were calculated. Multiple regression analyses, using the end-of-semester language measures as dependent variables, were then performed.

RESULTS

Time, Attitude, and Student Affective/Cognitive Factors

The first question under investigation, whether students' cognitive/affective characteristics were related to their time spent using and attitude toward CALL, can be answered in the affirmative with respect to the subjects tested. There was a significant negative correlation between field independence and both time and attitude, indicating that highly field independent students tended not to like to work on CALL (see Table 1).

TABLE 1
Pearson Product-Moment Correlations Among Nonlanguage Measures

Variable	2	3	4	5	6
1. FI	.205*	-.184	-.394**	-.394**	-.423**
2. AT	—	.021	-.185	-.115	-.197
3. MOT		—	.007	.257**	.511***
4. ANX			—	.037	.152
5. Time				—	.591***
6. CATT					—

Note: FI = field independence; AT = ambiguity tolerance; MOT = motivational intensity; ANX = English-class anxiety; Time = time spent using CALL; CATT = attitude toward CALL.

* $p < .10$. ** $p < .01$. *** $p < .001$.

A significant positive correlation was found between motivational intensity and both time and attitude. In other words, those students who reported themselves to be working hard at learning English also tended to spend a lot of time using CALL and had a more positive attitude toward it. The relationship between motivational intensity and attitude toward CALL (what students said they liked) was stronger than that between motivational intensity and time spent on PLATO (what students actually did). The similarity of the self-report types of questions on the attitude and motivational intensity measures undoubtedly accounts for some of their shared variance. The significant ($p < .001$) positive correlation between the time students spent using CALL and their attitude toward CALL indicates that there is a strong relationship between what students said they liked and what they actually did.

There were no significant correlations of ambiguity tolerance and English-class anxiety with time and attitude. It was expected that students who preferred a more structured environment (those with low AT) would like to work on the PLATO lessons, that is, that AT would correlate significantly, but negatively, with attitude and time. In fact, the direction of the relationship was negative, but not to a significant degree. Similarly, it was thought that students who felt nervous in English classes would like working on English at their own private terminals. The nonsignificant correlations between ANX and the CALL variables did not support this frequently made claim.

Because field independence and motivational intensity were both significantly related to time and attitude, it was necessary to determine if both variables were needed to account for the variance in time and attitude. In other words, was it simply that the motivated students liked to use CALL and that they just happened to be field independent as well? To answer this question, four multiple regression analyses were performed (see Table 2).

Using time and attitude as dependent variables, motivational intensity was entered into the equation and found to be a significant predictor for both variables. Field independence was then entered into the equation and also found to be a significant predictor for both variables. If field independence had been significantly related to time and attitude simply because it was also related to motivational intensity, it would not have been found to be a significant predictor when entered into the multiple regression analysis after motivational intensity.

The second pair of regressions addressed the question in the reverse order: Are the students who liked to use PLATO those with little field independence who just happened to be motivated? Time

TABLE 2
Multiple Regression Analyses

Dependent variable	Step	Variable entered	<i>r</i>	R ²	<i>F</i>
Time	1	MOT	.264	.070	2.9*
	2	FI	-.347	.161	4.1**
CATT	1	MOT	.553	.306	17.2***
	2	FI	-.447	.427	8.1**
Time	1	FI	-.347	.120	5.3**
	2	MOT	.264	.161	1.8
CATT	1	FI	-.447	.200	9.8**
	2	MOT	.552	.427	14.2***

Note: FI = field independence; MOT = motivational intensity; Time = time spent using CALL; CATT = attitude toward CALL.

* $p < .10$. ** $p < .01$. *** $p < .001$.

and attitude were again used as the dependent variables, but this time, however, field independence was entered first. Motivational intensity was found to predict a significant amount of additional variance in attitude, but not in time. Since motivational intensity and attitude toward CALL were both self-report measures, some of their shared variance can be accounted for by this similarity. Time spent on PLATO, on the other hand, was a measure of what students did—their actual behavior. On this measure, FI alone accounted for all of the explained variance; motivational intensity was not a significant predictor.

These analyses indicate that students who are not FI show a significant preference for using CALL; moreover, FI was the exclusive predictor of time spent on PLATO. In interpreting these results, it is important to underscore the fact that the ESL lessons on the PLATO system cannot be equated with all possible CALL; instead, they represent a particular approach—one taken in many CALL lessons—but certainly not the only possible approach. The findings of this study might have been quite different if the lessons offered on the PLATO system had represented a greater variety of approaches.

It is likely that the FI students, who are capable of and accustomed to using their own internal referents, found the structured approach of the lessons in the ESL PLATO series to be inconsistent with their learning styles. They may have found it irritating to have information and exercises structured in a way different from how they would have done it for themselves. Lacking the stimulation of using their own capabilities to select and

organize relevant language details, they may have been bored. Perhaps these qualities of the ESL PLATO lessons were unattractive to FI students.

In contrast, students with little FI may have liked being provided with a fixed set of exercises to work through. These students tend to rely on others to formulate objectives and point out important points, a role played by the PLATO lessons.

CALL as a Predictor of Second Language Success

The second question was whether those students who used CALL more would receive higher scores on the end-of-semester English tests than those who spent little time using CALL. If the significant negative correlations between time and end of semester scores, presented in Table 3, are seen as the answer to the CAI effectiveness question, then those students who spent the most time using CALL were those who did poorly on the end-of-semester tests. (See Chapelle & Roberts, in press, for a discussion of the negative correlations between motivational intensity and the language measures.) Before drawing that conclusion, however, it is necessary to consider simultaneously the other variables related to end-of-semester ESL proficiency.

TABLE 3
Pearson Product-Moment Correlations Between the Nonlanguage Measures
and the End-of-Semester Language Measures

End-of-semester language measure	Nonlanguage measures				
	FI	AT	MOT	ANX	Time
TFL 2	.750***	.237*	-.465***	-.303**	-.481***
CC 2	.539***	.062	-.529***	-.180	-.336**

Note: FI = field independence; AT = ambiguity tolerance; MOT = motivational intensity; ANX = English-class anxiety; Time = time spent using CALL; TFL 2 = end-of-semester TOEFL; CC 2 = end-of-semester speaking test.

* $p < .10$. ** $p < .01$. *** $p < .001$.

Several other factors must be added to predict improvement. First, because end-of-semester test scores alone do not represent the differences in progress made by students throughout the semester, beginning-of-semester English scores must also be taken into account. Second, use of the PLATO lessons cannot be considered

as a sole predictor of success because many factors come into play in L2 acquisition, among which are the affective/cognitive factors measured in this study. Thus, the question of CALL effectiveness must be posed as follows: Does time spent using CALL predict variance in end-of-semester English proficiency beyond what can be predicted by beginning-of-semester English proficiency and affective/cognitive characteristics?

To answer this question, a multiple regression analysis was performed using end-of-semester scores on the language tests as the dependent variables (see Table 4). The first variable entered into the equation was the corresponding beginning-of-semester score. Of course, the beginning-of-semester score was a significant predictor of the corresponding end-of-semester score; that is, those students who did well on the language tests at the beginning of the semester tended to be those who did well at the end of the semester. Entering the cognitive/affective variables accounted for an additional portion of the variance in end-of-semester scores. Specifically, on the TOEFL, FI and AT were found to be significant predictors of success; on the test of oral communication, FI and MOT were significant predictors. Time spent using CALL was added to the equation last to determine if this variable could account for additional variance. Time spent using CALL was not a significant predictor—either positive or negative—of end-of-semester performance on the language measures after other relevant variables had been entered.

CONCLUSIONS

Learners and Lessons

The fact that FI students tended not to like to use the CALL lessons on PLATO raises the question of what kind of instruction they might like better. As suggested, these students may prefer to use their natural abilities to structure information rather than to be presented with lessons which define the course of their learning—a suggestion consistent with the FI individual defined by Witkin et al. (1977). However, it is necessary to ask not only what kind of instruction FI students might like but also what kind of lessons they might benefit from.

There is some evidence indicating that learners are more successful when the method employed in a particular learning activity matches their cognitive style. For example, in a series of experiments (Pask, 1976) in which students were classified by cognitive type as either holist or serialist, the results showed that instruction matched to the learner's style favors learning and that

TABLE 4
Multiple Regression Analyses

End-of-semester language measure	Step	Variable entered	<i>r</i>	R ²	<i>F</i>
TFL 2	1	TFL 1	.931	.866	239.3***
	2	FI	.737	.907	15.8***
	3	AT	.225	.918	4.9**
	4	ANX	-.289	.922	1.4
	5	Time	-.449	.925	1.4
CC 2	1	CC 1	.796	.634	64.0***
	2	FI	.612	.708	9.0**
	3	MOT	-.506	.736	3.8*
	4	AT	.034	.740	.4
	5	ANX	-.218	.741	.0
	6	Time	-.322	.748	.9

Note: The program omitted MOT from the TOEFL regression because the *F* value was too low. FI = field independence; AT = ambiguity tolerance; MOT = motivational intensity; ANX = English-class anxiety; Time = time spent using CALL; TFL 1, TFL 2 = beginning-of-semester and end-of-semester TOEFL; CC 1, CC 2 = beginning-of-semester and end-of-semester speaking test.

* $p < .10$. ** $p < .01$. *** $p < .001$.

“mismatched instruction completely disrupts it . . . and leads to specific types of misconceptions” (p. 138). In another study (Zampogna, Gentile, Papalia, & Silber, 1976), students’ conceptual level was significantly predictive of their preference *and* need for structure in their L2 learning environment.

When these considerations are added to the fact that cognitive/affective characteristics influence success in L2 acquisition, it is clear that there is a need for individualized instruction for students who are at a disadvantage in a typical L2 situation. Off-line activities using such an approach have been described in great detail (Birckbichler & Omaggio, 1980) for students who are, for example, too impulsive, field dependent, or intolerant of ambiguity. The purpose of such an approach is to provide students with remedial tasks that address not only the content area in which they are having problems but also the cognitive strategies that they do not naturally employ. These possibilities for individualized instruction might be greatly enhanced through the use of interactive, on-line activities for students with special problems.

Though in some sense this application of research is premature, it points toward a possibly fruitful direction for CALL to explore. Current CALL is notoriously “insensitive” to individual learner differences (Hart, 1981), as a typical lesson presents all learners with

the same approach, albeit each at their own speed. To lay the groundwork for more sensitive lessons, the interaction of learning style and method of instruction must continue to be researched.

CALL Effectiveness

The research reported here casts a new light on the question of CALL effectiveness in the context of L2 acquisition. CALL cannot be evaluated without looking at the other student variables—some of which were assessed in this study—that are important in L2 acquisition. In a study of an intact group like the one reported here, it would have appeared that use of CALL predicted low ESL proficiency scores if other variables had not been considered (see Table 3). Consideration of FI, which was negatively correlated with time using CALL and positively correlated with ESL proficiency, rendered time spent using CALL nonsignificant (Table 4). Relevant student variables must also be taken into account in a control/treatment design assessing use of CALL versus no use of CALL. In this type of experiment, unintentional placement of FI students, for example, in one of the groups would cause the results to be distorted.

Clearly, CALL effectiveness cannot be looked at as though CALL represented one form of instruction and all students were in need of that kind of instruction. Instead, effectiveness must be analyzed in terms of the effects of defined types of lessons on students with particular cognitive/affective characteristics and needs. To do this, it is necessary to assess the characteristics of students and analyze the approach taken in a particular lesson or series. Through this thoughtful observation of students and approaches, progress can be made toward successful matching of students and lessons.

This is not a new idea; instead, these results emphasize the importance of the cognitive approach in educational research, as defined by Wittrock (1979):

It is more useful and meaningful to study, for example, how [approach] influences the attention, motivation and understanding, which in turn influence behavior, than it is useful and meaningful to study how [approach] directly influences student behavior. From this point of view, the art of instruction begins with an understanding and a diagnosis of the cognitive processes and aptitudes of the learners. (p. 5)

We have not yet scratched the surface of what CALL can provide in terms of individual instruction for language learners. Researchers and educators must continue to describe the strategies used by good language learners and to assess cognitive/affective characteristics that are important in L2 acquisition. In this way, our understanding

of L2 acquisition can be reflected in the intelligent use of computerized lessons and ultimately in the development of more "intelligent" lessons.



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