CHAPTER 8

SUMMARY AND CONCLUSIONS

The results of this research, while by no means conclusive, support previous indications in the literature that CAI is an effective means of delivery for educational materials, and that students have positive attitudes toward its use in their learning. The results are even less conclusive on the question of choice and control in CAI. However, this thesis has produced evidence suggesting that courseware allowing choice and control may result in more intense learning than does courseware that engages students less actively. The evidence also suggests that students have generally favorable attitudes toward CAI, and that students working the lessons in which choice and control were allowed had more favorable attitudes toward their experience than did those who worked the regular lessons.

8.1 Indications Concerning the Hypotheses

8.1.1 The Effectiveness of CAI and of Choice and Control

It was first hypothesized that both CALL lessons created for this experiment would be successful in teaching choice of gerund or infinitive complements after the matrix verbs 'stop', 'remember', 'forget', and 'regret'. It was further hypothesized that this teaching would be more effective when choice and control were programmed into the CALL lessons.

The lessons used in this study were proven effective only for the native speaking remedial English students. The lessons were effective with the non-native speaking ESL students only when the students were allowed to choose sentences they wanted to work and to control their movement within the lesson (but this effectiveness was not established at $\alpha = .05$). Conversely, the native speaking subjects appeared, according to statistical analysis, to make greater gains when denied choice and control.

These findings suggest that the lessons created for this project were most effective at "reminding" learners what they possibly already "knew". In other words, the NS subjects generally began treatment already having some command of the grammatical subject matter being taught, and the lessons were shown to be definitely effective only in perfecting this knowledge. That CAI might be especially successful in this kind of language learning suggests possible applications for remedial English students, and perhaps even for NNS "false beginners" reviewing grammar they have already studied at some previous time. However, the fact that NNS's with little or no prior knowledge of the grammatical subject being dealt with showed negligible results after having worked the REG lessons suggests that the success of such stand-alone units with students with no

prior knowledge of the subject matter being taught is by no means guaranteed.

The findings from the two research sites concerning the variables of choice and control appear to be in contradiction. It seems that the NNS subjects responded positively to having choice and control, making gains in learning which, while not statistically significant, were markedly better than those made by NNS subjects denied choice and control. The fact that they made these gains after working a fraction of the problems worked by the REG group -- and after having spent a part of their allotment of computer time adjusting to using the game paddles -- makes their gains in learning that much more striking. This leads the researcher to speculate that, for the NNS's learning a totally new grammar concept, the time spent at the computer was richer in learning for the PDL students cogitating over problems they themselves had chosen than it was for the REG students, who were working problems proffered by the computer one after another. The researcher further speculates that significant results might have been achieved for the former group had an experiment been constructed giving them enough time at the computer to get comfortable with the medium and to all work the recapitulation portion of the lesson.

An apparent contradiction to this speculation arises when reviewing the results from the NS students at LCC. In this

part of the study, greater gains were shown for students working the REG lessons than for those working the PDL lessons. However, it has been pointed out that this may have been due to a combination of the ceiling effect, in which gains in learning were smothered by the fact that almost all students in the study reached virtual perfection, and of the possibility that the PDL students as a group had a better grasp of the grammatical point at the outset. Although this latter claim is not substantiated statistically, it can be seen from Tables 4 and 5 in the Appendix that the mean of the pre test scores for the PDL group is 1.2 percentage points higher than that of the REG group. Yet the difference in mean post test scores narrows to within 0.4%, and both means are within 2 points of the ceiling of 40. Therefore, any claim that the REG group displayed better learning than did the PDL group would be tenuously extended, thereby allowing for the possibility that neither group was better, or that the opposite was true.

If indeed the LCC portion of the study seriously suffered from the confounds just mentioned, then the HLC study becomes the more reliable one as far as testing the variables of choice and control are concerned. Although that study yielded no conclusive results, it appears that choice and control was a factor in the gains made by the PDL

students over those of the REG group. However, in considering the results, certain limitations should be kept in mind.

Aside from the fact that results at HLC failed to reach statistical significance, other factors influencing the outcome of the study must be reviewed here. One such factor was the logistical setting. The researcher was a guest on the premises and was forced to work his experiment around the routine at the college. Conflicts with this routine prevented, for example, the pre and post tests from being timed. Also, concessions to classroom routine and erratic attendance precluded random selection of students, although random assignment was accomplished. In addition, an insufficient number of subjects for a thoroughly controlled study compromised assessment of lesson effectiveness. Finally, student unfamiliarity with computers may have influenced their performance, especially when they had to contend with game paddles. This last problem could have been solved by giving the students more time on the computers. Most of these problems were overcome in the LCC portion of the study, but here, the lessons were too easy for the majority of the students, and this resulted in the creation of the ceiling effect noted above.

Finally, an attempt was made to determine whether having choice and control in CALL had any effect on retention. A study of retention had not been originally planned for this thesis project and was undertaken only after a chi square

analysis of the three questions at the end of the questionnaire almost showed a significant difference in favor of the PDL group students at HLC. Unfortunately, the results of a readministration of the post test at HLC was severely compromised by the fact that 5 PDL students had since left the college. Thus, the results (see Tables 1 and 2) were not at all revealing. However, it might be worthwhile examining in future studies whether retention is markedly different when courseware is designed to be cognitively engaging, especially in light of Edwards et al.'s (1975) finding that CAI in general resulted in reduced retention when compared to that found for students undergoing traditional means of instruction.

8.1.2 Attitudes of Subjects Toward CAI and Toward Having Choice and Control

As was pointed out in the last chapter, the CALL lessons seemed in general to be favorably received by students in this study, as hypothesized. This finding is consistent with similar findings noted in the literature surveyed in the first chapter. It was also hypothesized that the PDL lessons would be better received than were the REG ones, and this hypothesis was accepted, but with greater reservations than for the preceding hypothesis.

In general, students reported objecting less to restarting the PDL lesson than they did to having to restart

the REG one. Students were more prone to report that they liked having worked the PDL lesson (as opposed to the other) than were the REG students with their lesson, and they reported overall more positive feelings about their CALL experience after having worked the PDL lesson than did the REG students. However, the reasons for their having favored the PDL lesson is difficult to pinpoint. It may have been that some students simply enjoyed the novelty of using the game paddles. On the other hand, they may have genuinely been expressing their pleasure at having been extended control over their own learning. No effort was made in this thesis to determine the precise reason that they enjoyed the PDL lessons more, nor has there been much research to date into affective variables and CAI. Obviously, this is an area worth pursuing in future studies.

One interesting finding in the attitude survey done for the present project regards the variation in attitudes between students who were using the computer for the first time and those who had used computers several times before. Students with little prior exposure to computers generally entered into the experience with some trepidation but left it with positive attitudes. However, as students gained in experience with computers, their attitudes dropped toward neutrality and even into negativism. This suggests that as computers proliferate and as their use in schools becomes

more common, courseware developers are going to be greatly challenged to produce courseware that will interest this technologically oriented generation of students.

As with the quantitative portion of the study, limitations existed with the attitude survey which acted as confounding variables. The major confound was that it was impossible to give the follow up questionnaire to each student at a set time after he had undergone experimental treatment without disrupting class routine at the two experimental locations. At HLC, the questionnaires were at least given out several weeks after the experiment, so that the differences in time between treatment and follow up did not vary greatly from student to student. But at LCC, students were given the questionnaire at intervals ranging from one week to one day after treatment. This discrepancy, although unavoidable since the experiment ran to within a day of the end of the school term, must be kept in mind when considering an analysis of the results.

8.2 Implications and Suggestions for Future Research

The present project was undertaken for two reasons in addition to that of testing out the experimental hypotheses. The first of these ancillary purposes was to demonstrate that a non-programming subject matter instructor (i.e., a teacher of ESL) could, working independently and within

limited time (about two months in "spare" time), learn a CAI authoring language proficiently enough to implement respectable CAI. The second purpose was to produce pedagogically sound courseware. Both these goals were accomplished, and, by extrapolation, are achievable by any other subject-matter instructor who has time to familiarize himself with an authoring system, perhaps, as in the author's case, by working through the Apple PILOT manuals.

In addition to demonstrating by example what can be done by instructors with a desire to develop CAI, the author has tried to emphasize the necessity of teachers' becoming involved in the development of what is certain to become a force in classrooms of the not-to-distant future. In becoming a part of this development, teachers must bring their perspective as educators to bear on courseware. In so doing, they should heighten their awareness of the nature of computing and strive to accomplish their instructional goals via paradigms for education that are most appropriate to implementation on computers.

As was pointed out earlier in this thesis, the development and increasing use of microcomputers have made it possible for subject matter instructors to undertake, on their own, small-scale efforts in courseware development. However, research based on these efforts is at present still hampered by the difficulty of getting large numbers of

students to the machines. Even in those fortuitous situations where students, computers, and appropriate software are all available under one roof, there exist problems in conducting research on CAI in such a way that the integrity of the medium, e.g. its ability to create an autotelic environment and its ability to encourage voluntary and spontaneous study, are preserved. Thus, there are problems to be overcome in research on CAI for which resolution is nowhere in sight.

Where opportunities for research do present themselves, the field is virtually open. Many of the suggestions for adapting various paradigms to CAI made in the first two chapters of this thesis need to be tested empirically. In addition, all manner of cognitive and affective variables, various types of feedback, modes of display, uses of graphics, color, and sound, and application of periferal devices must be tested as well for their efficacy with CAI. Research into these and other variables within the medium of CAI itself, such as that done for the present project, has so far been largely neglected; hence, the possibilities for such research are endless.

Although much can be discovered about CAI given present technologies and educational settings, progress in these areas will create opportunities for even more meaningful research. Although effective in their present numbers,

computers will not begin reaching optimal levels of effectiveness in education until they become as common as electronic calculators, at which time they will be used leisurely by teachers and students alike in settings ranging from institutions to homes. As intimated in the foregoing discussion, only when computers reach this level of acceptance, a level at which their use is not something out of the ordinary, will real knowledge of the nature of their effectiveness be possible.

Likewise, improvements in software and hardware technologies will ameliorate some of the intervening variables in current attempts at researching this medium of instruction. At present, the range of software is extremely limited; software must be essentially created for almost every instance of research into CAI. This software is created by people who, having little in the way of example to draw on, know relatively little about the medium (compared with what is known about the creation of taped or filmed media, for example). Thus, limitations are imposed on research from the outset.

Technology at the delivery level is also primitive at this stage of CAI development. Taking the present project as an example, there were limitations in memory and in peripherals available that will certainly be overcome in future systems. More specifically, disk access time with

PILOT was a drawback, as were limitations on what could be stored in the computer and on disk. Future delivery and authoring systems should make possible the instantaneous interaction presently available on microcomputers only with assembly and machine language programming. Development of greater memory capacities housed in greatly reduced space will remove a further limitation hampering present development. Also, innovations such as touch-screens for microcomputers will obviate the need for relatively more awkward arrangements such as the game paddle configuration in the present project.

In summary, the author foresees continued improvements in future possibilities for language instruction using microcomputers. These improvements will greatly expand opportunities for research and development concerning this medium of instruction and learning. As educational settings become more amenable to research in and development of CAI/CALL, many of the barriers to research and development presently in existence, such as limitations on courseware and hardware and lack of teacher and subject sophistication with the medium, will fall. As this occurs, acceptance and use of CAI as an adjunct to other media of instruction will become commonplace and highly effective. Until this evolution is well under way, studies such as this one will continue to meet with limited success, but such studies

should be undertaken nonetheless, because each contributes in some way toward the culmination of this evolution.