AVC - Calgary
Computer Assisted
Reading Instruction Project
Technical Report

Prepared for

Alberta Vocational College - Calgary
Alberta Advanced Education and Career Development
National Literacy Secretariat

Alberta Vocational College - Calgary

Computer Assisted Reading Instruction Project

TECHNICAL REPORT

December 1997

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EXECUTIVE SUMMARY

Evidence is increasingly showing that for many teaching and learning situations, computer-assisted instruction (CAI) is an effective method of instruction. With growing numbers of adult learners, the results of research investigating the academic and socio-cultural impact of computer-assisted instruction can offer useful information to those adult education organizations making decisions related to program development and instruction.

In early 1996 a two-year quantitative and qualitative evaluation of computer-assisted reading instruction began at Alberta Vocational College - Calgary, Alberta. Alberta Vocational College is a post-secondary institution providing adult academic upgrading, English as a Second Language and career-entry programs of one year or less in health, business, and service industries.

The purpose of the evaluation[1] was to determine the short- and long-term effectiveness of CAI software in improving the reading skills of three groups of adult upgrading students: Adult Basic Education (ABE) students, English as a Second Language (ESL) students, and Adult Basic Literacy (ABL) students.

The qualitative evaluation collected information about the experiences and perspectives of the students and instructors involved in using CAI. The quantitative assessment considered three variables (sightwords, decoding, and comprehension) in development of reading skills.

[1]This evaluation study was made possible through a partnership between the Canadian Federal Government, the Province of Alberta, a private sector software supplier (Autoskill International), and AVC - Calgary. Funding was made available through the National Literacy Secretariat.

Method

The design of the evaluation was a quasi-experimental, non-randomized, pretest-posttest, control group design. While attempts were made to match control and treatment groups, random assignment of groups was not possible. The independent variable was the CAI program (Autoskill and/or PLATO). The dependent variables were reading performance in sightword recognition, decoding skill, and comprehension.

Treatment

The **Autoskill Reading Program** is a computerized skills-oriented learning resource aimed at promoting the acquisition of skills needed for the mastery of reading.

The **PLATO** (Basic Literacy Skills Reading - Canadian Edition) is a modularized computer-assisted instruction program designed to meet individual learner needs, and to match the objectives of learners' educational or training programs.

Effects of the treatment and a moderator variable (entry-level reading skill) were considered. Groups were combined and grouped according to treatment and control. Analyses were conducted according to: 1) Stage One ABL, ESL, and ABE students, 2) Stage Two ABL, ESL, and ABE students, and 3) Stage One and Two combined ABL, ESL, and ABE students. Groups were further categorized into low, medium, and high reading ability according to pretest results.

Assessments of reading level were conducted using the Bader Inventory, Yopp-Singer Test, and Woodcock-Johnson standardized reading inventory. Data were collected three times (pretest, posttest, 6-month follow-up retention test).

Qualitative data were collected immediately following the treatment in both Stage One and Stage Two from students and instructors. Evaluators observed students using the computer. Both survey and interview techniques were applied.

Evaluation Design

Subject Assignment	Pretest	Treatment Period	Posttest1	Posttest2
Not Random	O_1	X_1	O_2	O_3
Not Random	O_1	No X	O_2	O_3

A total of 167 students were initially registered in the study (84 Stage One, 83 Stage Two). A total of 127 students completed the study.

Stage One Participant Assignment

Group	Duration	Control Group		Treatment Group	
		Registered	Completed	Registered	Completed
ABE	15 weeks	16	16	17	13
ESL	10 weeks	16	9	17	14
ABL	20 weeks	9	5	9	4

Stage One Treatment Schedule (Autoskill Program)

Treatment Group	Duration	Hours/Day	Total Time on Autoskill
ABE	15 weeks	1-1.5 hr/day	12 hrs. (maximum)
ESL	10 weeks	1 hr/day for 5 days	50 hrs.
ABL	20 weeks	2 hrs./day for 4 days	160 hrs.

Changes to treatment and testing tools were made in Stage Two (September 1996 to June 1997) of the study. The PLATO computer-assisted reading software replaced Autoskill as the intervention for ABE and ESL students. The Woodcock-Johnson standardized reading inventory replaced the Bader Reading Inventory and Yopp-Singer Test.

Stage Two Participant Assignment

Group	Duration	Control Group		Treatment Group	
		Registered	Completed	Registered	Completed
ABE	15 weeks	16	12	17	13
ESL	10 weeks	15	11	15	14
ABL	20 weeks	9	8	11	8

Stage Two Treatment Schedule (Autoskill/PLATO Programs)

Treatment Group	Duration	Hours/Week	Total Time on Computer
ABE	15 weeks	Approx. 1 hr/week	2-12 hrs.
ESL	10 weeks	2 hr/week	20 hrs.
ABL	12-13 weeks	1 hrs/day for 4 days	48 hrs
ABL (part time) N=2	15 weeks	1 hr/week	15 hrs.

Results

Results of this study were similar to many other control studies of computer-assisted instruction. A modest to small treatment effect was observed for some variables, but for the most part, no significant differences were observed between the reading performance of students receiving computer-assisted instruction and those receiving the conventional program of studies at AVC - Calgary. Also similar to other studies of this type, is that qualitative results suggest that students in this study enjoyed working with computers and, in many instances, appeared more highly motivated to complete their academic tasks.

Computer Effect

While this study reveals few significant differences between the reading performance of students receiving computer-assisted instruction and those

receiving the conventional program of studies, statistical results indicate a gain in reading performance by some groups of students whose program included computer-assisted instruction.

The results of this study suggest that ABL and low initial entry-level readers appear to make greatest gains using CAI programs. This trend may become more significant with increased concentration and sustained used of CAI. High entry level readers did not gain significantly from the versions of Autoskill or PLATO used in this study.

Course Completion

While motivation across groups to use the computer was moderate to high, there appears to be no appreciable difference in the rate with which students successfully completed courses involving computer use.

Integration of CAI

Integration of CAI with conventional face to face instruction with ABE and ABL was higher in the Stage One than in Stage Two. Integration of CAI into the ESL program remained about the same over the two Stages. As might be expected, where CAI was more fully integrated into instruction, it had a stronger positive effect on student performance, which may suggest that a certain "critical time mass" is required for CAI to be effective.

Student Satisfaction

With the exception of the Autoskill experience for Stage One ABE students, all students in this study reported enjoying their CAI experience. They believed they received some benefit from using the computer. It is interesting to note that ESL students regarded the computer as part of course content rather than separate from it. In contrast, both ABE and ABL groups reported wanting to "learn" the computer as a tool.

Instructor Satisfaction

Before the study began, instructors received varying amounts of orientation and training on Autoskill. Their satisfaction with the training was mixed, however. Some said training was insufficient; others reported that only experience using Autoskill sufficiently prepared them to teach it. Instructors were very willing to explore CAI and were supportive and cooperative throughout the study. Overall, their satisfaction with CAI was moderate to high.

Challenges to Implementing Controlled Studies

Implementing a comprehensive evaluation study in a fully functioning college is a challenge, especially when evaluations involve elements of control. Creating equivalent treatment and control groups, as well as student attrition posed complications and compromises to the study. Results should therefore be considered within these limitations that point mainly to factors confounding experimental design studies: sample selection and assignment, treatment and control group matching, changes in test instruments, and subject attrition.

Recommendations

The following are some suggestions for the continued use of CAI with adult audiences at AVC - Calgary:

1. **Continued Use of CAI**

   CAI should continue to be used with low and mid-range reading level audiences. Autoskill can be expected to have its best effect with low level readers.

2. **Strategically Use CAI**

   Where used, CAI should be applied in a consistent and concentrated fashion. It should be used strategically and not as a blanket solution for all students.

3. **Use CAI to Reinforce Computer Skills**

   There are some value-added gains in using CAI with students. Additional time on computers reinforces previously and newly learned computer skills such as keyboarding and use of the mouse. In addition, some benefits can be attributed to the computer use in improving student confidence and self-esteem.

4. **Update PLATO**

   PLATO reading software should be updated. The current version at AVC - Calgary cannot take advantage of Windows features on 486 + computers.

5. **Continue to Evaluate Reading Software**

   AVC - Calgary should continue to evaluate reading software, especially those programs which have extensive adult content and approaches to interpret users' intentions, and stimulate mental associations, or, are rich in information resource capabilities.

6. **Continue to Evaluate CAI Use**

   AVC - Calgary should continue to monitor and evaluate the use of CAI with adult learners.

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INTRODUCTION

In early 1996 a two-year quantitative and qualitative evaluation process of a computer-assisted reading instruction program began at Alberta Vocational College, Calgary, Alberta. The purpose of the evaluation was to determine the short- and long-term effectiveness of computer-assisted instruction (CAI) software in improving the reading skills of three groups of adult upgrading students: Adult Basic Education (ABE) students, English as a Second Language (ESL) students, and Adult Basic Literacy (ABL) students.

Results presented in this report are derived from analysis of quantitative and qualitative data collected during two stages: Stage One (February 1996 to February 1997), and Stage Two (September 1996 to June 1997). Each stage involved a different cohort of students.

Qualitative evaluation collected information about the experiences and perspectives of students and instructors using CAI. Qualitative data were collected to enhance quantitative findings, which address pre-test, post-test and follow-up reading skills achievement. The quantitative assessment examined three variables (sightwords, decoding, and comprehension).

This report is presented in 10 sections: 1) Introduction; 2) Context; 3) Literature; 4) Questions; 5) Method; 6) Results; 7) Discussion; 8) Recommendations; 9) References; and 10) Appendices.

CONTEXT

Alberta Vocational College, Calgary, Alberta is a post-secondary institution providing adult academic upgrading, English as a Second Language and career-entry programs of one year or less in health, business, and service industries.

AVC - Calgary has existed for over 30 years and has developed relevant ways to make learning a lifelong experience. This expertise enables the College to successfully deliver responsive programming to meet the needs of adult learners and the demands of their employment environments. By using competency based curricula, prior learning experience can be recognised and assessed, individual learning instruction plans developed, and training programs customised.

The Basic Education Alternative Delivery (BEAD)

The Basic Education Alternative Delivery (BEAD) program uses alternative delivery strategies to offer individualised education programs to adult learners. Students may be full-time or part-time in basic mathematics, English and reading. The BEAD program features continuous enrolment, flexible attendance, individualised programs, self-paced study and computer-assisted instruction.

Students are able to register in one of a variety of locations, including the main AVC campus, urban community campuses, or several rural community campuses throughout southern Alberta. Adult Basic Education Level 1 (ABL) students are deemed to be below Grade 4 reading level, Level 2 (ABE) students at the Grade 4 to 6 range, and Level 3 students at the Grade 7 to 9 reading range.

ABE classes are available to students Monday through Thursday, 9:00 a.m. to 2:00 p.m., September to May. The student to instructor ratio is approximately 18 to one.

Full-time ABL students can attend classes for 24 hours a week; part-time students for nine hours a week. Classes are available Monday to Thursday, September to May. The student instructor ratio in ABL is ten to one with additional support from volunteer tutors.

English as a Second Language (ESL)

The English as a Second Language programs at AVC - Calgary are split into two levels--beginning and intermediate. Both programs have a comprehensive focus on building students' listening, speaking, pronunciation, grammar, reading and writing skills. Teachers use innovative teaching methods and a variety of books, films and tapes to ensure that students learn rapidly and effectively. Class size is limited in order to give students individualised attention from the instructor. New students are given placement tests and enrolled at level commensurate with their English proficiency.

The full-time ESL program provides intensive English language instruction. Students attend classes Monday, Tuesday, Thursday and Friday from 9:00 a.m. to 2:30 p.m. and from 9:00 a.m. to 12:15 p.m. on Wednesdays. Course terms are ten weeks long and run consecutively throughout the year (5 ten-week terms), including the summer. There is testing and placement in new levels each term.

The Intermediate Plus ESL program is intended to provide additional training for ESL students who exceed beginning levels and/or have high intermediate or advanced level ability in reading comprehension, but insufficient language skill to find employment or meet academic upgrading goals. This program has four fundamental courses: Conversation, Communicative Grammar, Reading and Discussion, and Improving Writing. Each course runs 4.5 hours a week on Mondays, Tuesdays, Thursdays and Fridays. Two option courses, Oral Skills Development and Introduction to Computers, are offered on Wednesdays.

Sponsorship of the Study

This evaluation study was made possible through a partnership between the Canadian Federal Government, Province of Alberta, a private sector software supplier (Autoskill International), and AVC - Calgary.

The software company contributed software at a significant discount. It should be noted that the company had no input into the design or interpretation of the study. Alberta Advanced Education and Career Development contributed expertise and was represented on the Advisory Committee. The Federal Government - National

Literacy Secretariat funded the cost of the evaluation and was kept informed throughout the evaluation process.

Evaluation versus Research

While the purpose of this study was to determine the short- and long-term effectiveness of computer-assisted instruction (CAI) software in improving the reading skills of three groups of adult upgrading students, this study was conducted as an evaluation. There are some differences between evaluation and research that contribute to the approach and interpretation of results of this Computer-Assisted Reading Instruction (CARI) study.

In general terms, the purpose of research is to contribute to theory and general knowledge. This purpose implies that the results of research should be generalizable--valid and replicable beyond the specific circumstances of the research study. Also, research aspires to attain value neutrality, although it can be argued that in practice, no research is value-free--choice of question, selection of tools, and the interpretation of results are all influenced by the interests, political affiliations, values, and beliefs of the researcher(s).

Research and evaluation may share the same or similar methods of inquiry. They do not necessarily share purpose or intent. Evaluation means to place a value on something, someone or some process. Although evaluators, like researchers, guard against biased results, their role in interpreting results is quite different. An evaluation goes beyond interpreting results as significant or not significant, to interpreting results as “good” or “bad.” Evaluations are used to inform decisions, often decisions as to whether a program, project, or process should change, continue or cease. While evaluations may transcend the particular, typically they are not designed to do so. They are designed to establish the effectiveness (often the primary criterion of the evaluation) of a program, product, or process. Other criteria include: efficiency, fairness, acceptability, and aesthetics. These criteria are used to assess data (evidence) according to its support for the achievement of objectives.

As an evaluation, the CARI study was intended to assist AVC - Calgary in

determining the "usefulness" and "value" of employing computer-assisted reading instruction. Staff wanted to determine the effect of this technology in the actual environment of its use. Moreover, the study was commissioned by the National Literacy Secretariat to investigate the usefulness of CAI as a reading instruction tool for adult audiences.

The Evaluators

An evaluation team was chosen that could bring considerable expertise in research design and practical experience in evaluations. The services of the consulting firms chosen for this study brought specific backgrounds in research design, applied measurement and evaluation, computer-mediated instruction, adult education, teaching, and adult reading programming.

LITERATURE

A literature review was prepared for this study. It is featured in Appendix A. What follows is an overview and synopsis of key themes.

Reading and writing are important skills and are directly linked to the social and economic well-being of Canadians. According to the Organisation for Economic Co-operation and Development (1995) and Statistics Canada (1996), low literacy levels potentially threaten the economic strength and the social cohesion of a nation. Canada and six other industrialised nations (United States, Germany, the Netherlands, Poland, Sweden, and Switzerland) have inadequate levels of literacy among a broad section of the population.

The potential of using computer-assisted instruction to teach reading to adult learners has been of interest to administrators, researchers and practitioners since the 1970's when the personal computer became a viable educational tool. A recent meta-analysis by Rachal (1995) examined the effectiveness of computer-assisted instruction (CAI) on the teaching of reading at adult basic and secondary education levels. The meta-analysis included a number of quasi-experimental

studies comparing experimental (CAI) groups to groups using more conventional instructional approaches.

Of the twenty-one studies examined, variation was reported in their designs, objectives, settings, software, skills examined, and conclusions. While the majority of these studies indicate no significant difference occurring in student achievement, five studies reported improvement in achievement scores for CAI over conventional reading approaches. In addition, other benefits of using computer-assisted instruction were reported: faster rates of learning, more immediate feedback, reduced attrition, increased student self-confidence, and increased privacy. It should be noted, however, that these findings were reported as researchers' perceptions rather than empirically derived findings.

The research described above is among numerous other studies that support the continued use and exploration of the effectiveness of computer-assisted instruction (Johnson, Cox and Watson, 1994; MERC, 1993; Khalili and Shashaani, 1994; Kulik, Chen-Lin, and Kulik, 1987).

No significant difference is significant. The literature indicates that for many teaching and learning situations, computer-assisted instruction can be as effective as human instruction. Most reports show both student attitude and motivation increase when technology is used to assist instruction. However, there are some inherent complexities in determining the effect of computer-assisted instruction on achievement. Factors such as teachers' and students' attitudes, extent of integration in the curriculum, user interface with the hardware and software, determine the impact of technology on achievement no less than the technology itself.

It is relevant, therefore, to continue investigating computer-assisted instruction as it relates to reading and adult education, particularly in a controlled environment. With growing numbers of adult learners, the results of research investigating the academic and socio-cultural impact of computer-assisted instruction offer useful information to Alberta Advanced Education and Career Development and the National Literacy Secretariat in making decisions related to program support and

development. Since a large portion of the student population at Alberta Vocational Colleges across this province is comprised of adults of low level reading abilities, some of whom are challenged both mentally and physically, and other students who are acquiring English as a Second Language, this evaluation was particularly timely.

QUESTIONS

The purpose of this study was to develop an evaluation to assess the effectiveness of Computer Assisted Reading Instruction (CARI) in improving the reading skills of selected student groups at AVC - Calgary. By measuring whether and to what extent CARI impacted student learning and success, administrators, funders and practitioners would be better prepared to make decisions related to the funding and support of computer-assisted instruction. The evaluation would also contribute to the theoretical and practical literature base on adult education and computer-assisted instruction.

Objectives

The overall objective of this evaluation was to:

Assess the short- and long-term effectiveness and efficiency of Computer Assisted Reading Instruction (CARI) in upgrading the reading skills of Adult Basic Literacy (ABL), English as a Second Language (ESL), and Adult Basic Education (ABE) students at AVC Calgary in comparison with conventional classroom reading instruction.

More specifically, the objectives of this evaluation were to:

1. Prepare a comprehensive review of the literature on computer-assisted reading instruction for adult learners;

2. Assess the effect of CARI on rates of reading gain, retention, transferability;

3. Assess the impact of CARI on course completion and attendance;

4. Assess the level integration of CARI into existing instructional programs;

5. Assess instructor and student satisfaction and experiences with CARI;

6. Assess the effects and impacts of CARI across identified variables and across student categories: Adult Basic Literacy (ABL), English as a Second Language (ESL), and Adult Basic Education (ABE);

7. Create a profile of characteristics for students most/least likely to benefit from CARI;

8. Suggest strategies to encourage instructors to use computer-assisted instruction effectively in their instruction;

9. Assess growth toward self-directedness (reduction of instructor intervention) in the CARI groups; and,

10. Provide data to assist AVC in conducting cost-benefit analyses.

METHOD

This evaluation used a quasi experimental, non-randomised, pre-test-post-test, control group design. While attempts to match control and treatment groups were exercised, random assignment of groups was not possible. The independent variable was the CAI program (Autoskill and/or PLATO). The dependent variables were reading performance in sightword recognition, decoding skill, and comprehension.

Effects of the treatment and a moderator variable (entry-level reading skill) were considered. Together, ABL, ESL, and ABE students were combined and grouped

according to treatment and control. Each group was further delineated according to level at pre-test (low, medium, and high). Groupings were determined by percentile (low < 33 percentile, mid 33 to 66 percentile, and high > 66 percentile). Subjects with two to three low scores on the variables sight, phonics, and comprehension were assigned to the low initial reading level group. Subjects with two to three mid-range scores on the variables sightwords, decoding, and comprehension were assigned to the mid level initial reading group. Subjects with two to three high scores on the variables sightwords, decoding, and comprehension were assigned to the high initial reading level group (see Appendices B and C).

Autoskill

The Autoskill Reading Program is a computerised skills-oriented learning resource aimed at promoting the acquisition of skills needed for the mastery of reading. It includes a student management system, individualised assessment (testing), and instructional materials (training). The on-line automatic assessment yields a profile analysis of students' reading skills to determine the different subtypes of reading difficulty. Lesson content is customised to address the specific skill level of each student (Autoskill International Inc.).

Testing is designed to produce subtyping and uses four different procedures: oral reading, auditory-visual matching, visual matching and visual scanning. Subtypes are represented as Type O, Type A or Type S.

Autoskill trains students trained by using different procedures according to the strengths and weaknesses evident in students' profiles. Exercises in each module range from simple to complex. Sentences and paragraphs contain child or adult content at several levels of difficulty. Student receive immediate feedback for every response. Results for accuracy and speed are presented for each exercise.

The Autoskill program is designed with some foundation in education theory. It incorporates subgrouping of reading difficulties with subsequent differentiated remediation for deficits. The program incorporates the automaticity theory, which suggests that over learning of basic letters and syllables to a level of rapid

automatic responding promotes higher levels of reading. Task-analytic and process oriented approaches are included supporting a position that reading is a step-by-step sequential process. Behaviour principles of immediate and positive reinforcement are also used to enhance learning.

AVC - Calgary selected the program (in particular Academy of Reading--an extension of Autoskill Comprehensive Reading Skills) because of the above features and because selected independent research reported average gains of 2.5 grade levels with 25-30 hours of instruction. These improvements were reported to be maintained over time (Autoskill International Inc.). In addition, applications of this program were used in secondary schools, community colleges, literacy programs, correctional facilities, and in workplace settings.

PLATO

PLATO (Basic Literacy Skills Reading-Canadian Edition) is a modularised computer-assisted instruction program designed to be customised to meet individual learner needs, and to match the objectives of learners' educational or training programs (TRO Learning Inc.).

Data Collection

Data were collected three times (pre-test, post-test, 6-month follow-up retention test) by trained research assistants. Quantitative data analysis included descriptive and inferential statistical tools. Qualitative data were analysed thematically.

Table 1. Evaluation Design

Subject Assignment	Pre-test	Treatment Period	Posttest1	Posttest2
No R-A	O_1	X_1	O_2	O_3
No R-A	O_1	No X	O_2	O_3

Qualitative data were collected in both Stage One (February to June 1996) and Stage Two (September 1996 to June 1997) from students and instructors. Evaluators observed students using the computers to facilitate triangulation of qualitative data. Both survey and interview techniques were applied. In both stages data were collected immediately following the treatment.

Stage One

In Stage One the Bader Reading and Language Inventory (Bader, 1983) was used to assess student reading skills. As well, the Yopp-Singer Test of Phoneme Segmentation (1995) was used to measure phonemic awareness skills. From these two assessment devices several dependent variables were collected through individual assessments of each student in the program both before he/she began Autoskill (Pre) and at the completion of the reading program (Post). Half of the students were assigned to use Autoskill in addition to other reading instruction components. Half were involved in the conventional instruction at AVC - Calgary.

Reading Skill Assessment

Word Analysis. Three measures of word analysis were used. First, eight Phonics subtests of the Bader Inventory assessed the students' skills at decoding individual letters, sounds and sound combinations in isolation. For the second analysis, the Decoding measure from the Bader Inventory assessed the students' decoding accuracy of words read individually from word lists. The students' reading levels for decoding these words were interpreted as grade equivalents. Third, the Phonemic Awareness measure, taken from the Yopp-Singer Test, measured the students' skills in phoneme segmentation in the context of 22 words. Their performance was categorised into 3 levels: Level 1 representing no correct segmentation, Level 2 representing partial segmentation (for example, getting the onset sound, or rhyme in the word), and Level 3 representing complete segmentation accuracy.

Reading Comprehension and Fluency. The students' reading comprehension was measured using paragraphs on the Bader Inventory, read both aloud and silently. Students' reading levels were interpreted as grade equivalents.

Participant Assignment and Treatment Schedule

A total of 167 students were initially registered in the study (84 Stage One, 83 Stage Two). A total of 127 students completed the study. Table 1 represents students by gender, age and first language (74 females and 53 males). Ages ranged from 18-66 years.

Table 1. Demographics

Demographic	Stage One	Stage Two
Female	37	37
Male	24	29
Age 18 - 25	18	12
Age 26 - 35	28	27
Age 36 - 45	10	21
Age 46 - 55	3	5
Age 56 +	2	1
English	13	11
French Canadian	1	
European	22	13
Aboriginal	2	3
Pacific Rim	11	23
South East Asian	8	13
African	4	
Not Identified		3

Tables 3 and 4 represent the number of student participants by group and their treatment schedules in Stage One of the evaluation:

Table 3. Stage One Participant Assignment

Group	Duration	Registered Control Group	Completed Control Group	Registered Treatment Group	Completed Treatment Group
ABE	15 weeks	16	16	17	13
ESL	10 weeks	16	9	17	14
ABL	20 weeks	9	5	9	4

Each group of students received instruction from a single instructor.

Table 4. Stage One Treatment Schedule (Autoskill Program)

Treatment Group	Duration of Program	Hours per day	Total Time on Autoskill
ABE	15 weeks Feb - Jun 30 '96	1-1.5 hr/day	12 hrs. (maximum)
ESL	10 weeks Mar - Jun 30 '96	1 hr/day for 5 days	50 hrs.
ABL	20 weeks Feb - Jun 30 '96	2 hrs./day for 4 days	160 hrs.

ABE students received 1-1 1/2 hours of instruction four days per week and were required to make up any time lost due to absenteeism. Classes were scheduled between 8:30 AM and 2:00 PM Monday through Thursday. Most ABE students felt that 1 1/2 hours per day was too long. Students felt that it was unnecessary to make up lost classes as they found the program easy. The instructor confirmed that ABE students experienced little difficulty familiarising themselves with the program, and that ABE students were able to use on-screen cues independently.

For the ESL group, Autoskill replaced the conventional reading portion of their curriculum (one-half hour per week). ESL students received 5 hours/week during fixed lab times. ESL students reported being unclear as to the purpose of the Autoskill program. They felt they lacked sufficient explanation as to the reason

and rationale for its use. They felt that the first five hours on the program were most difficult, and that they could have used more instructional assistance.

ABL students spent one hour per day, four days per week, on Autoskill at fixed class times. ABL students reported enjoying their time on Autoskill. The ABL instructor confirmed this finding, suggesting that for optimal use, ABL students should be assigned lab or classroom space to provide students maximum privacy.

Stage Two

Changes to treatment and testing tools were made in Stage Two. The PLATO computer-assisted reading software replaced Autoskill as the intervention for ABE and ESL students. The Woodcock-Johnson standardised reading inventory replaced the Bader Reading Inventory and Yopp-Singer Test. Both changes were made as a result of discussions held following the presentation of results of Interim Report One (August 1996).

Reading Skill Assessment

The Woodcock-Johnson Psychoeducational Battery - Revised (WJ-R) was used in Stage Two. It has eleven subtests which comprise the Tests of Achievement. These subtests are subdivided into the Standard and Supplemental Batteries. Any number or combination of subtests can be selected depending upon the referral question and the information required.

Letter-Word Identification

The first five items of this subtest involve symbolic learning. The remaining items measure the subjects reading identification skills in identifying isolated letters and words that appear in large type. The term identification implies that the subject may be asked to respond to letter forms or words that he or she has never seen before. This procedure is in contrast to recognition, which implies a response to a stimulus with which a person has had prior experience. In this test it is not necessary for the student to know the meaning of any word. The items

become more difficult and words are presented less and less frequently in English. A grade equivalent score is attained from this test.

Passage Comprehension

For this test, the first four items are presented in a multiple choice format requiring the subject to point to the picture represented by a phrase. The remaining items measure the subject's skill in reading a short passage and identifying a missing key word. The task requires the subject to state a word that would be appropriate in the context of the passage. In this modified close procedure, the subject must exercise a variety of comprehension and vocabulary skills. Again, a grade equivalent score is attained from this test.

Word Attack

Word Attack measures the subject's skill in applying phonic and structural analysis skills to the pronunciation of unfamiliar printed words. The subject reads aloud letter combinations that are linguistically logical in English but that do not form actual words (nonsense words), or words that constitute low frequency words in the English language. A grade equivalent score was attained for each student.

Participant Assignment and Treatment Schedules

Tables 5 and 6 represent the numbers of students involved by group and their treatment schedules in Stage Two of the evaluation:

Table 5. Stage Two Participant Assignment

Group	Duration	Registered Control Group	Completed Control Group	Registered Treatment Group	Completed Treatment Group
ABE	15 weeks	16	12	17	13
ESL	10 weeks	15	11	15	14
ABL	20 weeks	9	8	11	8

Each group of students received instruction from a single instructor, with the exception of the ABL part-time students (Stage Two).

Table 6. Stage Two Treatment Schedule (Autoskill/PLATO Programs)

Treatment Group	Duration of Program	Hours per Week	Total Time on Computer
ABE	15 weeks Sep '96 - Jan '97	Approx 1 hr/week	2-12 hrs.
ESL	10 weeks Oct '96 - Dec '96	2 hr/week for 10 weeks	20 hrs.
ABL	20 weeks Sep '96 - Jan '97	1 hrs/day for 4 days (12-13 weeks)	48 hrs
ABL (part time) N=2	19 weeks (9 hrs./week) Sep '96 - Jan '97	1 hr/week	15 hrs.

ABE classes were scheduled between 8:30 AM and 2:00 PM Monday through Thursday. While students had daily access to the computer, they were allowed to choose the amount of time they wanted to spend on the computer-assisted reading program. As a result, the maximum time any one student spent using PLATO was 12 hours; the minimum was 2 hours.

For the ESL group, PLATO (Basic Literacy Skills Reading-Canadian Edition) replaced one half of the conventional language arts portion of the curriculum (reading portion). ESL students received 4 hours/week during fixed lab times. The remainder of the ESL language arts program included grammar, spelling, and short compositions.

Full-time ABL students spent one hour per day, four days per week, for 12-13 weeks on Autoskill at fixed class times. This arrangement was not a full replacement of their reading program. Two part-time students spent approximately 15 hours using Autoskill. Autoskill training accounted for all reading instruction received by part-time ABL students.

RESULTS

Quantitative results of this study are grouped first according to program (ABE, ESL, ABL), Stages one, two and combined and secondly, according to entry-level (LOW, MEDIUM, and HIGH), Stage One, Stage Two and combined (see Appendices B and C). Qualitative results are reported according to program and participant groups (students and instructors).

Computer-Assisted Instruction Effect on Reading Performance

Because the study was designed to determine both an immediate and lasting effect of the treatment, a multivariate analysis of variance (MANOVA) was used. The difference between relevant means (univariate F-tests) was determined and accepted as significant at a *p* value of .05 or less. Therefore, the difference between mean grade-level scores of the control and treatment groups can be considered significant if the results could not be attributed to chance more than 5 out of 100 times.

In general, there was no strong CAI effect on reading performance of groups across programs nor across Stages. A modest to small treatment effect was observed for some variables. However, statistical analysis suggests some trends in favour of the treatment.

ABE

While Stage One ABE students showed a significant difference in favour of control on the variable decoding, uneven entry levels and a ceiling effect reduce the significance of this finding. The Autoskill intervention may have had a positive effect on sight words (see Figure 1). No difference was observed between control and treatment groups on the variable comprehension. All effects for the total group appear to diminish over time.

The treatment (PLATO) in Stage Two had no significant effect on Stage Two ABE students. In fact, from pre to post test the control group showed a more

positive performance on sight words and comprehension. However, the long term trend suggests that PLATO may have had a positive influence on decoding (see Figure 2).

Combined results across Stages one and two show no positive effect for CAI.

Figure 1.

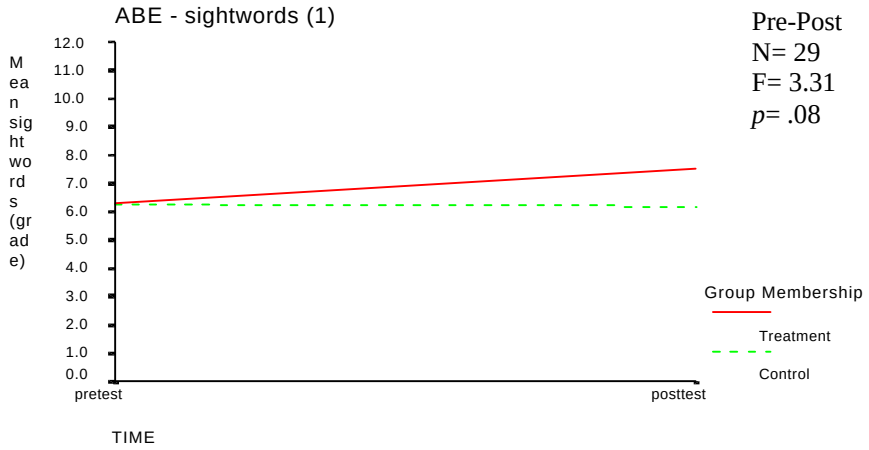
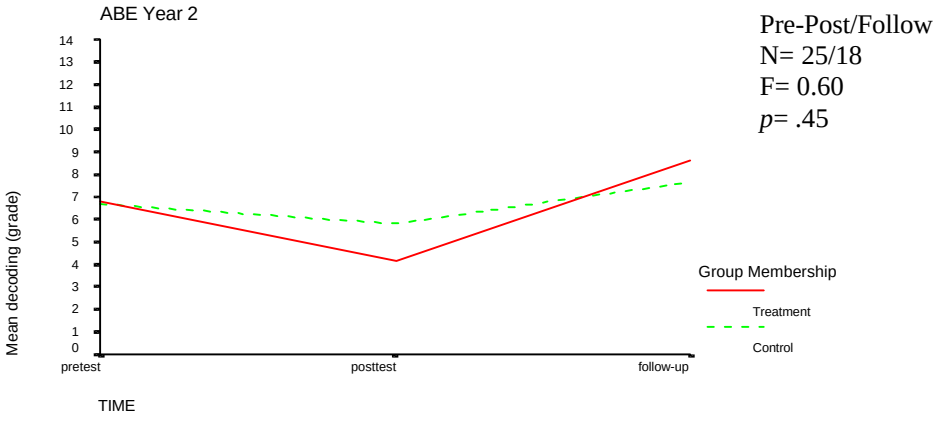


Figure 2.



ESL

The Autoskill treatment appeared to have no significant effect on Stage One ESL students, with the exception of a positive trend in decoding when measured across pre and post-tests (see Figure 3). However, the trend does not appear to last over time.

The PLATO treatment had a significant positive effect on sightwords. The control group appeared to do significantly better in comprehension and sightwords (see Figures 4a, b, and c). However, uneven entry levels and a ceiling effect for control reduce the significance of these results, which should be considered as trends.

Again, there were no significant differences across Stage One and Two.

Figure 3.

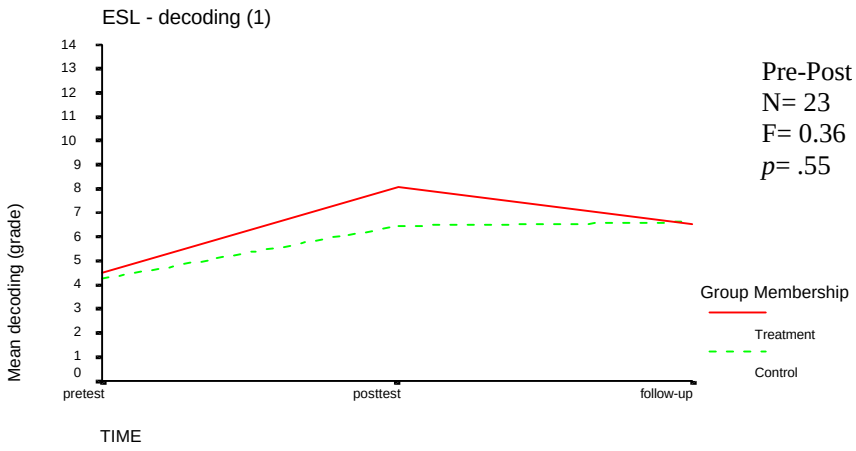


Figure 4a.

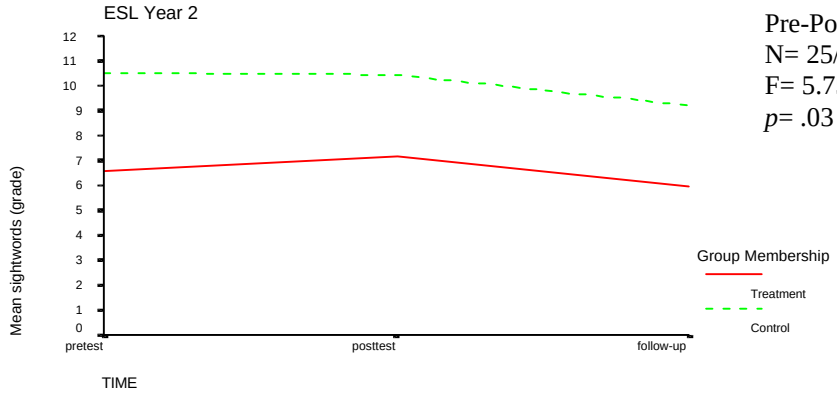


Figure 4b.

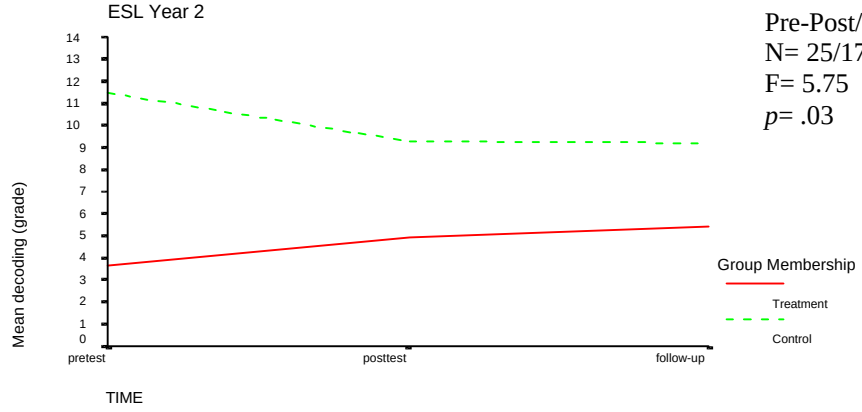
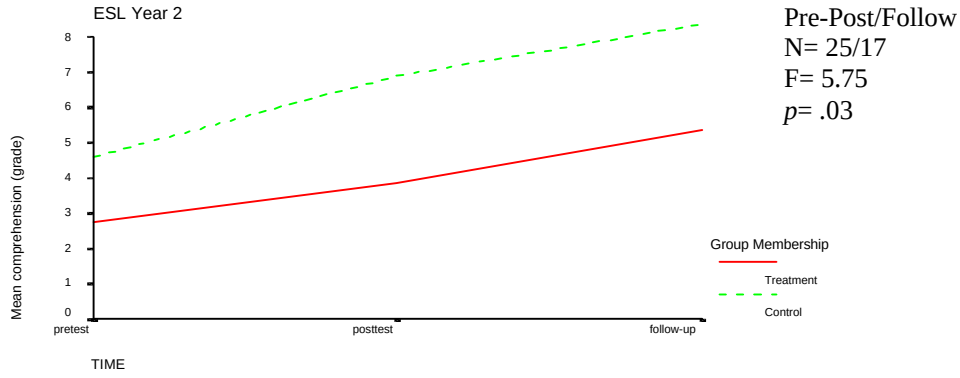


Figure 4c.



ABL

Autoskill appeared to effect a positive trend in Stage One ABL students' reading performance. None of the effects, however, proved statistically significant (see Figures 5a, b, and c). This trend continued with sightwords and comprehension in Stage Two (see Figures 6a, b).

While there were no significance differences across Stages One and Two, Autoskill appears to have some positive effect on comprehension, especially over time (see Figure 7).

Figure 5a.

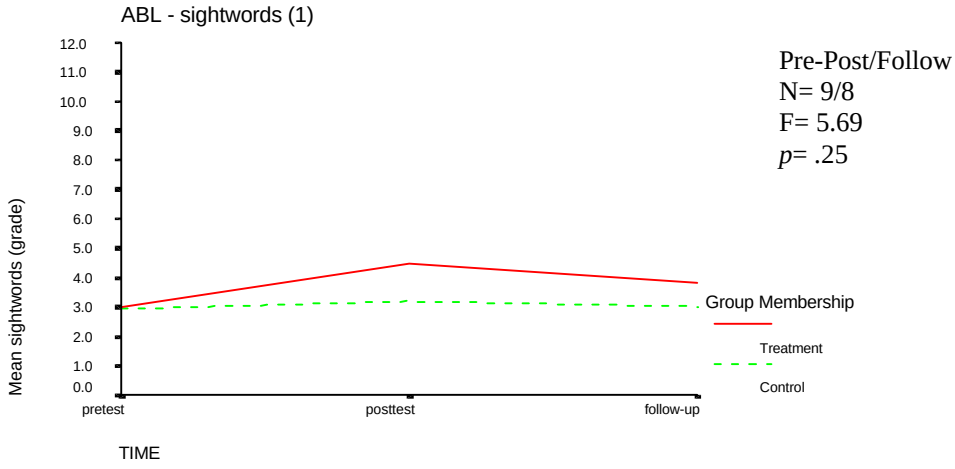


Figure 5b.

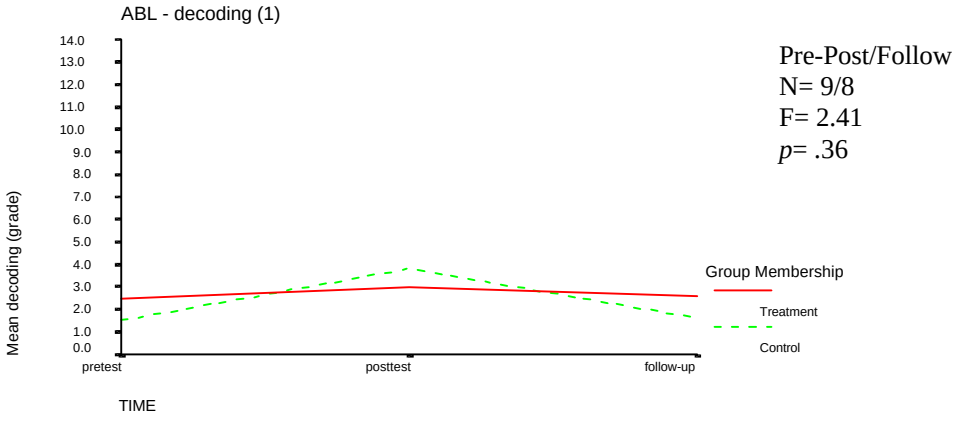
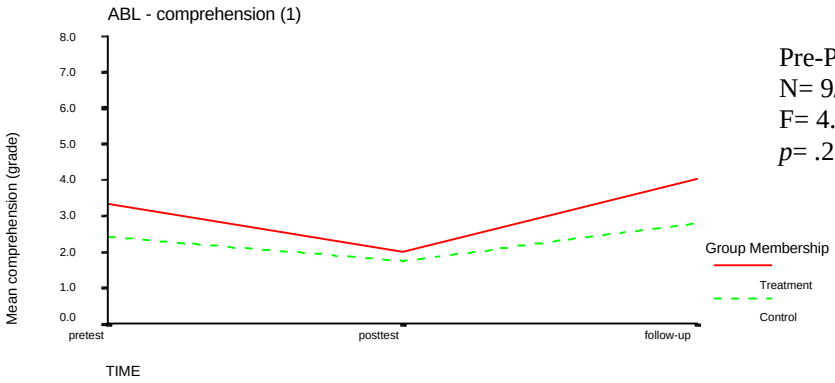
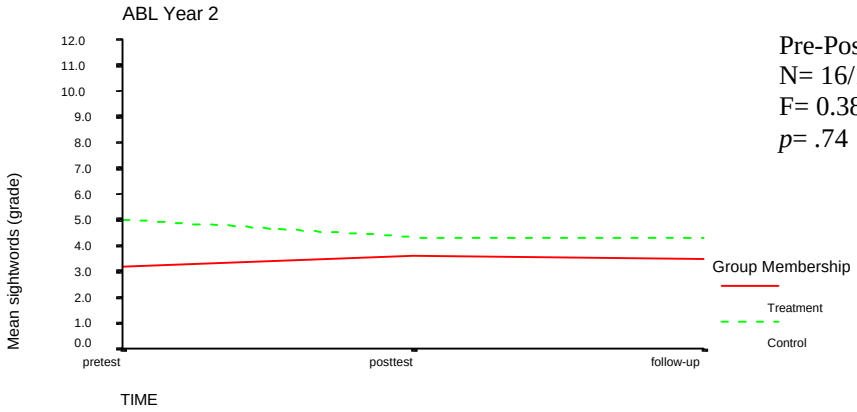


Figure 5c.



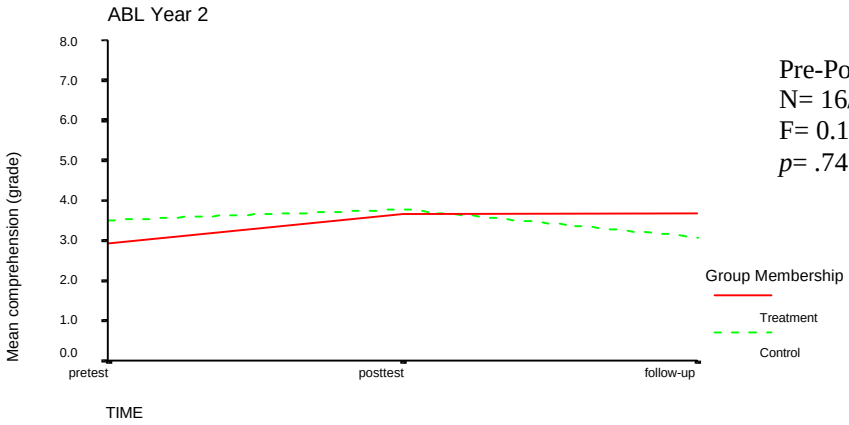
Pre-Post/Follow
N= 9/8
F= 4.08
p= .29

Figure 6a.



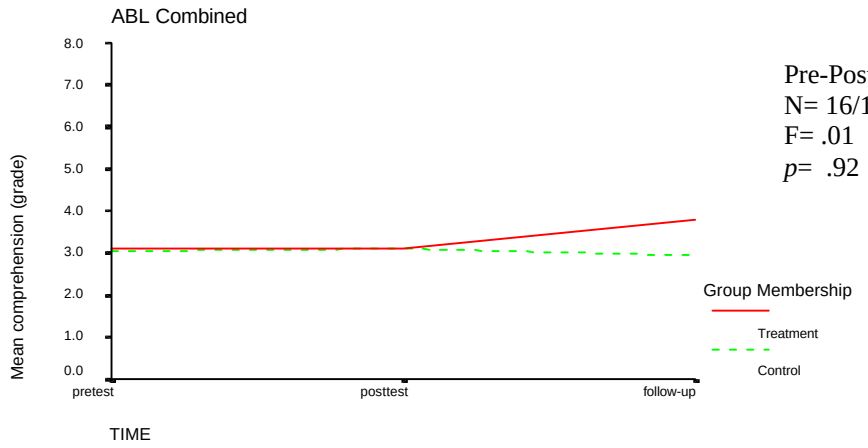
Pre-Post/Follow
N= 16/11
F= 0.38
p= .74

Figure 6b.



Pre-Post/Follow
N= 16/11
F= 0.13
p= .74

Figure 7.



LOW

Stage One low level readers appeared to benefit from Autoskill, especially in decoding where a statistical significance is apparent (see Figure 8a and b). In Stage Two this trend only continues in comprehension where low level learners would have received either Autoskill or PLATO (see Figure 9).

Combined results indicate no significant difference between low entry-level readers who received CAI and those who received conventional instruction. The trend, however, is that CAI had a positive effect on comprehension (see Figure 10).

Figure 8a.

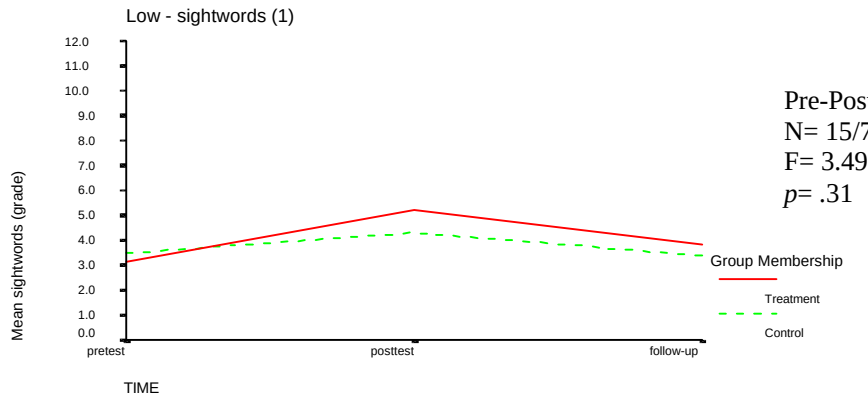


Figure 8b.

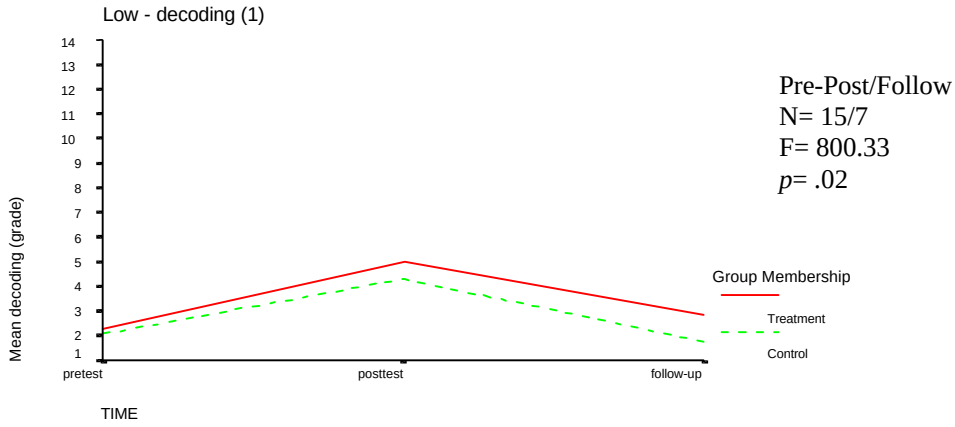


Figure 8c.

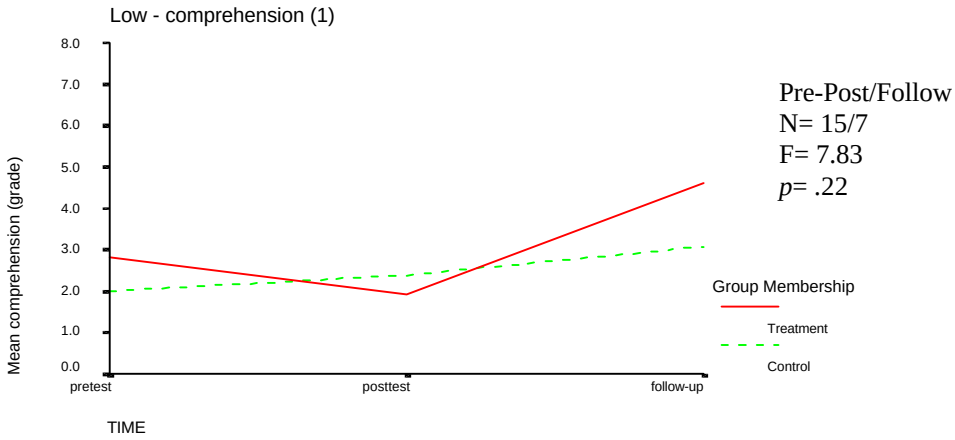


Figure 9.

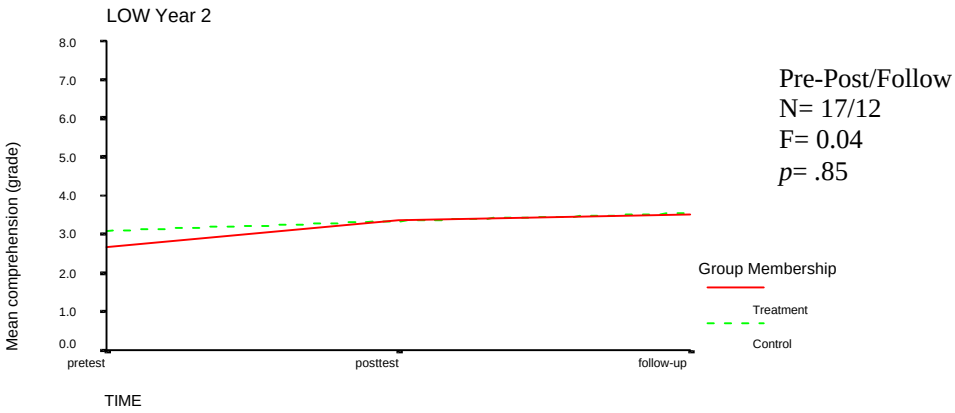
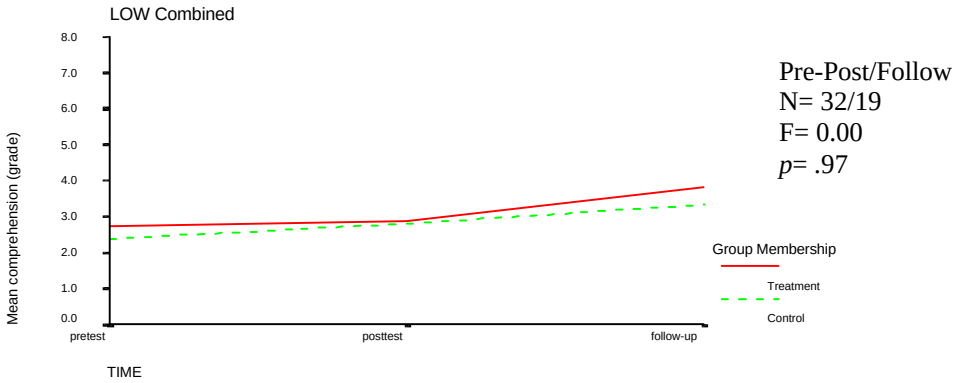


Figure 10.



MID

In Stage One, mid-range readers appear to benefit from Autoskill in decoding and sightwords (see Figure 11a and b). That benefit disappears for decoding and sightwords in Stage Two, but a positive trend is noted for comprehension (see Figure 12). However, the differences are not statistically significant. All trends in both stages are stronger between pre- and post-testing than they are for follow-up testing.

There are no significant differences across stages, and trends appear to even out over time. However, combined results show a positive trend in favour of treatment for the variables sightwords and comprehension (see Figures 13a and b).

Figure 11a.

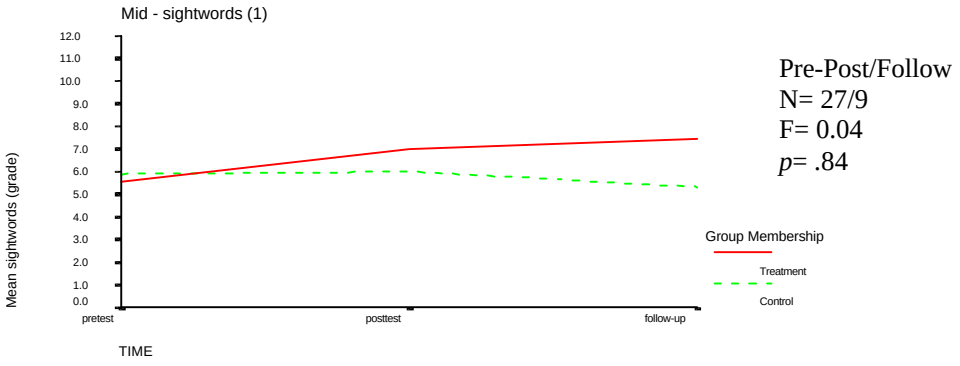


Figure 11b.

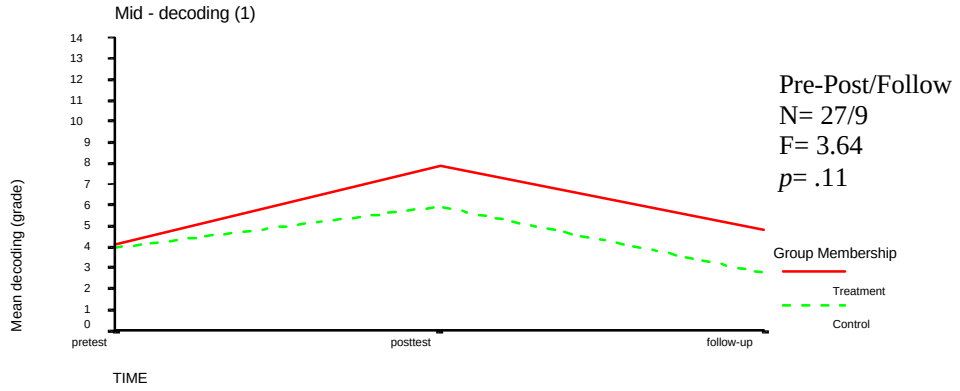


Figure 12.

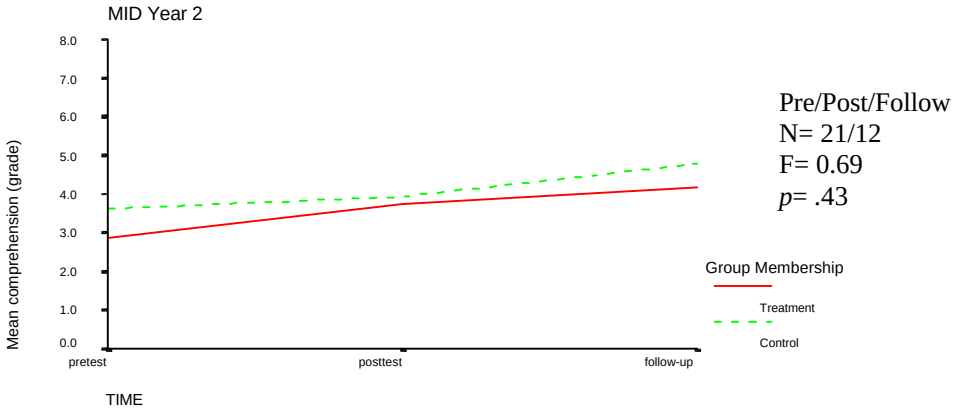


Figure 13a.

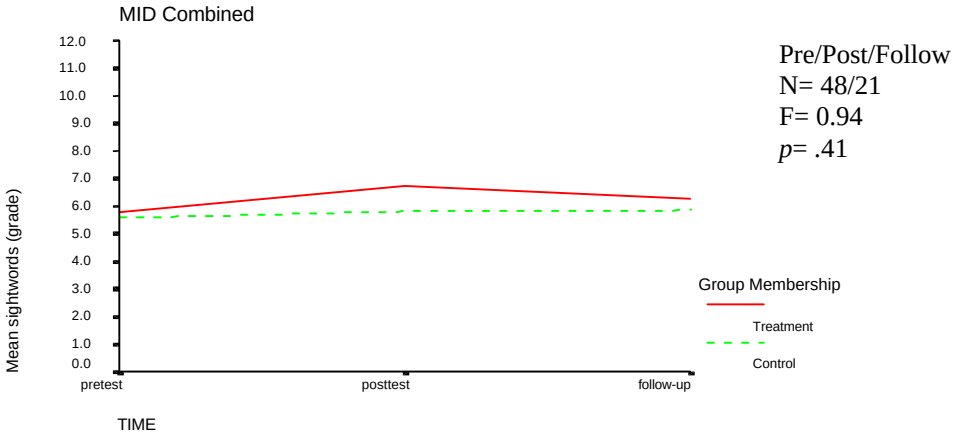
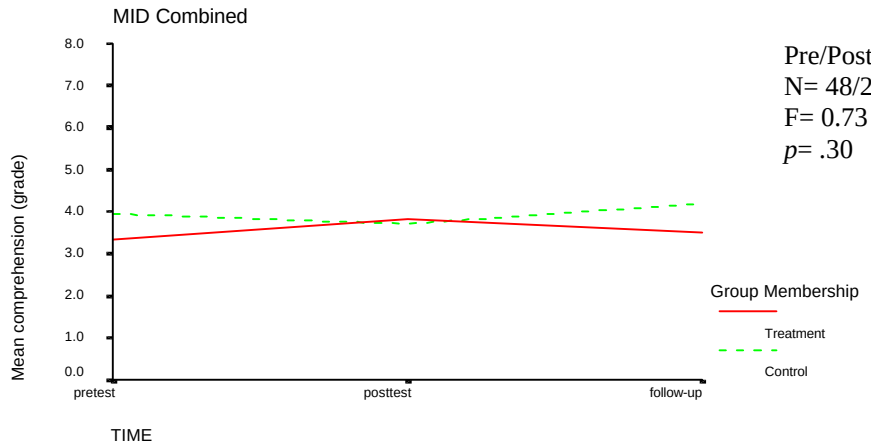


Figure 13b.



HIGH

Across both Stages, high-range students' reading performance does not appear to be positively effected by either Autoskill or PLATO, with the exception of decoding in Stage Two (see Figures 14a,b,c and Figure 15). In fact, in most instances the effect trend is more positive in favour of the control group. It should be noted that subjects test very high at the pre-test on all variables and regression to the mean may account for some of the lower scores on the post-test in Stage Two.

Over Stage One and Two the trend is toward a negative effect of CAI on reading performance of high entry level students, especially on the variable comprehension (see Figure 16).

Figure 14a.

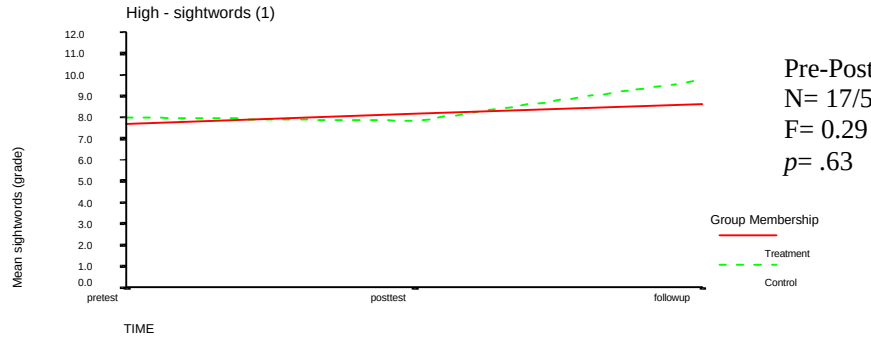


Figure 14b.

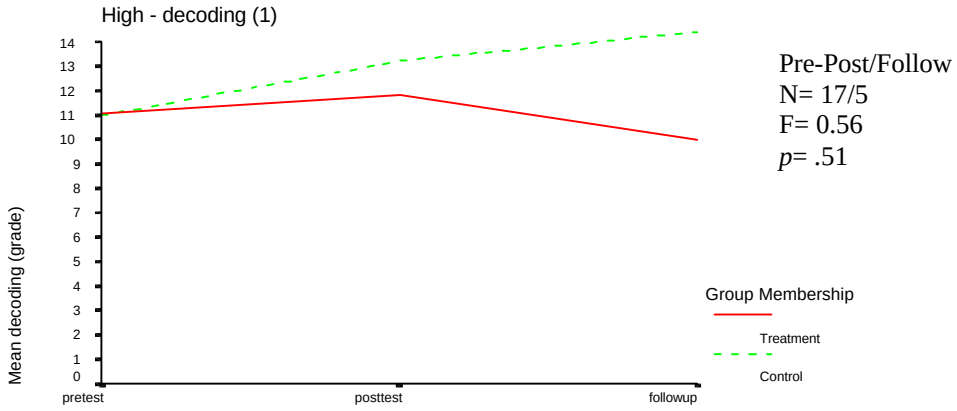


Figure 14c.

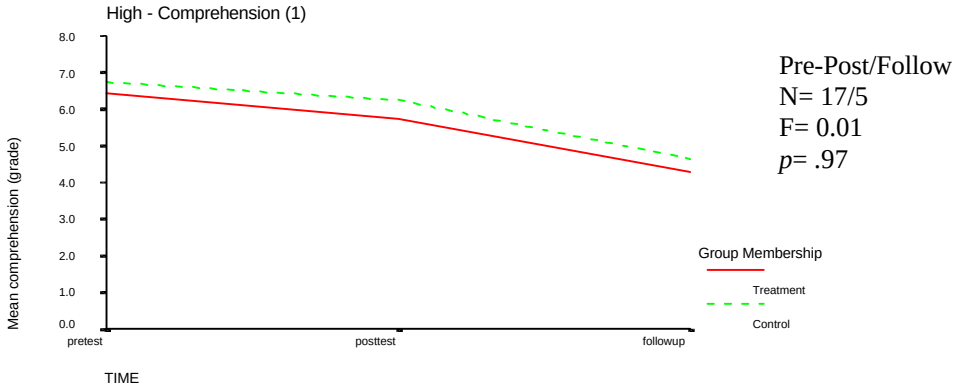


Figure 15.

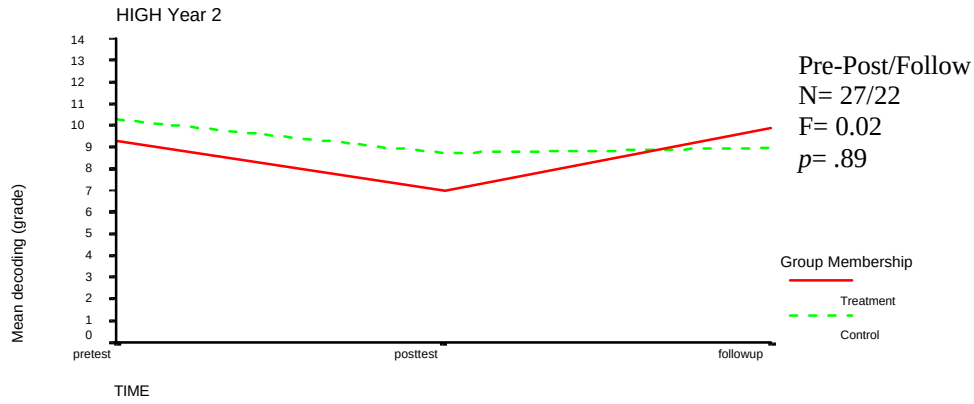
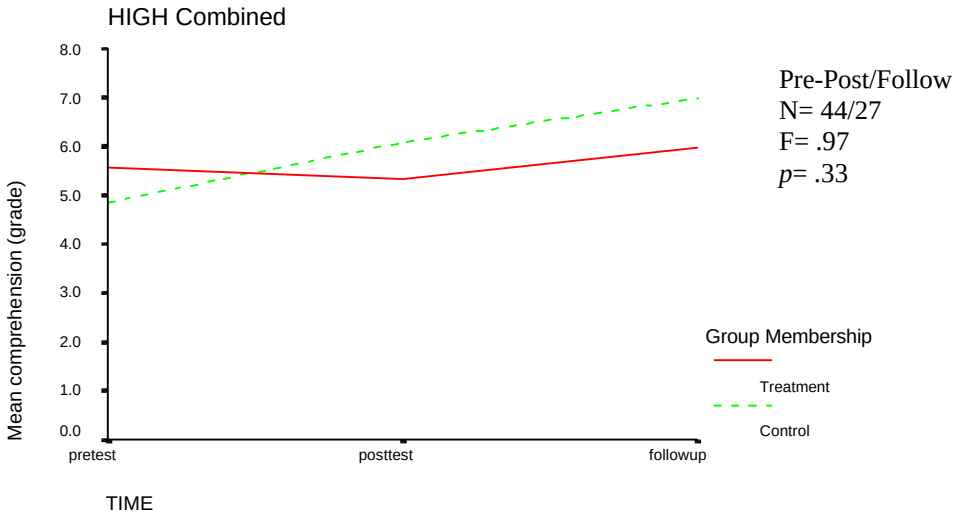


Figure 16.



Student Perspectives

In general, students were positive about their computer experiences. Data were collected through interview, survey and observation. The results of the qualitative data analysis were ordered by theme according to: 1) students' previous experience with computers, 2) experience with Autoskill testing, 3) satisfaction with progress tracking, 4) perceived benefits of CAI, and 5) assessment of working independently.

ABE Students

Computer Experience. Stage One ABE students reported having some computer experience (self-reported as "fair"), prior to using the Autoskill program. Stage Two ABE students reported their previous experience with computer as "fair" to "good."

Autoskill Placement Testing. In addition to AVC entrance tests for both treatment and control groups, students in the CARI project (treatment groups only) were required to go through a series of Autoskill placement tests.

ABE treatment students felt that much of their success depended on how fast they could move the mouse, rather than on how well they could read. Students felt that the tests were time consuming, too easy, "insulting," and that the levels were mis-named (e.g., "Level 10 was more like Grade Six"). Further, students resented being placed at the lowest level of the training portions of the program, despite having passed the placement tests. Only a couple of students, whose first language was not English, regarded the tests themselves as a further opportunity to learn English. This small sub-group found the placement tests "somewhat difficult."

Tracking Progress. ABE students reported that the Autoskill program had many errors. Students reported that even when they entered corrected responses, Autoskill recorded their original incorrect response. A major frustration for ABE students was that Autoskill would not store responses for partially completed sections. Students reported having difficulty finding and following their progress on the Autoskill screen displays. They felt it cumbersome to have to leave the room in which they were working, in order to access their achievement scores and progress charts. Progress tracking did not appear to be an issue with the PLATO program. Stage Two ABE students felt that program feedback was accurate and useful.

CAI Benefits. Generally, Stage One ABE students were glad to be finished with Autoskill. They reported that Autoskill met their needs to only "some" extent, and that it improved their reading skills only "somewhat" or "not at all." The quantitative results supports this perception by students. The majority found it "boring," "kind of insulting," and a "total waste of time." ABE students found the Autoskill voice prompts "annoying," and regarded the nonsense words as "useless," and "boring." The ABE instructor reported that having a good working relationship with his students helped him to convince students to stay with the program for the duration of the pilot.

However, ABE students reported that Autoskill helped them "read faster." They rated comprehension and vocabulary development exercises as most helpful. And although most ABE students felt the comprehension passages were too easy, too

few in number, and excessively time-consuming, they did feel they improved their comprehension skills. The ABE group unanimously agreed that passages about "real problems" would have been better, although some information (finance, transportation, health, for example) was considered good, especially by those ABE students whose first language was not English.

Stage Two ABE students were given a brief survey to complete. Most ABE students described their entry level understanding of English as "fair" to "good." With the exception of one student, all reported "liking" the PLATO program. They found the program easy to use (not requiring much outside guidance from either instructors or user manuals) and found the material presented interesting. Just over 50% of students found the material/stories somewhat difficult. Most students (80%) rated the PLATO program "good" to "excellent." Fifty percent (50%) reported that the program met their needs. The remaining half of the ABE students reported that PLATO "somewhat" met their needs. Almost every student (with the exception of one) felt they made gains in vocabulary development, comprehension, grammar, and reading speed.

Following the survey, ABE students were given an opportunity to discuss the PLATO program. What follows are the themes that emerged from that discussion:

1. Students felt that the PLATO program helped them to read better.
2. Students liked that PLATO allowed for independent study. They liked being able to use it when they wanted to, and as much as they wanted to. However, the teacher is still very important and PLATO should not replace the teacher.
3. The grammar portion of the PLATO program appeared to draw the most attention. As one student said, "I like how PLATO has taught me to put words together."
4. The primary complaint about PLATO was that it ran too slowly.

Working Independently. Equal numbers of Stage One ABE students preferred working independently as working in groups. The majority of ABE students were comfortable with Autoskill being a stand-alone program, but some students were

not. Those who objected to independent work, felt that discussion and conversation were more meaningful, that they learned more from interacting with other students.

The majority of Stage Two ABE students were comfortable with PLATO being a stand-alone program. All ABE students indicated that PLATO helped them become more independent learners. However, all felt that their success in reading required the presence of a teacher.

ESL Students

Computer Experience. Some ESL students reported having used the computer for word processing and mathematical calculations in their home countries. These students reported their computer skill level as "good." The majority perceived their computer skill as "poor."

Autoskill Placement Testing. ESL students reported that three sets of tests (AVC entrance, Autoskill placement tests, and researcher pre- and post-tests) were burdensome and time consuming. They did not understand the need for all the tests and were unsure how they linked to learning to speak, read and write English. The majority of ESL students reported finding the Autoskill placement tests "somewhat difficult," although responses varied from "very easy" to "very difficult."

Tracking Progress. Stage One ESL students reported the same concerns as the ABE group. They said the Autoskill program had many errors, especially reporting that Autoskill did not accurately report corrections. Again, the students complained that the program would not store responses for partially completed sections. The ESL group added that all assignments, even when successfully completed, were not automatically removed from the student's menu. This effect meant that students often redid assignments without realising they had already completed them. Stage Two ESL students experienced no difficulties or errors with PLATO.

CAI Benefits. Although first-Stage ESL students were not quite so dismissive of Autoskill as their ABE counterparts, they too reported that Autoskill met their needs to only "some" extent and described the program as "boring." They found the program modules "very easy," or "easy." Only one ESL student reported finding the modules "somewhat difficult."

Generally, ESL students reported comprehension and rate of reading as the two areas where Autoskill helped them most (followed closely by vocabulary development). They named stories and paragraphs, specifically, as most helpful in improving their reading skills, but also described them as "boring" and lacking in sufficient content. They liked the vocabulary development and visual matching exercises best. However, they objected strongly to the use of nonsense words in the training and testing exercises. Nonsense words were "useless," "boring and "distracting," they said. They would have preferred learning "real" words.

Equal numbers of ESL students reported needing supplementary materials to help them understand unfamiliar English vocabulary, as those who did not. Many students had not realised that a dictionary appeared on the right-hand side of the screen.

Twenty-five percent (25%) of Stage One ESL students said their previous computer experience was "poor." Over 70% of Stage Two ESL students described their entry English skills as "poor" to "fair" and their computer skills as "fair" to "good." Every student reported "liking" the PLATO program. They did not find operating the program difficult and most (65%) reported the materials/stories easy or very easy to handle, yet none found the material/stories boring. Almost all students (with the exception of two) felt that PLATO met their needs. Students rated the program as good overall with 90% of students reporting that the program helped them improve their reading, especially in the areas of vocabulary development and comprehension.

The discussion following the administration of the survey revealed the following general impressions:

1) PLATO offered good instruction on suffixes and prefixes.

2) The cause and effect exercises were very helpful.
3) AVC should definitely keep using PLATO in ESL classes.

Working Independently. Stage One ESL students generally reported that Autoskill had no effect on their capacity to work independently. Stage Two ESL students were comfortable with PLATO being a stand-alone program. Eighty-five percent (85%) of Stage Two ESL students indicated that PLATO helped them become more independent learners. All, however, felt that their success in reading required the presence of a teacher.

ABL Students

Computer Experience. Most Stage One ABL students reported having little or no prior computer experience.

Autoskill Placement Testing. ABL students regarded the testing process as long and tedious. They expressed nervousness about the tests, and felt they were more for the benefit of the instructors than themselves. All ABL students reported finding the placement tests "somewhat difficult." Stage Two ABL treatment students did not recall this as being a hardship. The majority of Stage Two ABL students reported finding the Autoskill placement tests "somewhat difficult," although responses varied from "very easy" to "very difficult."

Tracking Progress. In contrast to the Stage One ABE and ESL groups, Stage One ABL students felt that Autoskill recorded their progress accurately, but they did report difficulty in being able to print their results. However, they often relied on their instructor to perform this task. Stage Two ABL students continued to experience some frustration with the progress records provided by Autoskill. They reported that even when they entered corrected responses, Autoskill recorded their original incorrect response. Partially completed exercises were not recorded and they reported having difficulty finding and following their progress on the Autoskill screen displays.

CAI Benefits. Less critical than their ABE or ESL counterparts, Stage One ABL students felt that Autoskill "mostly" met their needs. They rated the program as

"good" to "excellent," and felt that Autoskill helped them to improve their reading skills "very much," or "somewhat," particularly as they related to comprehension and vocabulary development. Equal numbers of ABL students found the modules "easy to use" or "somewhat difficult to use." Only one ABL student found the modules "very easy to use."

Since ABL students found that most books in the AVC library were beyond their reading level, Autoskill provided a safe environment for them to read at their own speed and at their own level. Students reported finding the reading comprehension passages "interesting," "somewhat difficult" (60%), or "easy" (40%). They felt there were too few comprehension passages, and that having the same questions appear after each passage was far too repetitive. They were frustrated by this, and believed they were able to memorise the passages, the questions, and the answers without really having mastered the reading level.

Students recognised that their knowledge of vowel sounds was weak, and that they needed drill and practice in these areas. Therefore, they regarded the vocabulary and comprehension passages as very useful parts of the program, and the phonemic exercises as "most useful." In contrast, they regarded the nonsense words as "annoying." Students reported that the audio portion of the program was very useful, but that the sound quality was very poor. "It does not sound like English," they said. In addition, most ABL students realised that a dictionary was available to them on-screen, but they reported not having the time to access it while the program was running.

Generally, Stage Two ABL students reported their previous experience with computer as "fair" to "good". Stage Two ABL students felt that Autoskill "mostly" met their needs. They rated the program as "fair" to "good," and felt that Autoskill helped them to improve their reading "somewhat," particularly as it related to comprehension and vocabulary development. All of the ABL students found the modules "somewhat difficult to use." Students reported finding the reading comprehension passages "somewhat difficult", or "easy." They felt there were sufficient numbers of comprehension passages.

Unlike Stage One students, they regarded the nonsense words as "good." They did not complain about the audio portion of the program. They did, however, think the program ran too fast, and did not give them enough time to enter their answers.

Working Independently. Stage One ABL students enjoyed working independently and choosing their own modules. ABL students reported that Autoskill helped them to be better independent workers. They praised their instructor for the help she had given them, and regarded her as a constant source of support. Because these students were very conscious of their low literacy level, learning to read in isolation from their peers was important. These students resented others entering the lab when it was their Autoskill time, quiet and privacy were essential for achieving optimal success.

Stage Two ABL students, while expressing a high degree of comfort working with the Autoskill program, were not as comfortable with the notion of independence, that is, becoming a more independent learner through using computers.

Instructor Perspectives

Instructors had mixed feelings about the benefits of using computers with their students. Stage Two instructors' level of satisfaction appeared to be more positive. Data were collected through interview and instructor logs. The results of the analysis of the qualitative data were categorised by theme according to: 1) instructors' previous experience with computers, 2) CAI training experience (with the software being used in this study), 3) satisfaction with Autoskill testing, 4) need to prepare students for CAI, and 5) perceived benefits of CAI.

ABE Instructors

Computer Experience. The Stage One ABE instructor was confident and comfortable using computers, having used them in the past with severely handicapped students. The Stage Two ABE instructor had previous computer

experience instructor with word processing, using computer-managed learning math programs, and other assorted software packages.

Training Experience. The Stage One ABE Instructor Assistant found the one-day Autoskill training session "totally useless," reported that it could have been accomplished in one hour through a self-discovery and/or print-based approach. The Stage One ABE instructor reported that the orientation was good, and that manuals and materials were also good. The ABE Instructor felt the program was "easy enough to get on to." Instructors reported manual assignment of student's time consuming. In addition, they reported technical problems surrounding computer access and connectivity in the classroom.

The Stage Two instructors reported that training for PLATO was acquired through a self-orientation process. No problems were reported.

Autoskill Testing. ABE instructors suggested that at a 4:1 ratio for instructor to student hours for testing, placement tests were excessively time consuming, and despite being of acceptable quality, instructors felt the placement tests were unrelated to the training exercises. This effect added to the unpopularity of Autoskill placement tests.

Preparing Students. The Stage One and Stage Two ABE instructors reported that ABE students had little trouble familiarising themselves with the computer.

Value of CAI. The ABE instructor reported that Autoskill had little or no value in improving his students' reading skills. The instructor felt that any improvement in achievement occurred during the testing, rather than the training portions of the program, so that the value of Autoskill lie in diagnosis rather than in treatment.

In addition, the ABE instructor felt that Autoskill had no impact on student independence or improved study skills, although he did feel that some positive novelty effect could be attributed to using the computer. (Students enjoyed the break from workbooks).

Overall, the ABE instructor felt that Autoskill was counterproductive to improving reading skills instruction, since CAI should reduce or eliminate instructor intervention. The instructor regarded both testing and training exercises as labour intensive. He concluded that Autoskill was inappropriate for high level reading groups, that he would not recommend Autoskill for ABE students, but that it had potential as an assignment and management tool. He suggested that the program needed to be designed to handle access by multiple users.

The students' freedom to choose both the amount of computer time they wished to access and the types of exercises they wished to complete was emphasised in the Stage Two ABE learning environment. Overall ABE instructors saw benefits in using PLATO. They viewed PLATO as an addition to the regular reading program. It provided students with "extra information and practice" in areas in which they were weak. Instructors suggested that the computer program assisted students in identifying areas of weakness and gave students an opportunity to remediate those weakness through strategic use of the PLATO program within individualised learning plans and schedules.

ESL Instructors

Computer Experience. The Stage One instructor was very confident in the use of computers. This confidence had come through the experience of using software programs for ESL students. Stage Two ESL instructors had previous computer experience through teaching computer technology and using software with ESL classes.

Training Experience. The Stage One ESL instructor reported that "despite lengthy inservice opportunities (three six-hour sessions--the first two one week apart several months before session, the last session one month before implementation), some areas of this program continued to be a learning experience." He felt that the "feature of automatic assignment," for example, was not well understood by any of the instructors. Technical problems were also reported.

The Stage Two instructor received varying amounts of introduction and training prior to delivering the PLATO program. However, training for this application of

the program was acquired through a self-orientation process. No problems were reported.

Autoskill Testing. The Stage One ESL instructor reported that ESL students experienced frustration on the testing section of Autoskill. He said they required increased orientation to the program. In particular, he noted that the long hours of testing did little to improve teacher/student relationship. Most Autoskill placement tests required the instructor to assist ESL students on a one-to-one basis.

Preparing Students.
The Stage One ESL instructor reported that students experienced difficulty manoeuvring the mouse. The ESL instructor felt that some "mouse" practice prior to starting Autoskill would have helped. However, the Stage One ESL instructor noted that students lost their fear of computers throughout the pilot, and as a result, the instructor noticed an improvement in student self-concept.

Value of CAI. Similarly, the ESL instructor was uncertain of any positive influence of Autoskill on his students. In his estimation, students were definitely bored with the program. Despite the importance of aural and oral training for ESL students, the instructor felt that it was unrealistic for 17 students to use microphones and headsets simultaneously in a group classroom setting. As for his own use, the ESL instructor reported "frustration" that Autoskill was not "teacher-friendly" in a server-based application environment. He found the program slow and time-consuming, and was critical of not being able to access the program to monitor student use (at least not while the students were using it).

The ESL instructor supported students' views, and felt there was no transfer between nonsense syllables and real words for this group of students. The ESL instructor also reported that students struggled with silent paragraph exercises, and felt that little information was available to assist students to progress independently through these sections.

The ESL instructor felt that Autoskill might work best with handicapped students on a one-to-one basis. Within the present scope of the AVC program, the ESL instructor did not recommend its further use.

The Stage Two ESL instructor reported that while some students enjoyed using PLATO reading software, others found it repetitive and boring. Some students experienced difficulty following instructions written on the screen and thus found themselves "looping" through the same activity. Therefore, a certain amount of instructor monitoring was necessary. The instructor also expressed a need to motivate certain students to use the program.

The ESL instructor viewed PLATO as an adjunct to the Language Program offered to ESL students. While benefits were observed, the instructor believed the version of PLATO selected should be updated, both in terms of content and in computer platform. He recommended that a Windows version be installed.

ABL Instructors

Computer Experience. The Stage One ABL instructor was confident using computers having instructed word processing classes during previous teaching assignments. The Stage Two instructor was somewhat less confident in using computers, but expressed no hesitation in using Autoskill. The Stage Two ABL instructor (full-time) noted that her experience with Autoskill increased her own skills in using the computer, in general, and specifically in using the computer as an educational tool.

Training Experience. Initially excited about Autoskill, the Stage One ABL instructor felt the one-day training session was ineffective for someone who had no previous exposure to the program. She reported only becoming comfortable with Autoskill through trial and error with her students. Manual assignment of students and frequent technical problems were other problems reported.

The Stage Two ABL instructor (full-time) received training from the part-time instructor, which reduced the instructor training time and frustration experienced in the Stage One iteration of Autoskill. The ABL Stage Two part-time instructor,

already had experience with Autoskill. She reported having less difficulty with the program than in the previous semester. She expressed more confidence in her ability to assist others with the program, and to handle technical problems.

Autoskill Testing. The ABE instructor felt that testing was extremely time consuming. However, she did suggest that the tests had diagnostic merit.

Preparing Students. The Stage One ABL instructor reported adding "mouse" tutorial sessions to improve her students' "mouse skills." The Stage Two ABL instructor estimated that it took about four weeks for ABL students to feel comfortable using the computer. She reported that in general, students experienced a high degree of success using the computer having mastered the computer for Autoskill. She also felt that using Autoskill was improving the students' abilities to work independently.

Value of CAI. The ABL instructor felt that Autoskill gave an accurate reading of student performance with results that were instant and easy to interpret. She felt that Autoskill made it easy to pinpoint students' strengths and weaknesses and that training results were easy to view and understand. Although she had concerns about the pre-testing and testing components of the program, she felt that Autoskill could be used again particularly with adequate support given to instructors to set up the program.

On a positive note, the ABL instructor reported that a student who had memory difficulties was making connections between letters and sounds as a result of the oral reading component of Autoskill. Another student who had a history of disliking school was reluctant to use Autoskill, but by the end of the course was enjoying it and making progress. The ABL instructor reported that students were eager to use the program and called their enthusiasm "contagious." She felt her students gained confidence to read aloud and to feel proud of themselves.

In addition, she reported that students were becoming confident using the computer. For example, "The first time a particular student was able to double click to get into the Autoskill program (until this point he had not been able to

manage this mouse skill) he clapped for himself as did the rest of the class! I felt really proud of him!"

The ABL instructor reported that a small class size gave her the opportunity to work individually with students. Working on specific Autoskill sub-skills, she said, allowed her to gain a more clear understanding of her students, and allowed her to develop a more trusting relationship with them. The Stage Two ABL instructor (full-time) reported that Autoskill provided "valuable practice in repetitious exercises for lower level readers, in a stimulating way." The feedback components of Autoskill encouraged students and helped them retain interest. All students were challenged by the program and students were sufficiently motivated to "master" their exercises. The instructor expressed it as "sparking a little competition within the group." Also, this instructor observed increases in students' abilities to use computers as a result of the Autoskill experience.

The ABL instructor (full-time) reported that once students were able to work independently more time was available for her to work on individual students' deficits. "Working closely with students in the oral parts of program, shows clearly differences in learning patterns." The instructor reported that Autoskill was useful in assisting the instructor to quickly identify student strengths and weaknesses, and in recognising individual differences in motivation.

While the ABL instructor (part-time) expressed that not enough time was devoted to Autoskill to make a significant impact on improving students' reading levels, the instructor observed students being more confident in their ability to read aloud, as well as increased confidence in using computers. The part-time instructor would not, however, recommend the use of Autoskill with part-time students (under the current conditions). She felt that 15 hours of Autoskill instruction did not do the students or the program justice.

DISCUSSION

Computer Effect

Generally speaking, this study revealed no significant differences between the reading performance of students receiving computer-assisted instruction and those receiving the conventional program of studies at AVC - Calgary. The trend effect, however, pointed towards a gain in reading performance by some groups of students whose program included computer-assisted instruction.

In this study, ABL and low initial entry-level readers appeared to make greatest gains when using CAI programs. This trend may become more significant with increased concentration and sustained usage of CAI with these students. We do not expect high level readers to gain significantly from the versions of Autoskill or PLATO used in this study.

Course Completion

While motivation across groups to use the computer was moderate to high, there appeared to be no appreciable difference in the rate of course completions associated with computer use. It should be noted, however, that attrition rates between pre- and post-testing were very high for Stage One ESL control (44%), Stage One ABL control (45%), Stage One ABL treatment (56%), and Stage Two ABL treatment (37%).

Integration of CAI

Integration of CAI with conventional face to face instruction with ABE and ABL was higher in the first stage than the second. Integration of CAI into the ESL program remained about the same over the two stages. As might be expected, where CAI was more fully integrated into instruction, it had a stronger positive effect on student performance, which may suggest that a certain “critical time mass” is required for CAI to be effective. In the case of Stage Two ABE students, where CAI was an optional activity, CAI may even have produced a negative effect on student performance. It may be that CAI may be taking away valuable time from class instruction that might be better spent on composition exercises.

Student Satisfaction

With the exception of the Autoskill experience for Stage One ABE students, all students in the study reported enjoying their CAI experience. They believed they received some benefit from using the computer. All groups (ABL, ESL, ABE) reported being comfortable with the computer. A number of students reported that CAI had helped them to learn how to use the computer.

It is interesting to note that ESL students did not regard the computer as being separate, or disconnected from course content. ESL students saw the computer as a tool to assist them in learning to read English. In contrast, both ABE and ABL groups reported wanting to "learn" the computer. They felt that improving their computer skills was important--particularly so for the ABL group who regarded the computer as "the way of the future." Based on researchers' observations of student use, the computer contributed to raising self-esteem levels of many of the ABL students.

In summary, while student satisfaction is always an important consideration, it does not always correlate positively with improved student performance. Whether students like to use a computer or not, does not suggest that the computer will necessarily have a positive or negative effect on student performance. Nevertheless, a dislike of computers, especially by adult audiences, would likely prove disappointing, if not harmful, to performance, and additionally, to student instructor relationship. It is important to note that for this study, entry-level reading scores were more predictive of student success than satisfaction with CAI.

Instructor Satisfaction

Instructors received varying amounts of orientation to Autoskill prior to delivering the program. Instructor feedback on satisfaction with that training was mixed. One thing was clear, however. Instructors expect adequate training time to accompany any introduction of new technologies to teaching learning environments.

Instructor satisfaction with CAI in this study overall, was moderate to high. It is clear that instructors were very willing to explore CAI. They were supportive and co-operative throughout the two Stages. They were, however, cautious of the influence and impact CAI would have on student performance. This sensitivity and caution were warranted given pressures to provide instruction in the most effective and efficient manner possible as students needed to return to the job market as soon as possible. Since student funding is time-specific, they were obliged to learn as much as they could in the shortest time possible.

Challenges for the Study

Accommodating a comprehensive evaluation study in a regular functioning college is a challenge, especially when evaluations involve elements of control. Problems associated with sample selection and rates of student attrition were manifestations of this challenge.

While AVC - Calgary had reasonable placement practices associated with entry level, it was not possible to group students homogeneously according to achievement on placement tests. Since students were scattered throughout the city, and attended satellite campuses near their homes, creating equivalent groups was compromised by selecting students according to where they lived, and with what campuses were most easily accessible to them. Therefore, there was variability within assigned groups.

In addition, it is difficult to conduct long-term studies with adult audiences who are transient in the job market. Attrition was a problem in this study, particularly in relation to follow-up and retention testing. As mentioned earlier, most students attended college with the intention of returning to the job market. As well, Alberta's Vocational Colleges are designed to accommodate at-risk students who encounter personal problems, trouble with the law, learning difficulties, economic pressures, and various family responsibilities. These complexities contributed to the difficulties associated with tracking students beyond the time students were attending the College.

In order to motivate students to return for follow-up or retention testing, a monetary stipend of $35.00 was paid to students. However, even after several personal phone calls made to students by the study co-ordinator, many students chose not to return for testing. We cannot conclude whether or not more money (within reason and appropriate budgets) would have made a difference, but the consensus among staff members was that it would have made little difference.

Limitations

Given these difficulties, results of the study should be considered within certain limitations that point mainly to factors that confound experimental design studies. Sample selection and assignment to groups was not random. It was made by convenience. Therefore, subjects in treatment and control groups were not always evenly matched on entry-level skill in Stage One and Stage Two. Combined group analysis was influenced by changes in pre-, post- and follow-up test instruments, as well as for CAI treatments in Stage One and Stage Two. And finally, due to attrition, particularly in the ABL groups, reduced numbers in post- and follow-up testing further limit the validity of conclusions which might be drawn.

RECOMMENDATIONS

Continued Use of CAI

CAI should continue to be used with low- and mid-range reading level audiences. Autoskill can be expected to have its best effect with low level readers. To be more useful, Autoskill requires more silent and oral reading passages within each level, close training exercises, a change in screen colour, and an easier mechanism for instructors to view training results and assign new material.

Strategically Use CAI

Where used, CAI should be applied in a consistent and concentrated fashion. It should be used strategically and not as a blanket solution for all students. Also, length of time required by students to benefit from either Autoskill or PLATO vary, therefore flexibility in times and length of access to computer-assisted reading instruction should vary from student to student. However, an average of an hour per day appears to be optimal.

Use CAI to Reinforce Computer Skills

There are some value-added gains in using CAI with students. While students gain the benefits of instruction and independence through the computer-assisted reading program, the extra use of computers reinforces previously and newly learned computer skills such as keyboarding and use of the mouse. In addition, some benefits can be attributed to computer use in improving student confidence and self-esteem.

Update PLATO

PLATO reading software should be updated. The current version at AVC - Calgary cannot take advantage of Windows features on 486 + computers.

Continue to Evaluate Reading Software

While control studies are difficult to administer in this setting, AVC - Calgary should continue to evaluate reading software, especially those programs which have extensive adult content and offer second and third generation CAI

approaches (see Appendix A, Literature Review - Second and Third Generation CAI). These are programs which incorporate approaches to interpret user's intentions, stimulate mental associations, or are rich in information resource capabilities.

Continue to Evaluate CAI Use

AVC - Calgary should continue to monitor and evaluate the use of CAI with adult learners. All instructors reported some frustration in both the access time available for students to use computers and in the quality of both software and equipment. ABL instructors added that Autoskill is best suited to learning environments that are quiet and private.

REFERENCES

Organisation for Economic Co-operation and Development and Statistics Canada. (1995). Literacy, economy and society: Results of the first international adult literacy survey, (Statistics Canada Catalogue no 89-545E.), Paris: OECD / Ottawa: Ministry of Industry.

Rachal, J. R. (1995). Adult reading achievement comparing computer-assisted instruction and traditional approaches. Reading Research and Instruction, 34, 239-258.

Statistics Canada. (1996). Reading the future: A portrait of literacy in Canada. Statistics Canada, (Catalogue no 89-551-XPE), Ottawa: Ministry of Industry.

Annotated References

Johnson, Cox and Watson (1994).
Evaluating the impact of IT on pupils' achievements.
Journal of Computer Assisted Learning.
British study conducted with 2300 pupils from 87 classrooms in primary and secondary schools.
Effect Size varies with age and subject.
Overall Effect Size .11 Standard Deviation units in favour of technology over traditional instruction.

Khalili and Shashaani (1994).
The effectiveness of computer applications: A meta-analysis.
Journal of Research on Computing in Education, Vol. 27, No. 1
American meta-analysis (correlation of the results of other studies) of 36 independent studies from elementary school to college.
Overall Effect Size .38 Standard Deviation units in favour of technology over traditional instruction.

MERC (Metropolitan Educational Research Consortium). (1993).
Learning technologies in the classroom: A study of results.
Virginia Commonwealth University.
Meta-analysis of 184 studies - CAI, CMI, CEI
Overall Effect Size .32 Standard Deviation units in favour of technology over traditional instruction.

Kulik, Chen-Lin, and Kulik (1987).
Computer-based instruction: What 200 evaluations say.
Association for Educational Communications and Technology.
Meta-analysis of 200 studies, 74 of which were conducted in schools.
Overall Effect Size .31 Standard Deviation units in favour of technology over traditional instruction.
32% reduction in instructional time.
Attitude-toward-instruction raised 0.28 Standard Deviation units.

APPENDIX A.
Literature Review

INTRODUCTION

Reading and writing are important skills and are directly linked to the social and economic well-being of Canadians. According to the Organisation for Economic Co-operation and Development (OECD) and Statistics Canada (1995), Canada and six other industrialised nations (United States, Germany, the Netherlands, Poland, Sweden, and Switzerland) have inadequate levels of literacy among a broad section of the population. Low literacy levels potentially threaten the economic strength and the social cohesion of a nation (Statistics Canada, 1996). Therefore, it is imperative that literacy levels are raised and that all levels of education address the literacy issue.

Traditionally, western cultures have relied on schools or other forms of formalised instruction to teach reading and writing, where for the most part, instruction materials are print-based and lessons are delivered by a teacher to a group of students. For some 200 years the most dominant technologies (teaching and learning tools) in education have been paper, pencils, desks, and blackboards. However, challenges to tradition have been plentiful. The most pressing pressures for change has been stimulated by advances in computers and information technology. From the development of computer-assisted instruction (CAI) on large mainframe computers in the early 1960's, CAI has been heralded as one of the greatest innovations in education. Indeed, the integration of computer technology has been of interest to administrators, researchers and practitioners since the personal computer became a viable educational tool in the early 1970's.

Many arguments are posed advocating the use of technology in instruction (Hawkridge Jaworski, & McMahon, 1990). The pedagogic argument promotes technology as a teaching tool, believed to improve student learning. It is the pedagogic argument that is still under considerable debate (Clark, 1994; Kozma, 1994). What follows is a synthesis of the literature addressing the relationship of modern technology (mostly computer technology) to teaching and learning generally, and teaching of literacy skills (reading and writing) to adults, specifically.

TECHNOLOGY USE IN INSTRUCTION

In the past few decades (1975-1995) there have been hundreds, if not thousands, of studies conducted in an attempt to clarify the relationship between technology and learning, more specifically the relationship between the use of technology and 1) performance, 2) attitudes/motivation, and 3) efficiency/cost effectiveness. Several of these studies were school-based.

The more publicised (cited often) have reported no significant difference to modest gains in student performance where control has been introduced for instructional method. Some of the more recent and commonly cited examples include: Johnson, Cox & Watson (1994), a British study conducted with 2300 pupils from 87 classrooms in primary and secondary schools reported an overall effect size of .11 standard deviation units in favour of technology over traditional instruction; Khalili & Shashaani (1994) an American meta-analysis which correlated the results of 36 other studies from elementary school to college reported an overall effect size of .38 standard deviation units in favour of technology over traditional instruction; Metropolitan Educational Research

Consortium (1993), another American meta-analysis of 184 studies of CAI, CMI, CEI with a reported overall effect size of .32 standard deviation units, also in favour of technology over traditional instruction; and Kulik, Chen-Lin, and Kulik's (1987) meta-analysis of 200 studies, 74 of which were conducted in American schools. The Kuliks reported an overall effect size of .31 standard deviation units in favour of technology over traditional instruction. Their study went on to report a 32% reduction in instructional time and an increase in positive attitude toward learning/instruction.

Like the Kulik study, other reports indicate that CAI can be a factor in improved attitudes/motivation and efficiency/cost effectiveness. For example, Darter and Phelps (1990) review of the literature on the use of the computer in teaching reading found that CAI has had a positive effect on student and teacher attitudes and motivation, saving teachers' time, savings of student' learning time and opportunities for increased practice and re-teaching. It did not, however, find advantage in using CAI to increase student achievement since scores on post-tests were no better than those which involved only traditional methods. A more recent meta-analysis of twenty-one studies by Rachal (1995) concludes while the majority of the findings indicated no significant difference occurring in student achievement, other benefits were reported: faster rates of learning, immediate feedback, reduced attrition, increased student self-confidence, and increased privacy. However, these findings were reported as researchers' perceptions rather than empirically derived findings.

Although few if any explanations are offered, many reports suggest that CAI has a particularly positive influence on achievement, attitude, and motivation of special audiences. For deaf children, gains have been reported in reading and writing new words and sentences (Prinz, 1991; Thompson, 1990). Incarcerated adult

males benefited from CAI, posting significant pre-test to post-test gains (Spivey, 1992). Thompson (1990) study indicated that CAI appeared to work more effectively for slower, disadvantaged, and below-grade-level readers than for average or above-average readers.

On the other hand, a number of researchers suggest that the literature supporting the use of CAI is at best inconclusive and at worst flawed. Olson & Krendl (1990) report that many studies suggest positive outcomes (improved achievement, lower absenteeism, higher self-esteem, better attitude toward school) resulting from computer use, while their meta-analysis concluded that most of the studies included flaws in the design, measurement and control of critical factors associated with the learning environment. Another meta-analysis of 63 studies (McNeil & Nelson, 1991) investigated cognitive achievement effects following interactive video (IV) instruction. While they felt the effect was similar to that of computer-assisted instruction, they reported that generalisations were impossible due to complex interrelationships among compatible variables and instructional conditions. Others (Darter & Phelps, 1990; Feldmann & Fish, 1991) report no positive effect from using CAI to increase student achievement. Scores on post-tests were no better than those, which involved only traditional methods.

CAI Studies with Adult Reading Populations

Few CAI studies have concentrated on adult subjects. Those that have, report mixed results. As expected, rigorous research studies of the influence of CAI on Adult reading populations are extremely limited. Often, those that do appear tend to be evaluations with little generalizability beyond the specific setting and activities of the research. Therefore, a few upper-level high school reports are added to this review.

A recent meta-analysis by Rachal (1995), examined the effectiveness of computer-assisted instruction (CAI) on the teaching of reading at adult basic and secondary education levels. This meta-analysis included a number of quasi-experimental studies comparing experimental (CAI) groups to groups using more traditional instructional approaches. Of the twenty-one studies examined in this meta-analysis, variation was reported in their designs, objectives, settings, software, skills examined, and conclusions. While the majority of the findings indicated no significant difference occurring in student achievement, five studies reported improvement in achievement scores for CAI over traditional reading approaches. In addition, other benefits were reported: faster rates of learning, immediate feedback, reduced attrition, increased student self-confidence, and increased privacy. These findings were reported as researchers' perceptions rather than empirically derived findings. Similarly, Garrett (1995) reports mixed results of CAI effectiveness in college to improve academic programs.

The Feldmann & Fish (1991) study has indicated that the use of computer-mediated reading supports did not improve high school students' reading comprehension scores. McLaughlin (1986) says CAI does not improve vocabulary skills, either. The study involving one control group and two experimental groups of college students, one receiving traditional instruction and individualised, in-class, computer-assisted instruction, the other receiving traditional instruction in class and computer-assisted instruction in a lab facility. The results were that no improvement in vocabulary skills between groups was shown, nor did one experimental group out-performed the other.

In contrast, and reporting more qualified results, Weiss (1994) has suggested that readers with access to computer-mediated reading supports score higher on recall

tasks. Findings of this study suggest that vocabulary knowledge is the primary contributor to reading comprehension, and that verb conjugation and background information played an insignificant role in enhancing readers' comprehension. The computer might provide unique opportunities to manage readers' interaction with the text during independent reading. An issue emerging from this study, and one to which Weiss advocates further research is the degree to which the reader of the computer controls the assistance provided by the computer.

Other reports provide more tentative conclusions about CAI effectiveness. Thompson (1990) concluded that CAI provided only tentative conclusions about its effectiveness in relation to reading. As already mentioned, this study indicated that CAI appeared to work more effectively for slower, disadvantaged, and below-grade-level readers than for average or above-average readers. Supporting these conclusions, Tzung-yu (1993) maintains that while Iowa State University students were more interactive with, and positive toward, computers, that computers help monitor successful learning, and encourage groups to spend more time on task, more studies are needed in different instructional situations and subject areas to confirm the use of computer-assisted instruction over traditional print in reading instruction.

Many studies advocate CAI as an adjunct, not a replacement for traditional approaches to teaching and learning. A Canadian study of computer assisted instruction for adults indicated that gains were made and students felt more confident in their abilities as students. Also, they wanted more instructor input. The study concluded that computer assisted learning systems could serve as successful adjuncts to traditional instructional models (Moore, 1993). Garza & Gibbs (1994) later supported this position by suggesting that most successful programs use a whole-language approach employing computer-assisted

instruction, study skills, and method evaluation. The same is recommended school-based audiences. Components of language experience, whole language, and computer-assisted instruction are most optimally incorporated into the core reading program (VanProoyen & Clouse, 1994).

With most instructional materials and approaches, quality is an issue. CAI appears to be no exception. Ertmer, Evenbeck, Cennamo, & Lehman, (1994) have found no direct relationship between time-on-task and levels of confidence suggesting that "quality " rather than "quantity" of computer experience may be most critical. They indicate the importance of placing the learner in an environment, which provides acceptable means for voicing frustration and for obtaining encouraging feedback from the instruction regarding one's developing skills.

Others would suggest that regardless of the direct impact of CAI on achievement, CAI and computers offer some definite advantages to the instructor and the learner. An Australian computer-assisted language learning (CALL) project (McCarthy, 1994) found specific advantages in seven areas: organisation of materials; display of items; volume of material and random presentation; feedback, scoring and record-keeping; focused tutorial assistance; graphics and animation; and cognitive direction.

Also, gender may be an issue in CAI. While much of the gender literature in CAI has focuses on male and female access and use of computers (Shashaani, 1994; Canada & Brusca, 1991), the following is somewhat curious. In many cases CAI requires students to follow directions precisely and independently. One important aspect of this issue is understanding what types of individuals attend to and follow directions. This study indicated that females with a low

computer self-efficacy followed more directions that those with a high self-efficacy. Those males with a low computer self-efficacy followed fewer directions than those with a high self-efficacy. An alternative is to provide exercises to increase computer self-efficacy for males. Those could include exercises, which enable the learner to gain confidence in manipulating the computer. These exercises could be provided prior to the CAI or better, embedded in the instruction itself. (Carlson & Grabowski, 1992).

Many support the continued use and exploration of the effectiveness of computer-assisted instruction (Johnson, Cox and Watson, 1994; MERC, 1993; Khalili and Shashaani, 1994; Kulik, Chen-Lin, and Kulik, 1987). In particular calls have been made for further investigation into the use of computers in language learning because of the capacity of the computer to offer interactive learning, and to handle a wider range of activities than other educational aids (Kennedy, 1989).

Second and Third Generation CAI

With the advent of increased computer power and swift and accessible telecommunications, development of CAI has increasingly adopted multimedia approaches to delivery. Multimedia software incorporates text, graphics, animation, pictures, video, and sound to present information. In the literature these new learning environments are being called “second generation CAI”. First generation CAI is defined by the limitations of the medium, primarily forcing learners to engage in simple learning tasks. Second generation CAI increases in complexity of design allowing learners to engage in complex processing, inference making, semantic elaboration and several means of monitoring, retrieval and feedback A third generation of CAI is emerging which offers assistance to students through guided constructive approaches to learning (Goodfellow, 1995).

Research results surrounding this medium are few. Early indications are that learners are better able to acquire vocabulary and improve comprehension, primarily due to the ability of these new programs to assist the learner in making various associations in more realistic and varied contexts (Chun and Plass, 1996a; Chun and Plass, 1996b; Goodfellow, 1995; McBride and Seago, 1996). Also, this new medium is reported to improve student attitude toward subject material and learning in general (Brett, 1996). Another encouraging feature of multimedia being reported is that various media appear to be successful in encouraging learners to take more responsibility for their own learning (McBride and Seago, 1996).

While we will witness an increase in the use of multimedia in all aspects of education and training, measurement of its effect on learning will be even more complex and controversial than with first generation CAI. As Najjar (1996, p. 129) suggests, people tend to share a common assumption that multimedia information helps people learn, an assumption "based more on personal opinion than on scientifically-based fact." He goes on to say that:

> specific situations in which multimedia information may help people to learn include (a) when the media encourage dual coding of information, (b) when the media support one another, and (c) when the media are presented to learners with low prior knowledge or aptitude in the domain being learned.

A growing concern in the measurement of effect of CAI on learning, whether multimedia or first generation programming is the issue of measuring learning differently. As Najjar (1996) points out, if we present information using the new media, should we not test using the same media?

CONCLUSION

Early beginnings in CAI were difficult. Usually it meant having to invest over a million dollars in hardware and software (Paramskas, 1993). However, in the past decade there have many changes in the evolution of computer-assisted learning (CALL). Some of these changes include the development of multimedia capabilities, colour, animation, and technical improvement of audio and video quality; availability of databases, better fit between computer "tools" and instruction; emphasis on grammar, vocabulary, and reading to support and enable instruction rather than as the content of instruction; improved techniques for drills and tutorials; and packaging of instruction (Jamieson, 1994). More importantly, over the years, computer capacity and power have vastly increased, while costs have remained the same or been reduced.

No significant difference is significant. The literature indicates that for many teaching and learning situations, computer-assisted instruction is as effective as human instruction. Most reports show both student attitude and motivation increases when technology is used to assist instruction. However, there are some inherent complexities in determining the effect of computer-assisted instruction on achievement. Factors such as teachers' and students' attitudes, extent of integration in the curriculum, user interface with the hardware and software, may determine the impact of technology on achievement no less than the technology itself. As Clark (1983) pointed out over a decade ago, research on the influence of media on learning is too often flawed by undefined treatment, treatment too briefly applied, and the lack of statistical controls needed to attribute the observed effect to any cause.

But, student achievement is not the only reason to have teachers and students use technology. Our review of studies tell us that when teachers change their teaching methods and use technology well, we can expect more positive results, not only in improved scores, but in students' ability to problem solve, communicate, and work as a team. This is particularly evident when students are asked to take more responsibility for their own learning. It is not so much "do computers and computer-assisted instruction have a positive influence on instruction and learning", but rather, "it depends." Therefore the questions we may need to ask are how are computers and CAI "best" used to improve learning and teaching, a question of evaluation rather than of generalizable research.

As the number of older students enrolled at post-secondary institutions increases, it becomes important and relevant to continue researching and evaluating computer-assisted instruction as it relates to reading and adult education, particularly in a controlled environment. This is compounded by increasing attention being given to multimedia and the many public assumptions of its positive effects on learning.

REFERENCES

Brett, P. (1996). Using multimedia: an investigation of learner's attitudes. *Computer Assisted Language Learning*, 9(2-3), 191-112.

Canada, K. & Brusque, F. (1991). The technological gender gap: Evidence and recommendations for educators and computer-based instruction designers. *Educational Technology Research and Development*, 39(2), 43-52.

Carlson, R. D., & Grabowski, B. L. (1992). The effects of computer self-efficacy on direction-following behaviour in computer assisted instruction. *Journal of Computer-Based Instruction*, 19(1), 6-11.

Chun, D., & Plass, J. (1996). Facilitating reading comprehension with multimedia. *Systems*, 24(4), 503-519.

Chun D., & Plass, J. (1996). Effects of Multimedia annotations on vocabulary acquisition. *Modern Language Journal*, 80(2), 183-198.

Clark, R. E. (1983). Reconsidering research on learning from media. *Review of Educational Research*, 53(4), 445-460.

Clark, R. E. (1994). Media and method. *Educational Technology Research and Development*, 42(3), 7-10.

Darter, C. L., & Phelphs, L. N. (1990). *The impact of the computer on the teaching of reading: A review of the literature*. TX.

Ertmer, P., Evenbeck, E., Cennamo, K., & Lehman, J. (1994). Enhancing self-efficacy for computer technologies through the use of positive classroom experiences. *ETR&D*, 42(3), 45-62.

Feldmann, S., & Fish, M. (1991). Use of computer-mediated reading supports to enhance reading comprehension of high school students. *Journal of Educational Computing Research*, 7(1), 25-36.

Garrett, R. L. (1995). Computer-assisted instruction in 2-year colleges: Technology of innovative teaching. *Community College Journal of Research & Practice*, 19(6), 529-36.

Garza, N. R., & Gibbs, L. (1994). *A description and analysis of selected successful developmental reading programs in Texas community colleges [and] analysis of developmental mathematics programs in Texas community colleges which are successful with Black and Hispanic students*. Paper presented at the 16th Annual International Conference of the National Institute for Staff and Organizational Development on Teaching Excellence and Conference of Administrators, Austin, TX.

Goodfellow, R. (1995). A review of the types of CALL programs for vocabulary instruction. *Computer Assisted Language Learning*, 8(2-3) 205-226.

Hawkridge, D., Jaworski, J., & McMahon, H. (1990). *Computers in third world schools*. Macmillan Press.

Jamieson, J. (1994, July). *A history of commitment in CALL*. Paper presented at a conference on Computers in Applied Linguistics, Ames, IA.

Johnson, D., Cox, M., & Watson, D. (1994). Evaluating the impact of IT on pupils' achievements. *Journal of Computer Assisted Learning.*

Kennedy, G. (1989). Computers in language teaching. In D. Little (Ed.), *Media technologies and language learning*. Proceedings of an IRAAL Seminar, Dublin, Ireland.

Khalili, A., & Shashaani, L. (1994). The effectiveness of computer applications: A meta-analysis. *Journal of Research on Computing in Education*, 27(1).

Kozma, R. B. (1994). Will media influence learning? Reframing the debate. *Educational Technology Research and Development*, 42(2), 7-29.

Kulik, C., & Kulik, J. (1987). *Computer-based instruction: What 200 evaluations say*. Paper presented at the Annual Convention of the Association for Educational Communications and Technology, Atlanta, GA.

McBride, N., & Seago, K. (1996). The 'a to z of grammar.' An integrated CALL project. *Computer Assisted Language Learning*, 9(1), 45-61.

McCarthy, B. (1994). *Grammar drills: What CALL can and cannot do*. Paper presented at the Meeting of the EUROCALL, Karlsruhe, Germany.

McLaughlin, P. (1986). ERIC Clearinghouse on Information Resources, Syracuse, N.Y. {BBB14619].

McNeil, B., & Nelson, K. (1991). Meta-analysis of interactive video instruction: A 10 year review of achievement effects. *Journal of Computer-Based Instruction*, 18(1), 1-6. Winter.

MERC (Metropolitan Educational Research Consortium) (1993). *Learning technologies in the classroom: A study of results*. Virginia Commonwealth University.

Moore, A. (1993). *Computer assisted instruction (ILS) for adults*. Paper presented at the 15th Annual International Conference of the National Institute for Staff and Organizational Development on Teaching Excellence and Conference Administrators, Austin, TX.

Najjar, L. (1996). Multimedia information and learning. *Journal of Educational Multimedia and Hypermedia*, 5(2) 129-150.

Olson, B., & Krendl, K. (1990-91). At-risk students and microcomputers: What do we know and how do we know it? *Journal of Educational Technology Systems*, 19(2), 165-175.

Organisation for Economic Co-operation and Development and Statistics Canada. (1995). Literacy, economy and society: Results of the first international adult literacy survey, (Statistics Canada Catalogue no 89-545E.), Paris: OECD / Ottawa: Ministry of Industry.

Paramskas, D. (1993). Computer-assisted language learning (CALL): Increasingly integrated into an ever more electronic world. *Canadian Modern Language Review*, 50(1) 124-143.

Prinz, P. M. (1991). Literacy and language development within microcomputer-videodisk-assisted interactive contexts. *Journal of Childhood Communication Disorders*, 14 (1), 67-80.

Rachal, J. R. (1995). Adult reading achievement comparing computer-assisted instruction and traditional approaches. *Reading Research and Instruction*, 34, 239-258.

Shashaani, L. (1994). Gender-differences in computer experience and its influence on computer attitudes. *Journal Educational Computing Research*, 11(4), 347-367.

Spivey, F. J. (1992). *Computer assisted instruction vs. direct teaching model of teaching reading to incarcerated adults.* Sam Houston State University, TX.

Statistics Canada. (1996). Reading the future: A portrait of literacy in Canada. Statistics Canada, (Catalogue no 89-551-XPE), Ottawa: Ministry of Industry.

Thompson, R. A. (1990, July). *The relative effectiveness of computer assisted instruction (CAI) for teaching students to read English*. Paper presented at the 13th World Congress on Reading, Stockholm, Sweden.

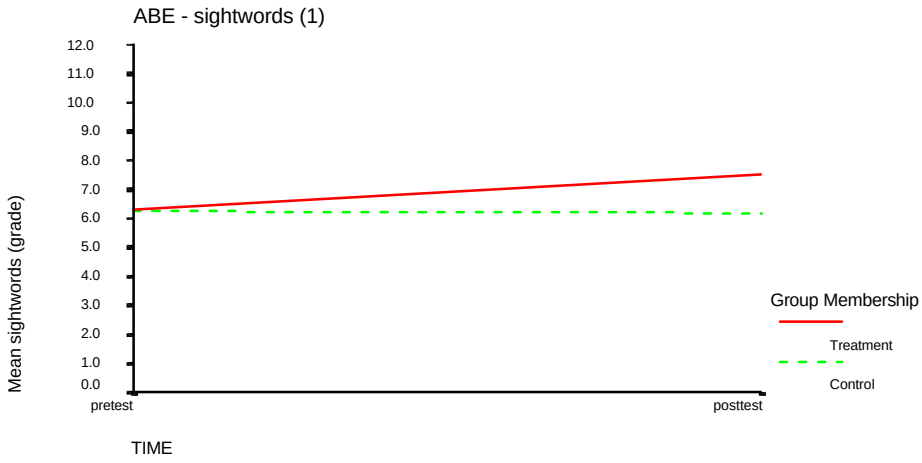
Tzung-yu, C. (1993). *Comparing the use of computers with traditional print in reading instruction: What the research says.* IN.

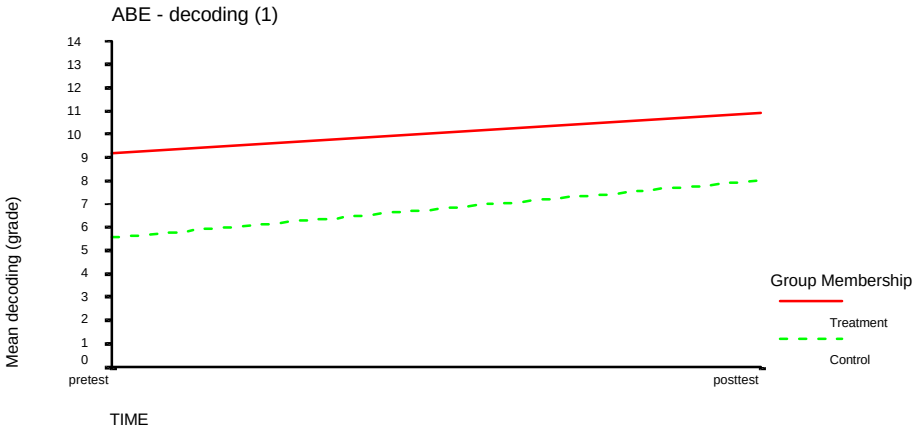
VanProoyen, N., & Clouse, R. W. (1994). *Three approaches to teaching reading: Basal, language experience, and computer-assisted instruction*. GA.

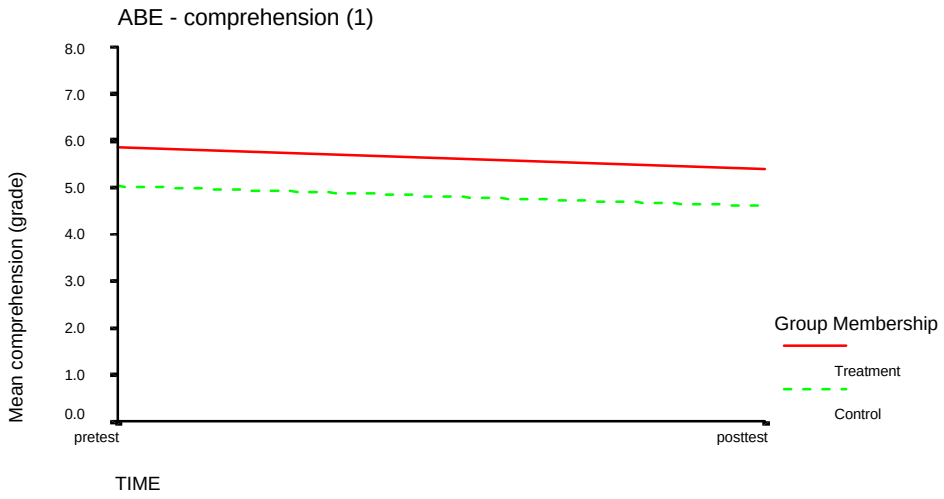
Weiss, S. A. (1994). Situating learning in technology: The case of computer-mediated reading supports. *Journal of Educational Technology Systems*, 23(1), 63-74.

APPENDIX B.
Line Graphs

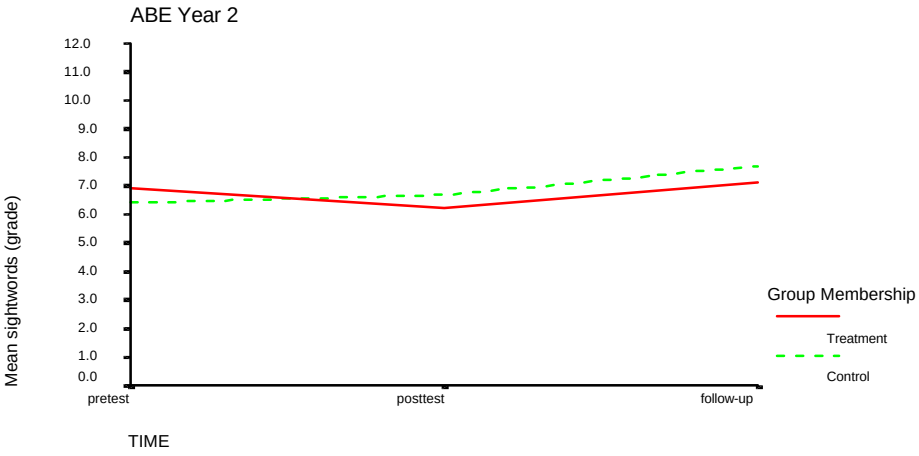
Stage One - ABE

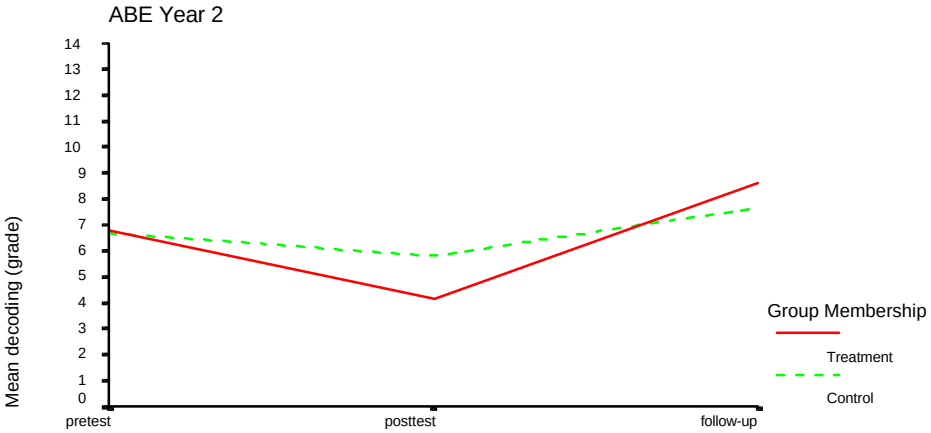


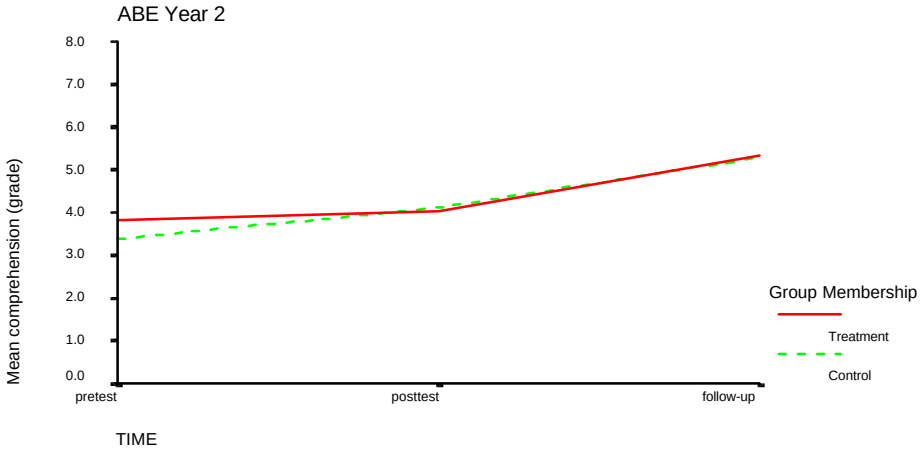




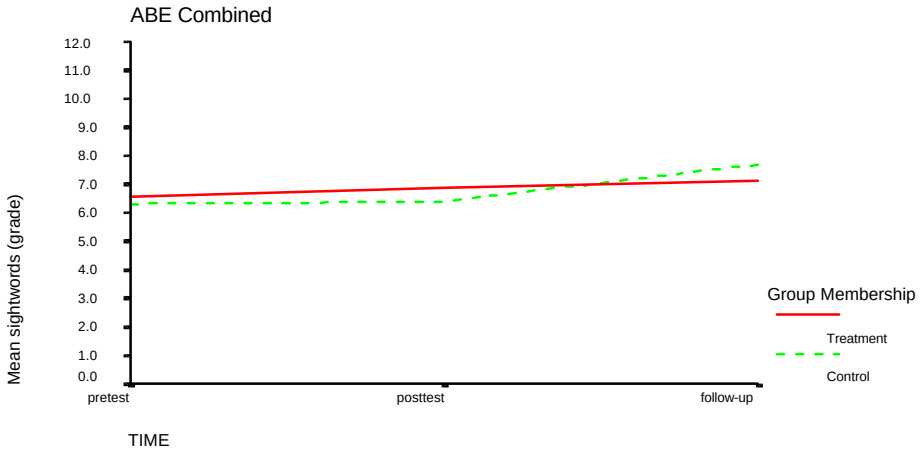
Stage Two - ABE

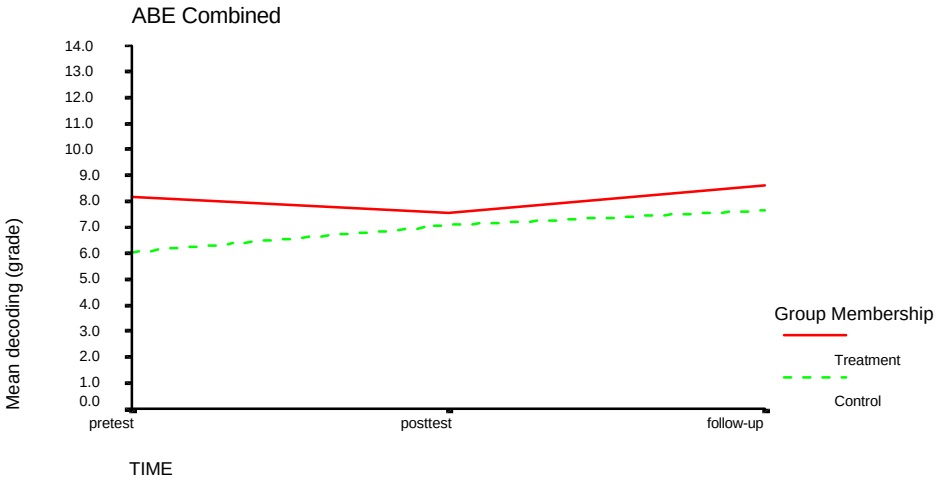


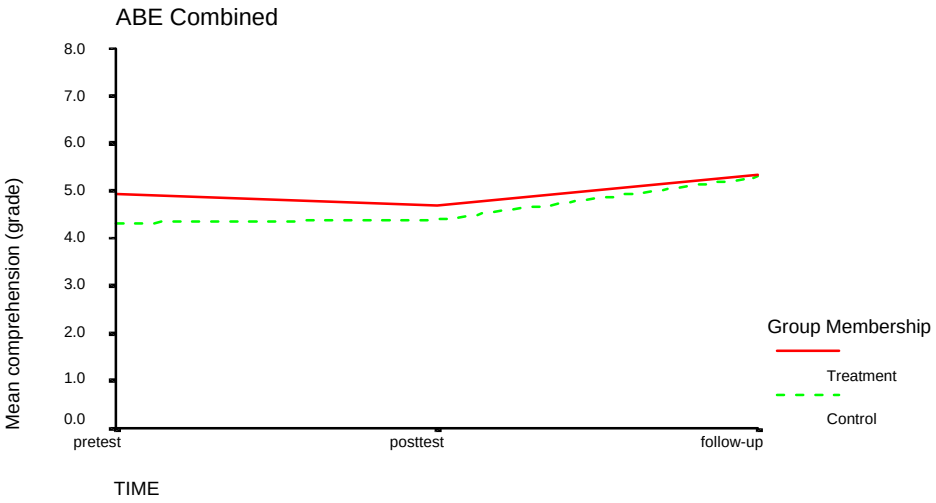

ABE Year 2
Mean decoding (grade)
14
13
12
11
10
9
8
7
6
5
4
3
2
1
0
pretest
posttest
follow-up
TIME
Group Membership
Treatment
Control


ABE Year 2
Mean comprehension (grade)
8.0
7.0
6.0
5.0
4.0
3.0
2.0
1.0
0.0
pretest
posttest
follow-up
TIME
Group Membership
Treatment
Control

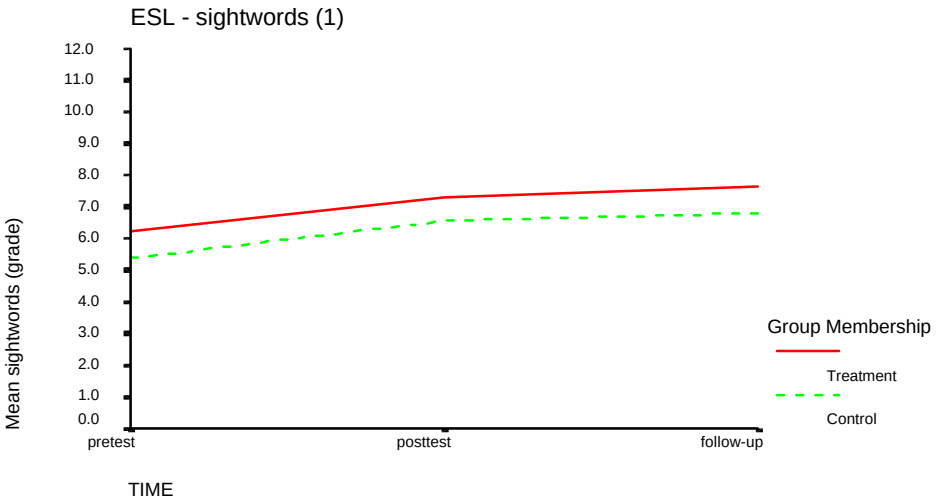
Stages One and Two - ABE

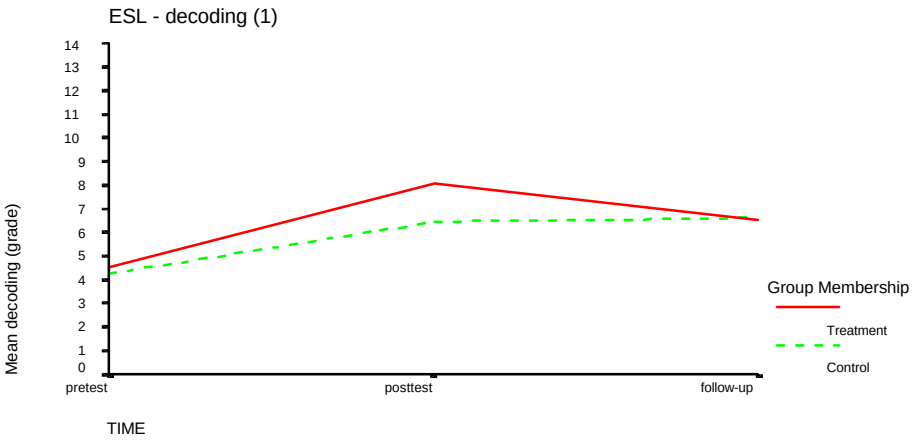


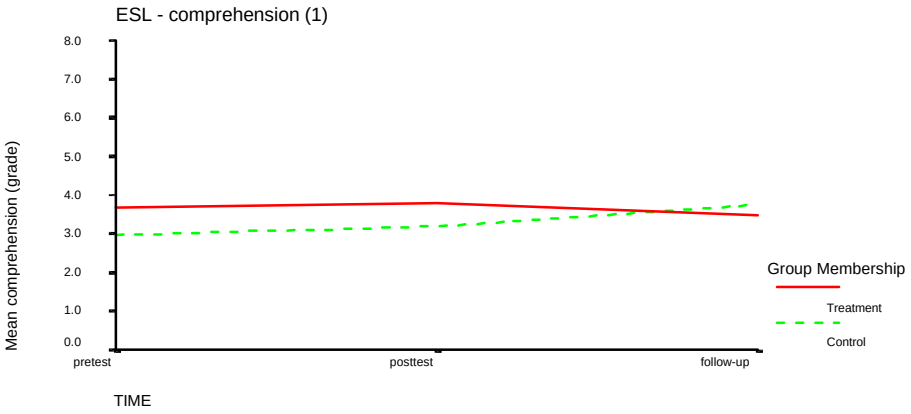



ABE Combined
Mean comprehension (grade)
8.0
7.0
6.0
5.0
4.0
3.0
2.0
1.0
0.0
pretest
posttest
follow-up
TIME
Group Membership
Treatment
Control

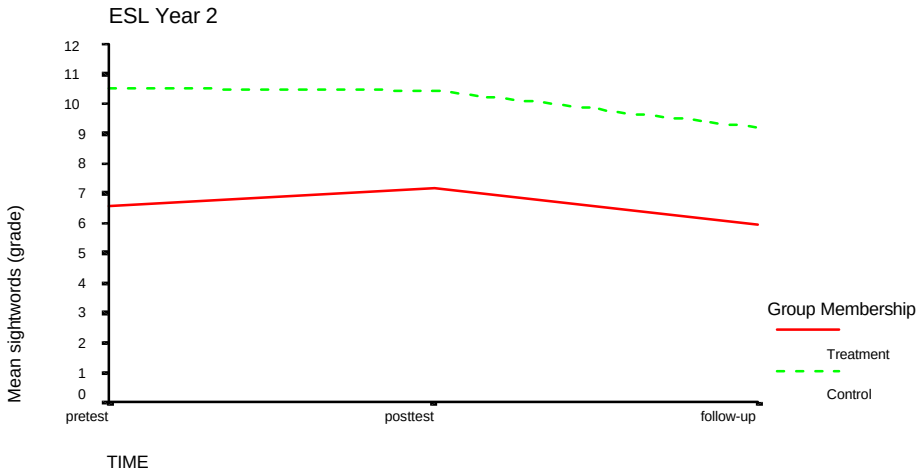
Stage One - ESL

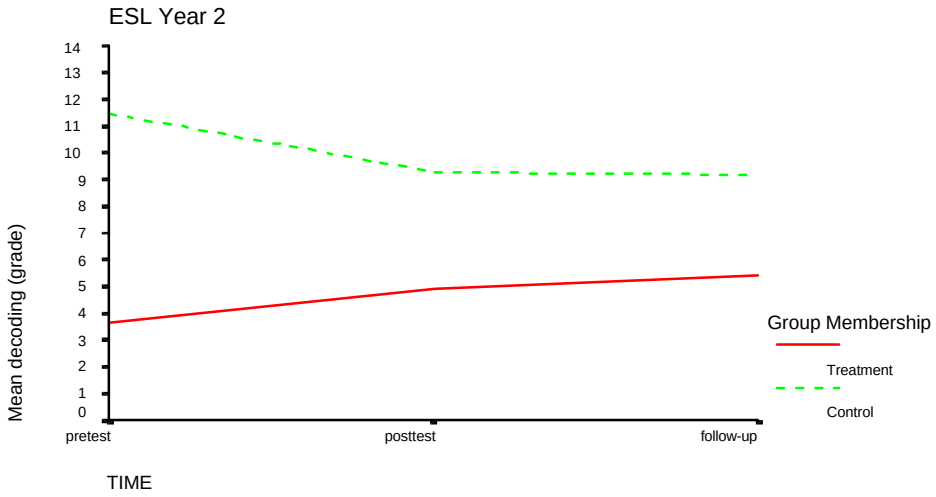


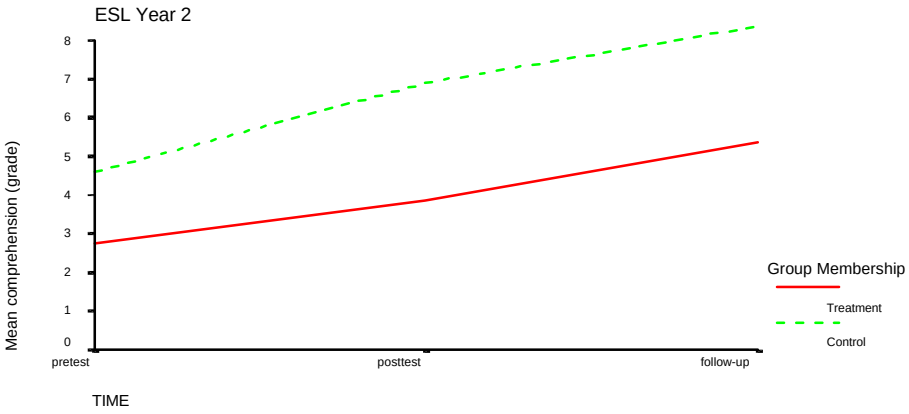




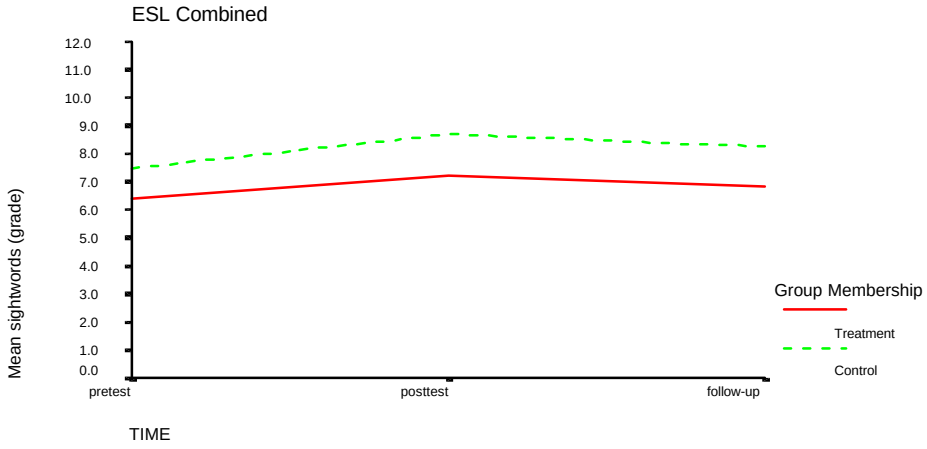
Stage Two - ESL

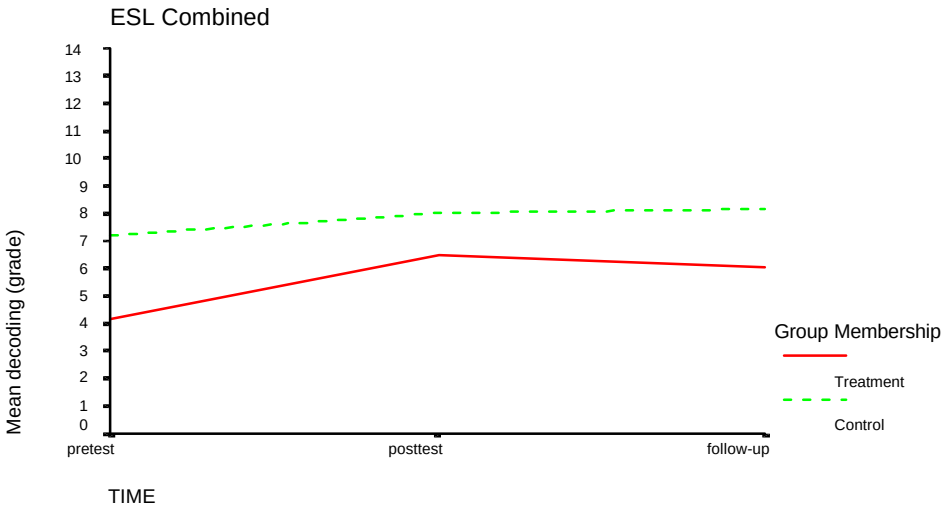


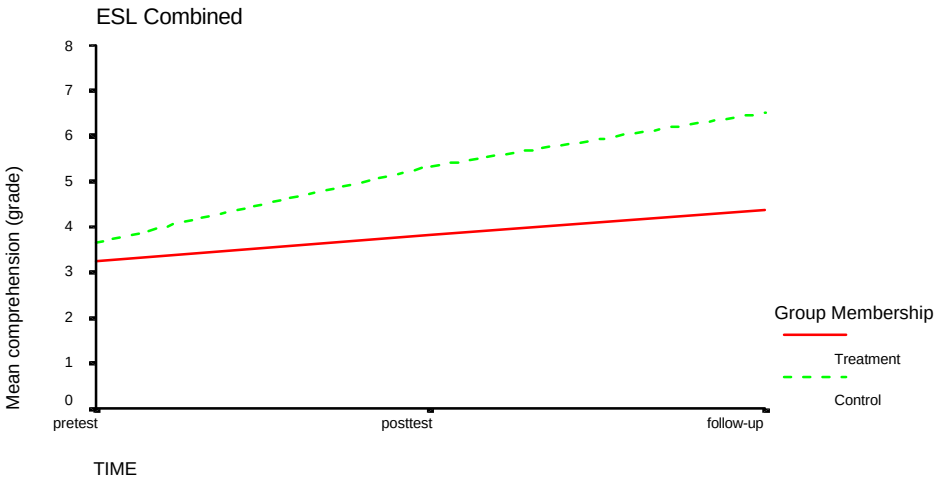



ESL Year 2
Mean comprehension (grade)
8
7
6
5
4
3
2
1
0
pretest
posttest
follow-up
TIME
Group Membership
Treatment
Control

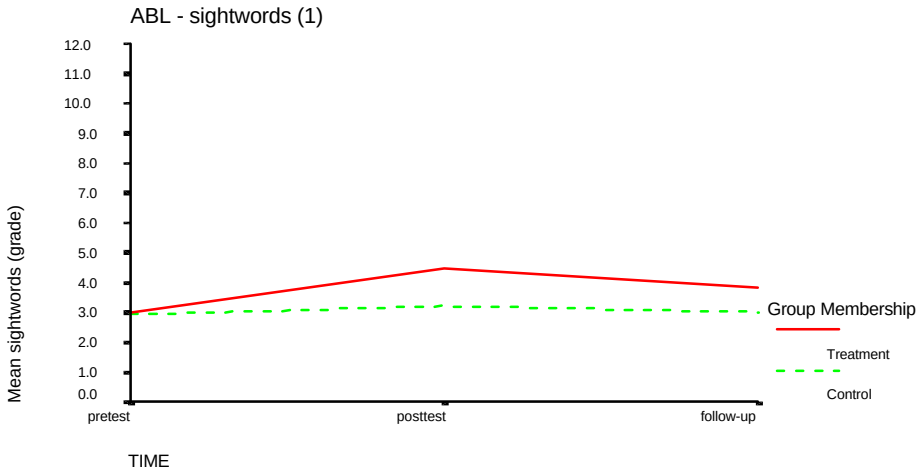
Stage One and Two - ESL

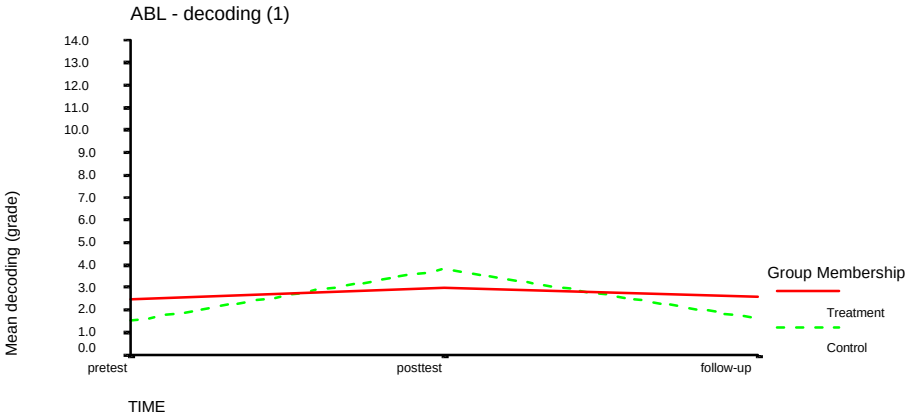


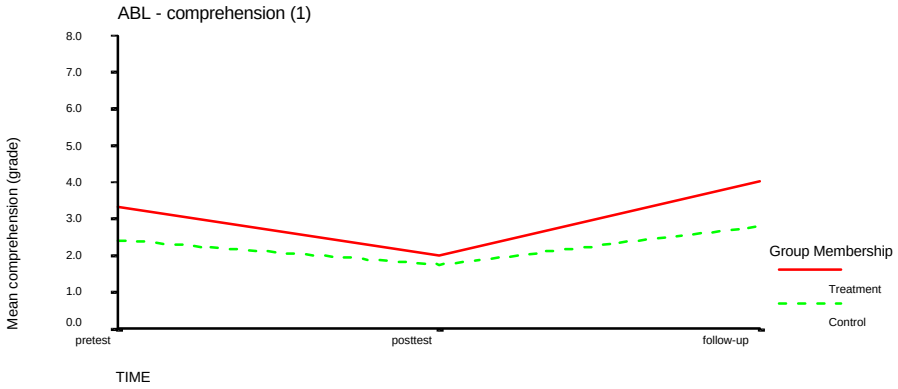



ESL Combined
Mean comprehension (grade)
8
7
6
5
4
3
2
1
0
pretest
posttest
follow-up
TIME
Group Membership
Treatment
Control

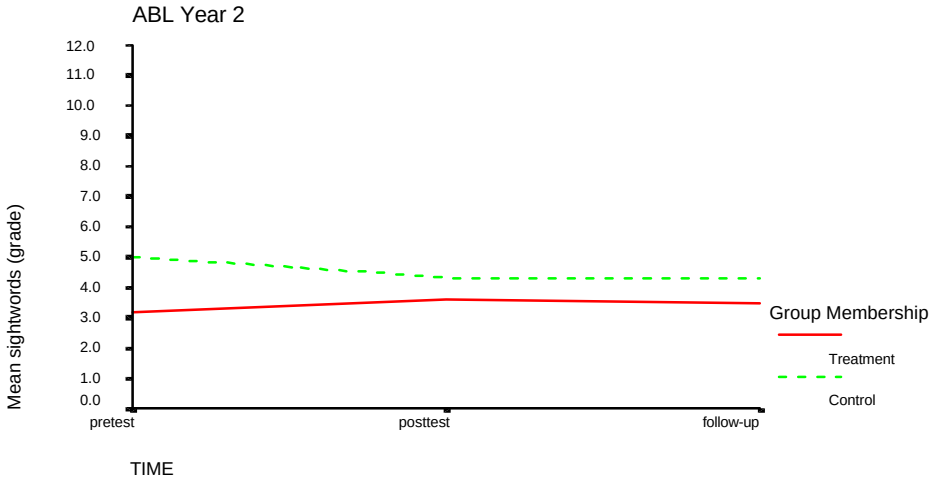
Stage One - ABL

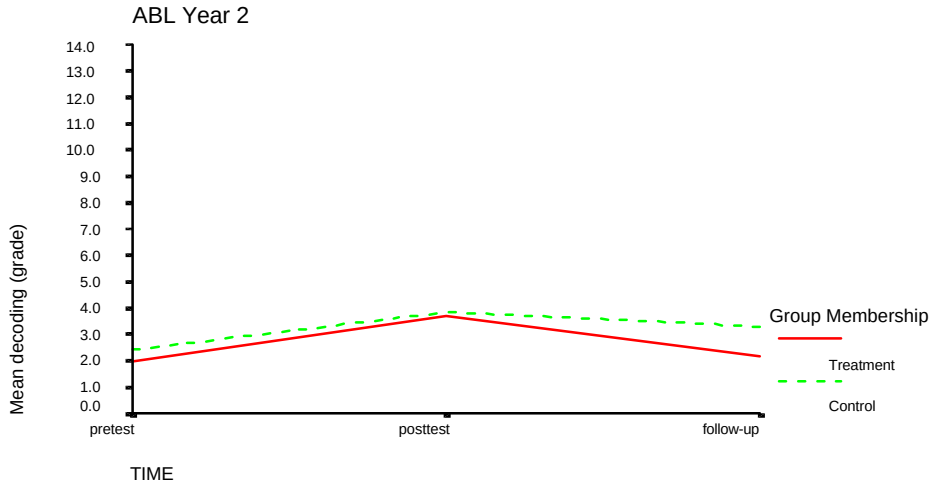


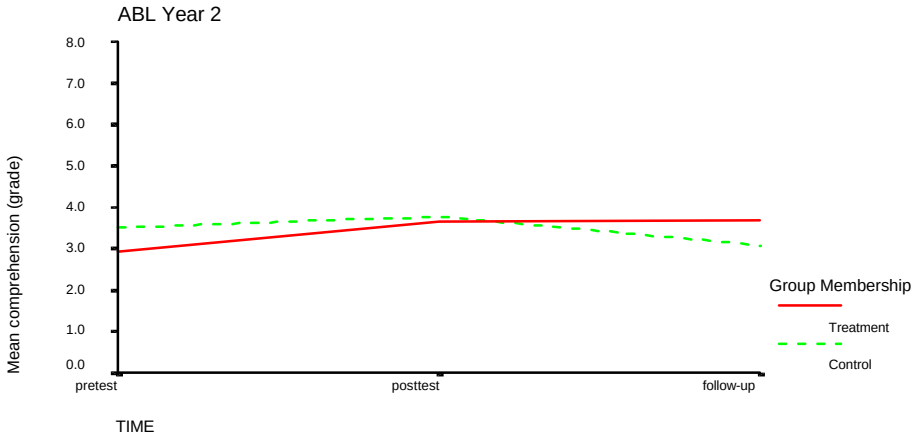




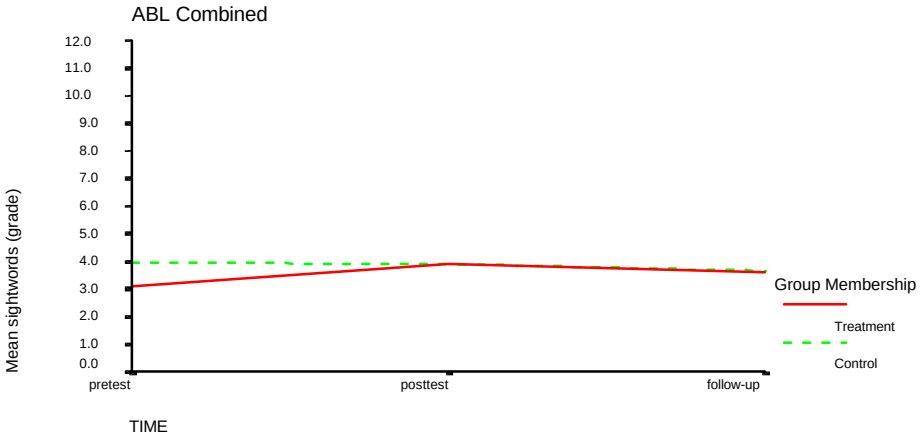
Stage Two - ABL

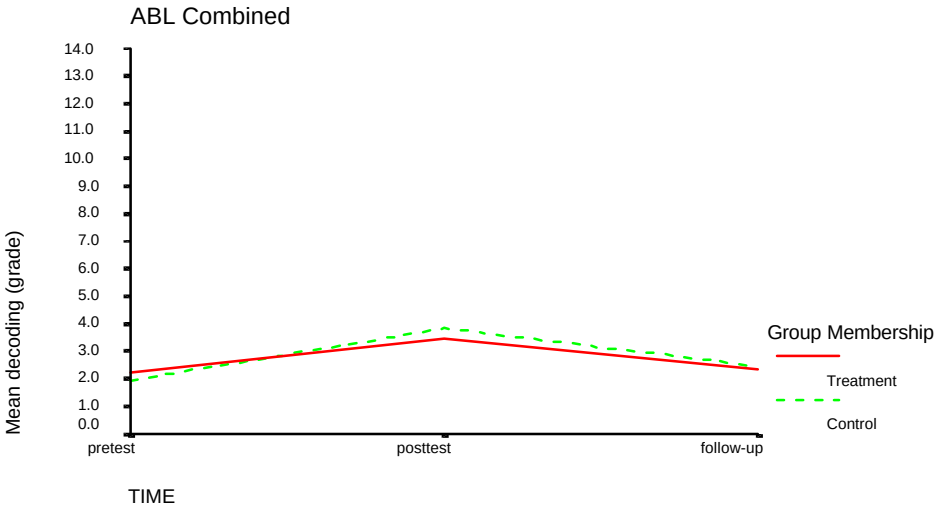


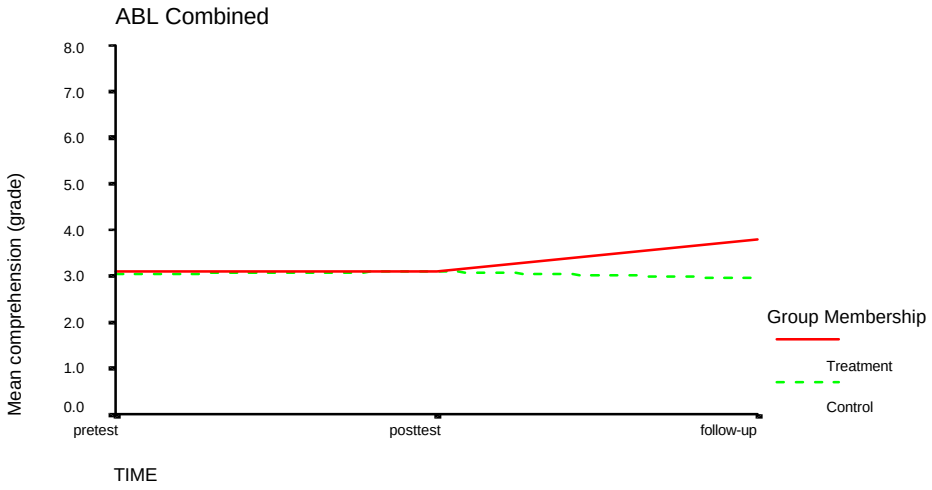



ABL Year 2
Mean comprehension (grade)
8.0
7.0
6.0
5.0
4.0
3.0
2.0
1.0
0.0
pretest
posttest
follow-up
TIME
Group Membership
Treatment
Control

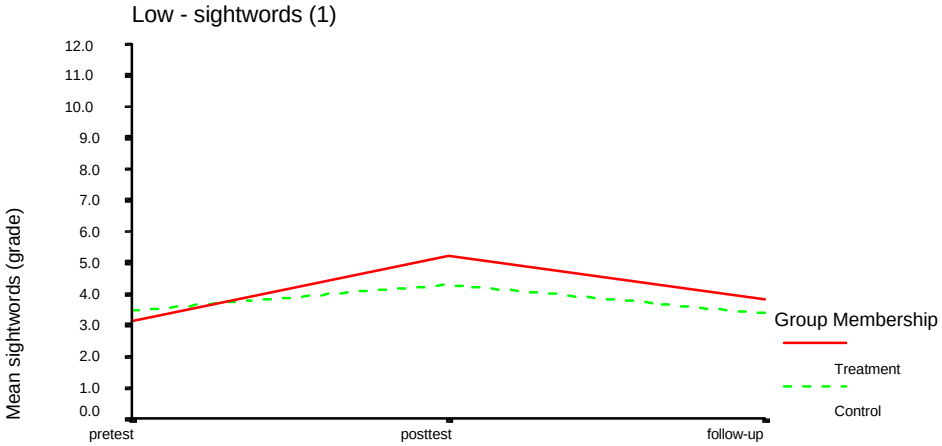
Stages One and Two - ABL

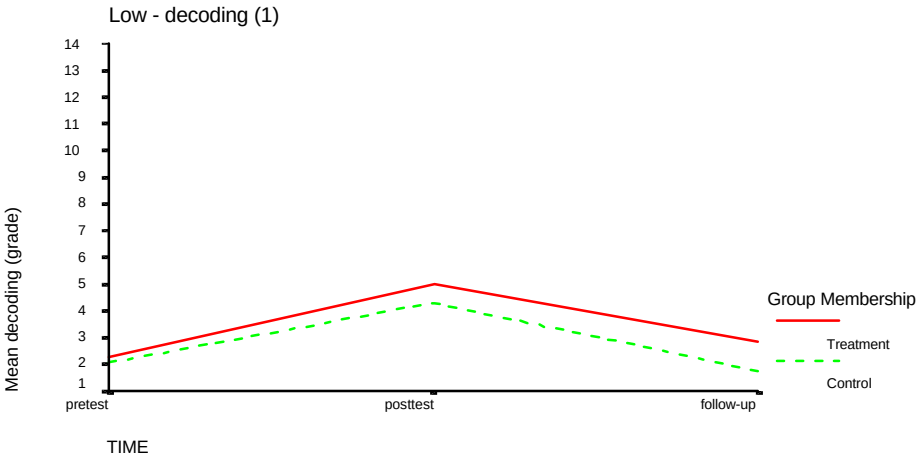


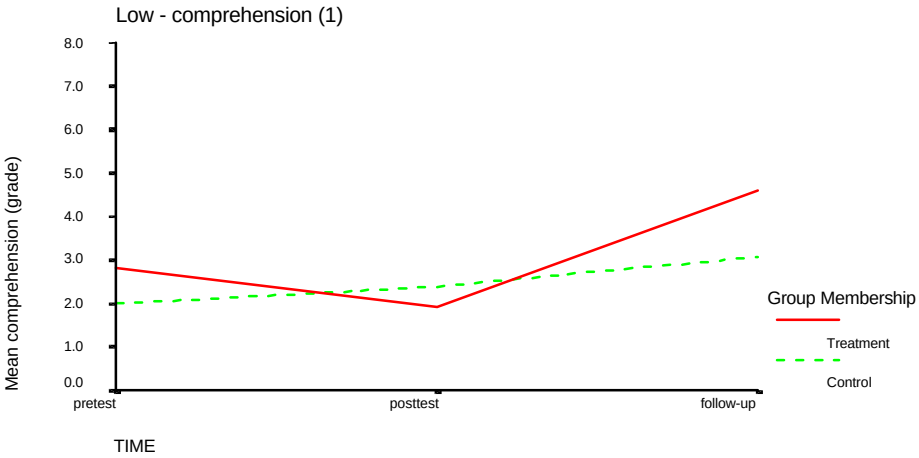



ABL Combined
Mean comprehension (grade)
8.0
7.0
6.0
5.0
4.0
3.0
2.0
1.0
0.0
pretest
posttest
follow-up
TIME
Group Membership
Treatment
Control

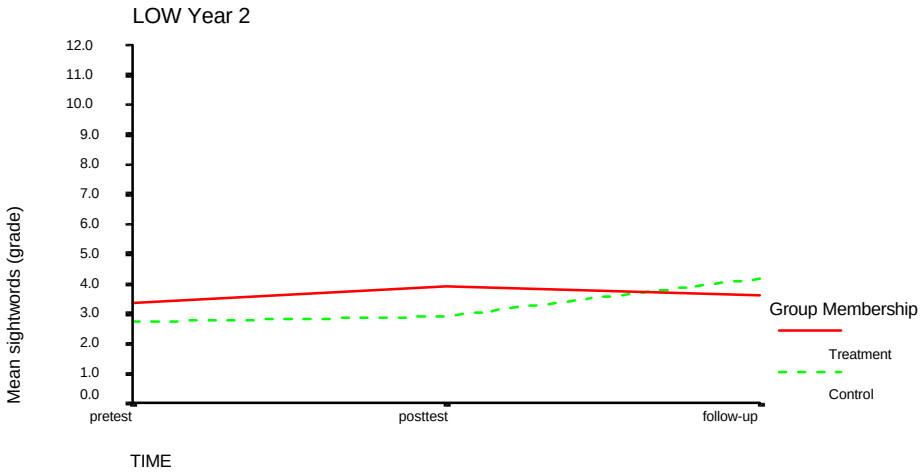
Stage One - Low

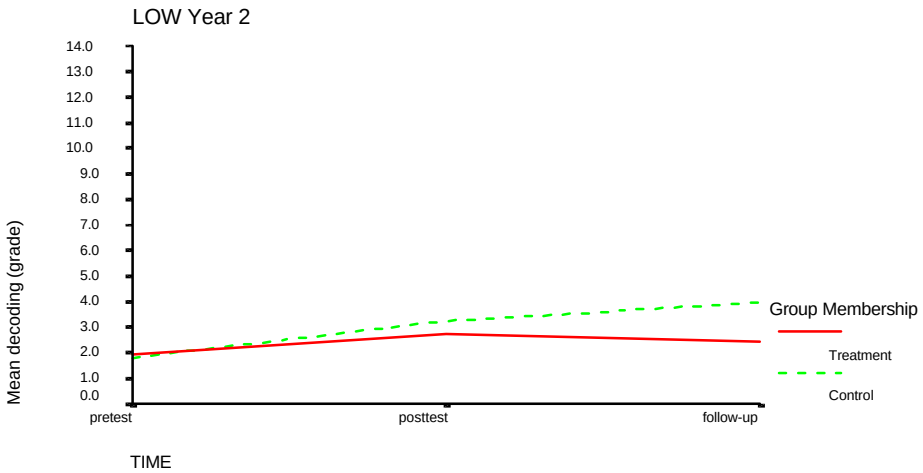


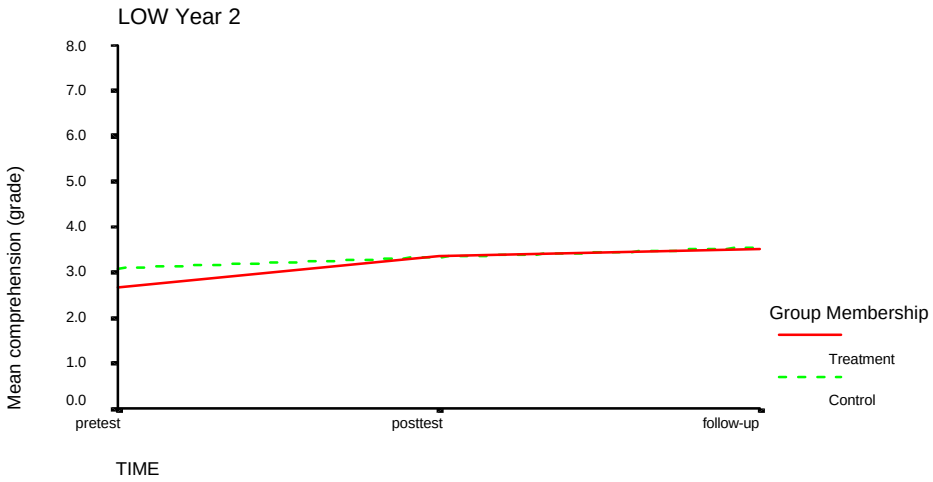




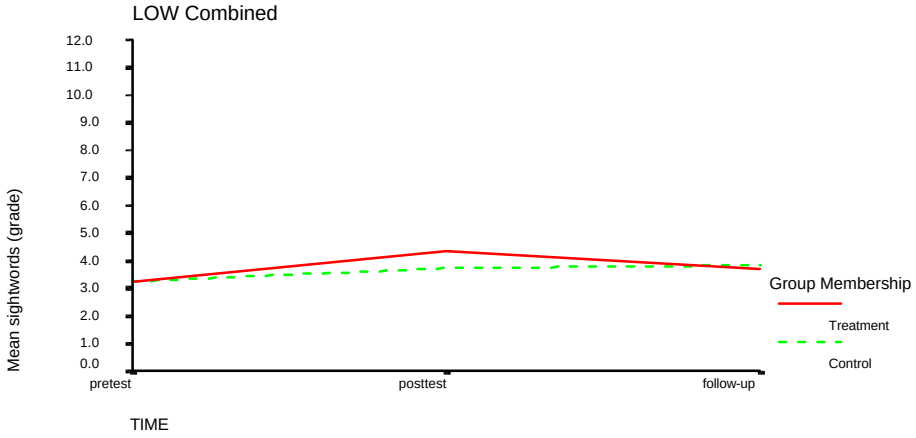
Stage Two - Low

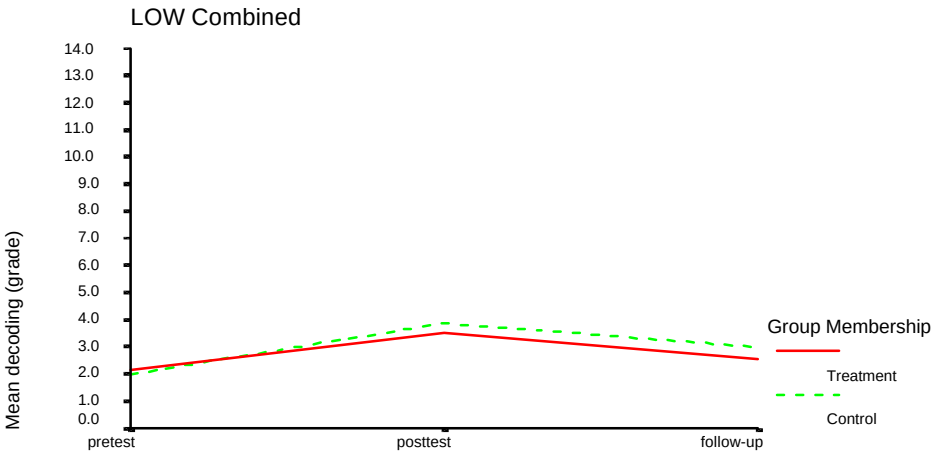


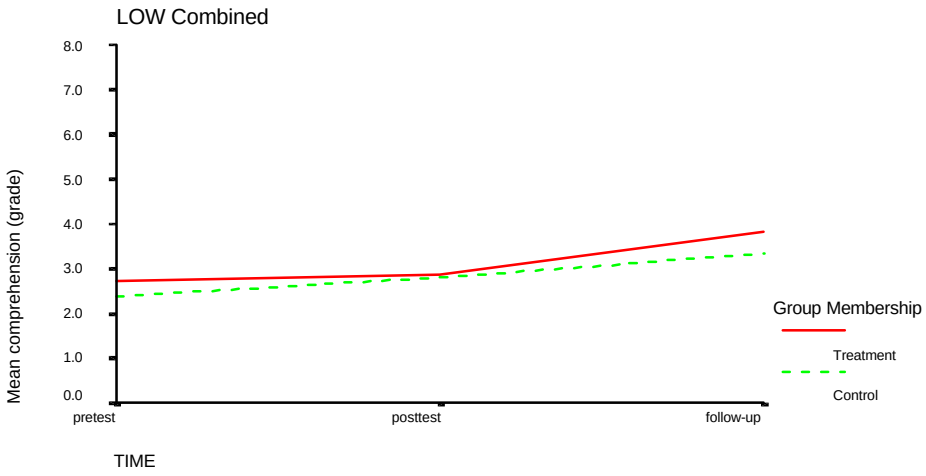




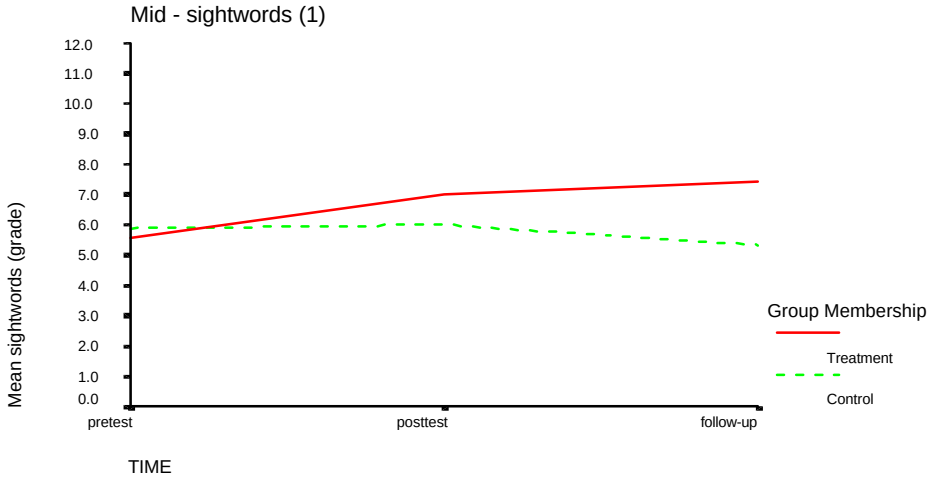
Stages One and Two - Low

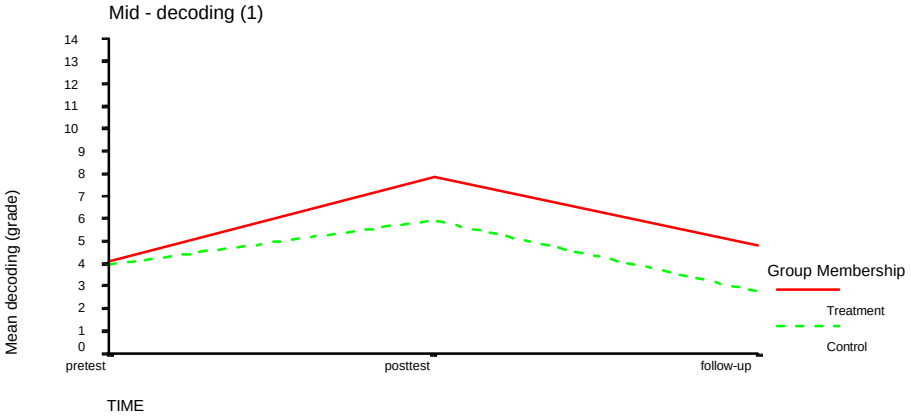


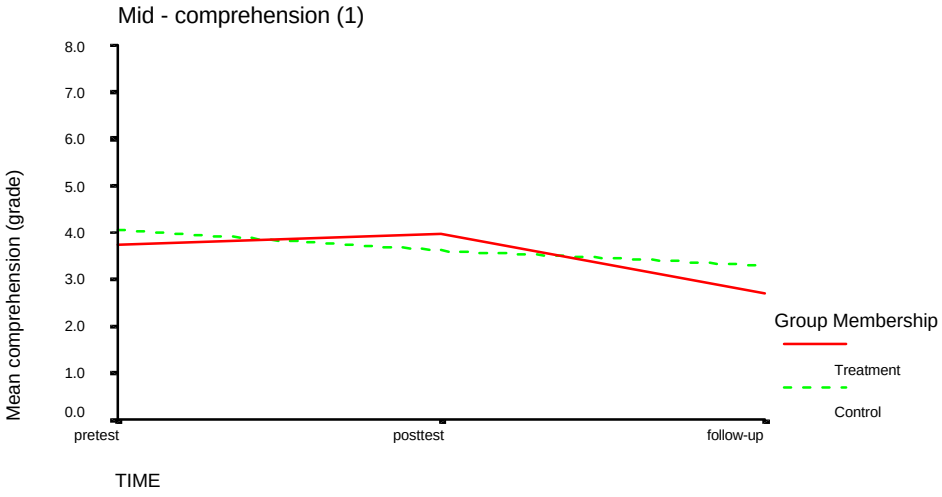

LOW Combined
Mean decoding (grade)
14.0
13.0
12.0
11.0
10.0
9.0
8.0
7.0
6.0
5.0
4.0
3.0
2.0
1.0
0.0
pretest
posttest
follow-up
TIME
Group Membership
Treatment
Control


LOW Combined
Mean comprehension (grade)
8.0
7.0
6.0
5.0
4.0
3.0
2.0
1.0
0.0
pretest
posttest
follow-up
TIME
Group Membership
Treatment
Control

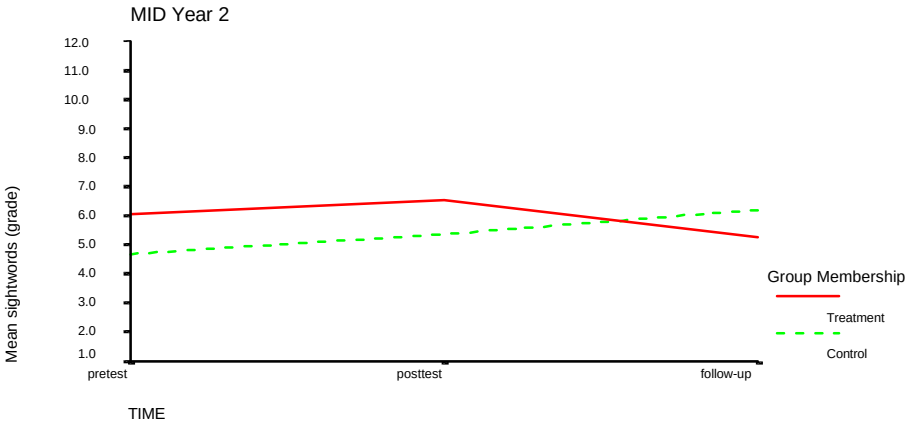
Stage One - Mid

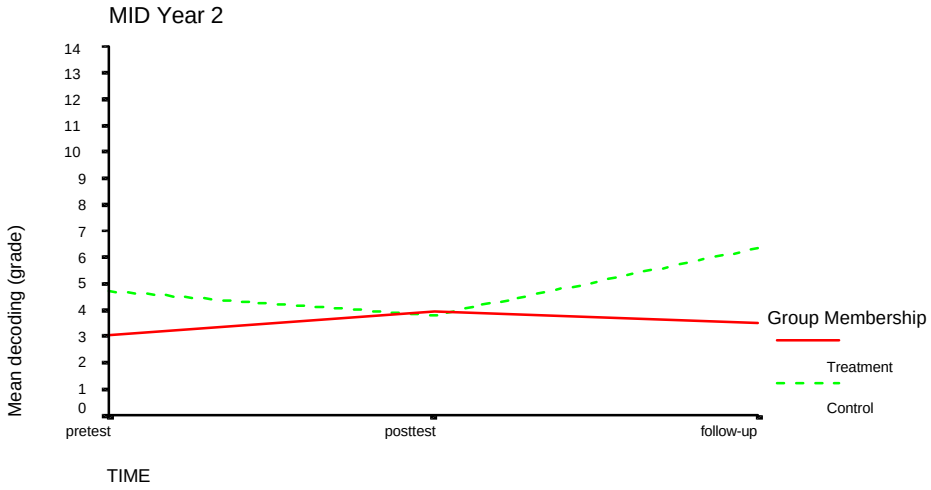


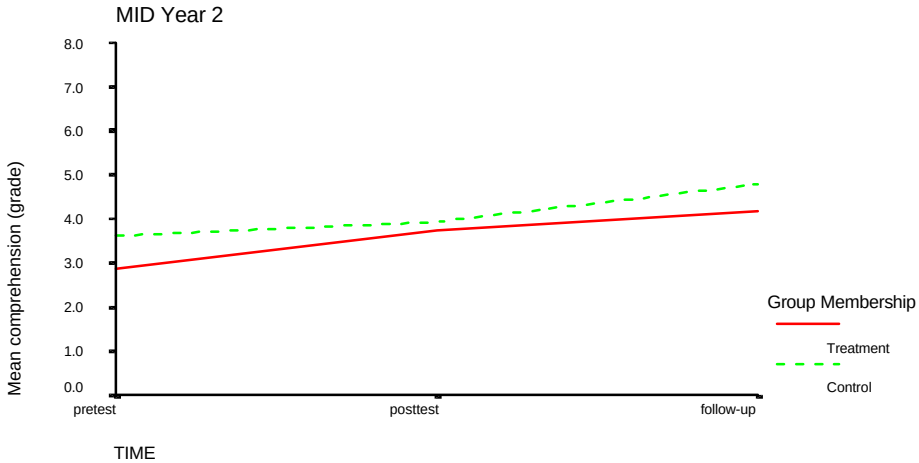




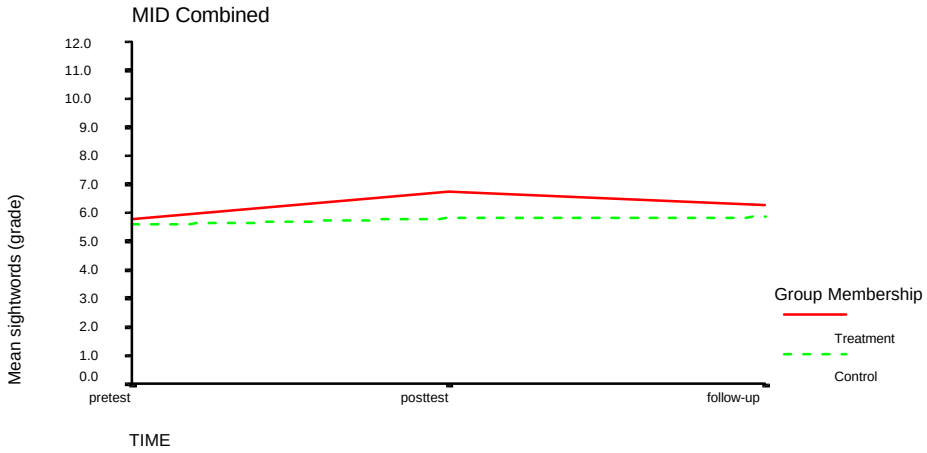
Stage Two - Mid

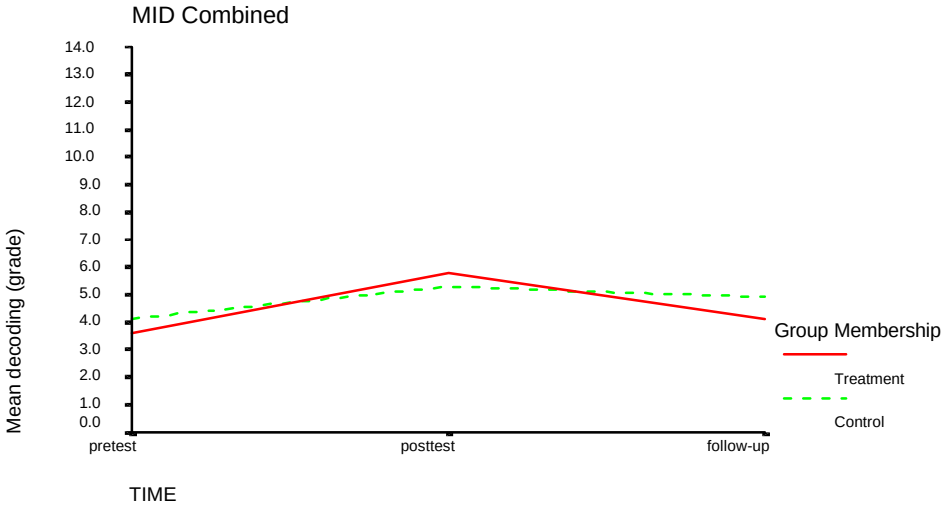


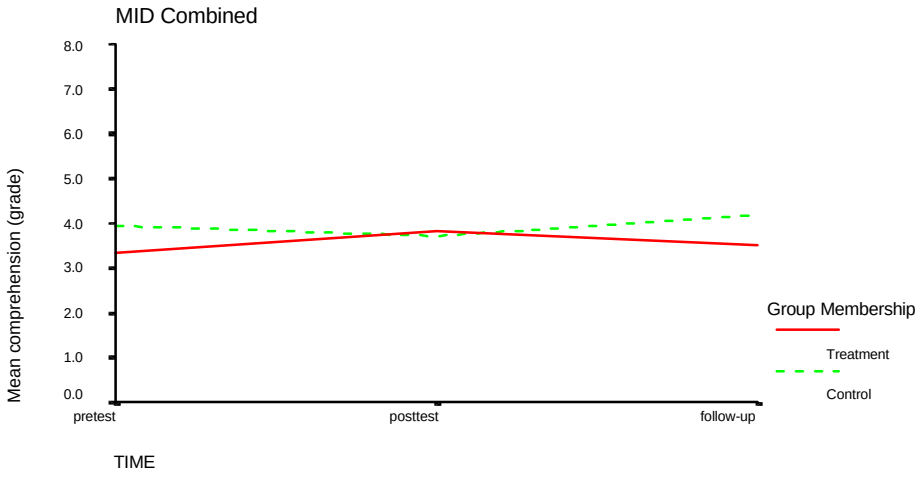




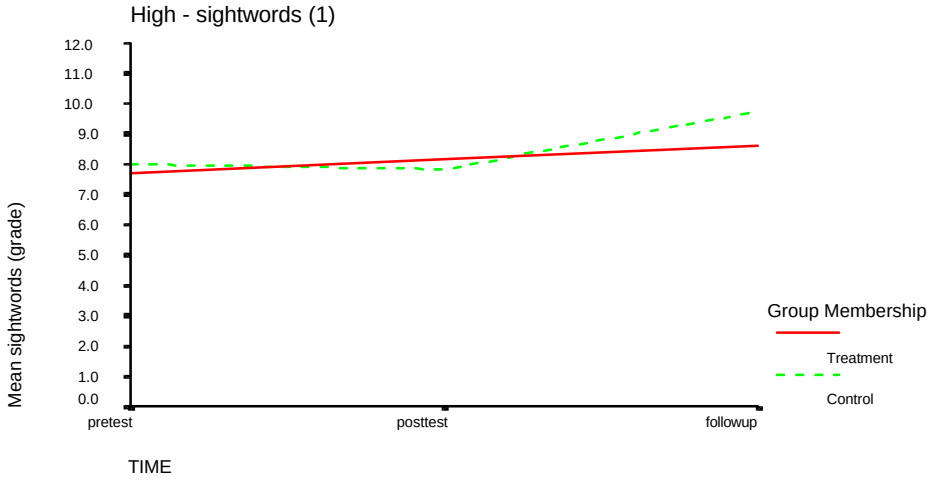
Stages One and Two - Mid

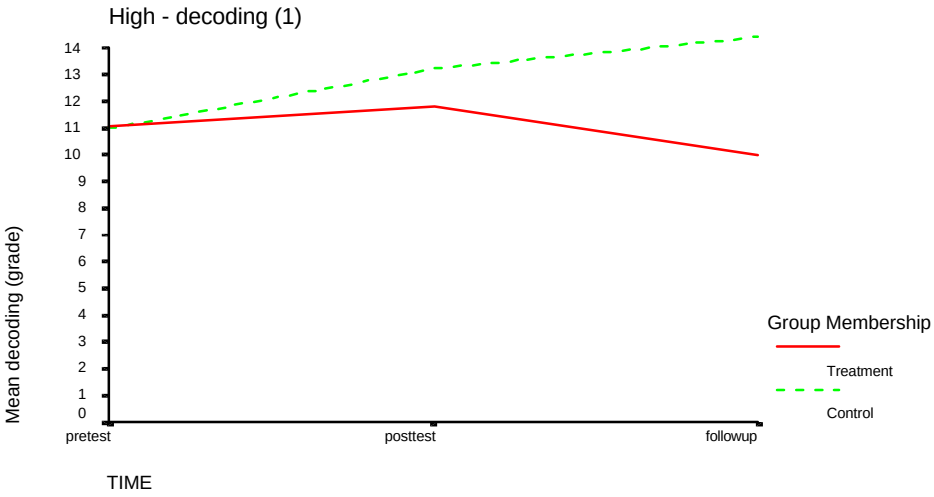


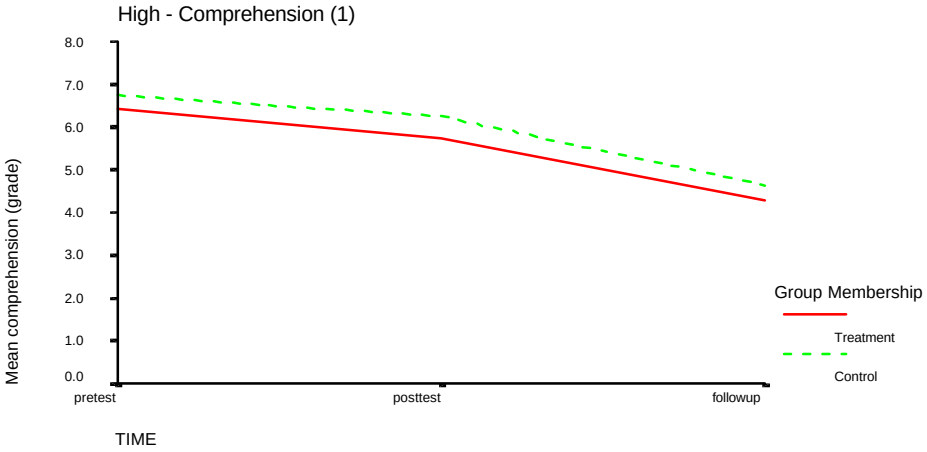



MID Combined
Mean comprehension (grade)
8.0
7.0
6.0
5.0
4.0
3.0
2.0
1.0
0.0
pretest
posttest
follow-up
TIME
Group Membership
Treatment
Control

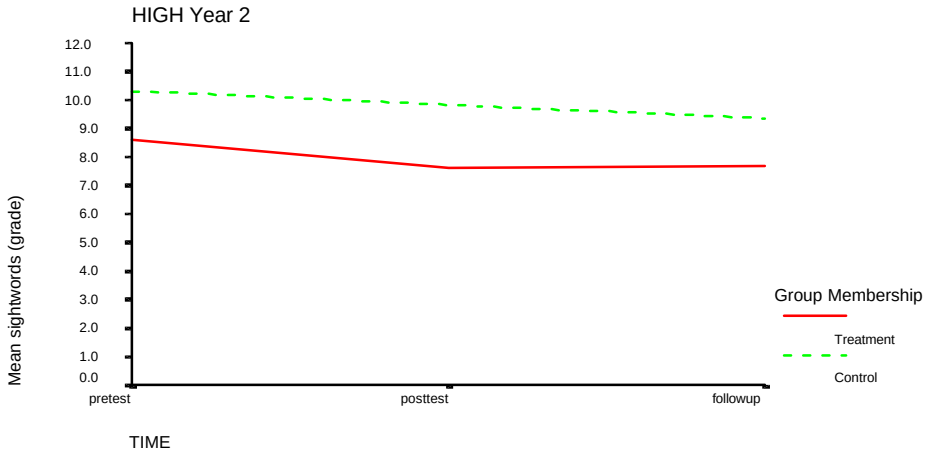
Stage One - High

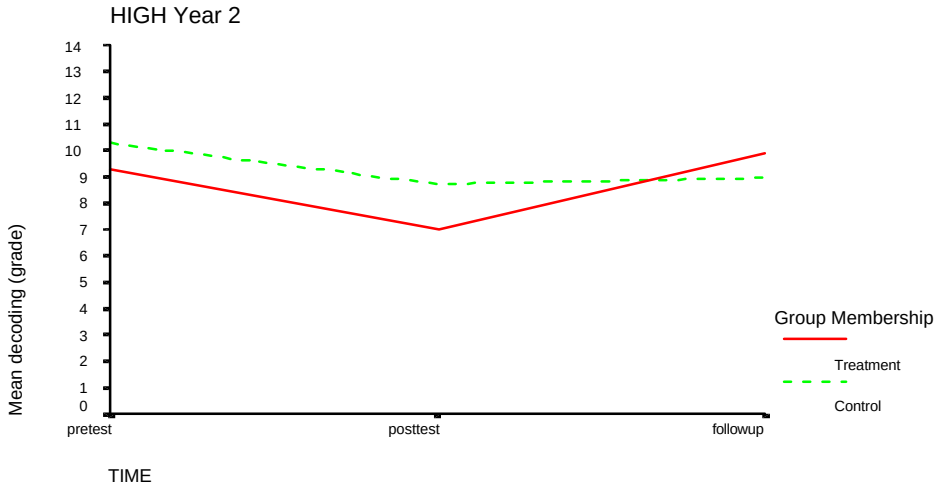


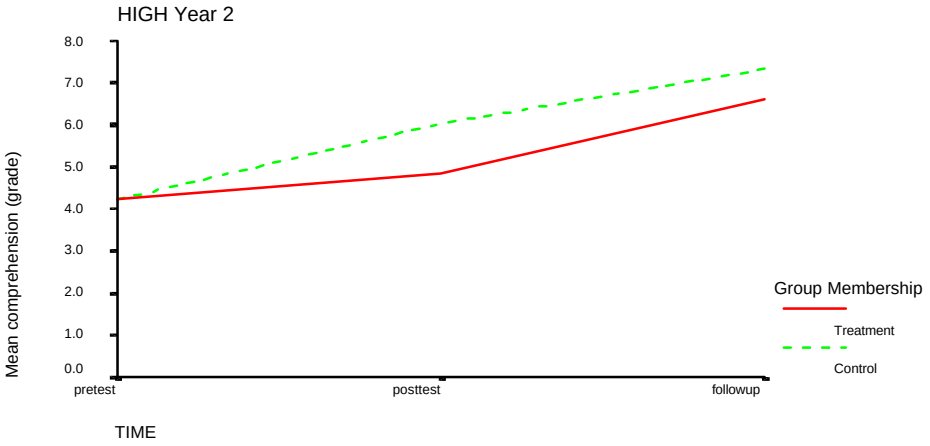




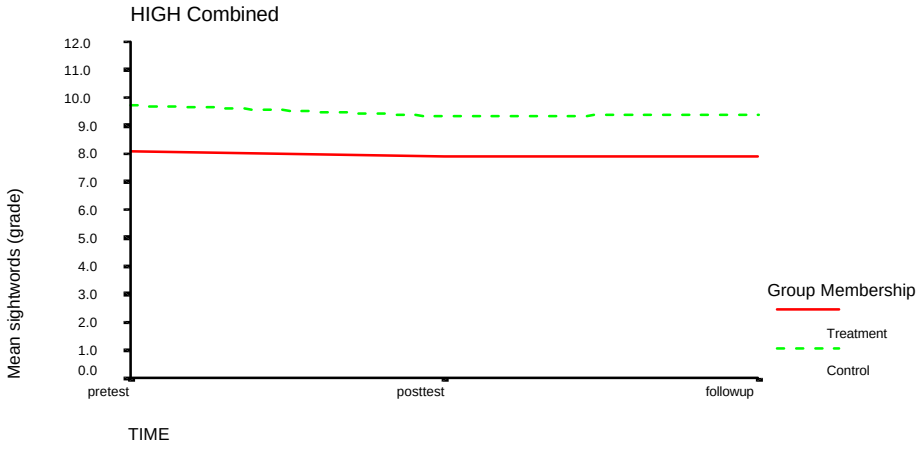
Stage Two - High

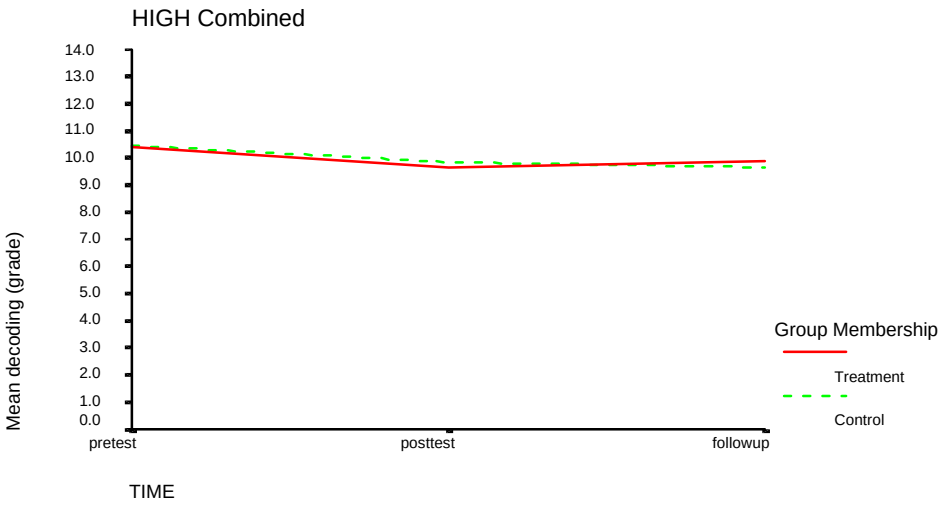


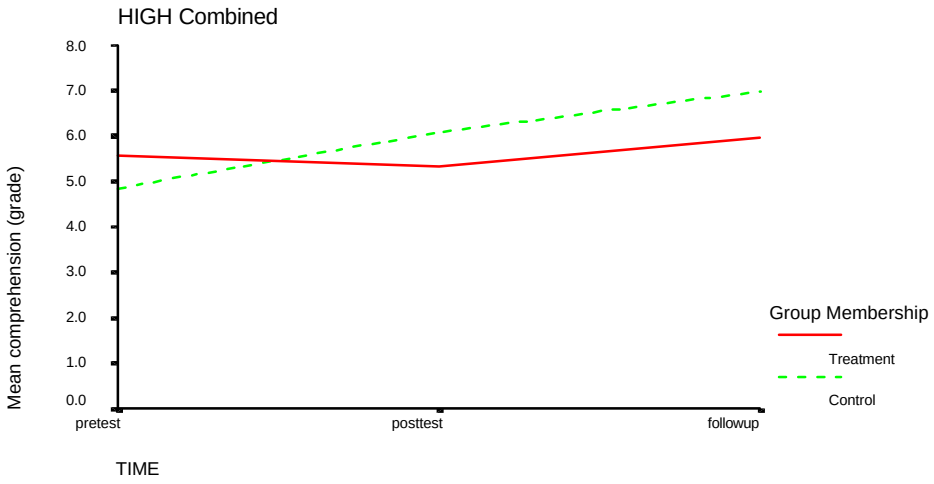



HIGH Year 2
Mean comprehension (grade)
8.0
7.0
6.0
5.0
4.0
3.0
2.0
1.0
0.0
pretest
posttest
followup
TIME
Group Membership
Treatment
Control

Stages One and Two - High






HIGH Combined
Mean comprehension (grade)
8.0
7.0
6.0
5.0
4.0
3.0
2.0
1.0
0.0
pretest
posttest
followup
TIME
Group Membership
Treatment
Control

APPENDIX C.
Statistics

Stage One Results

Variables	Effect	F	Df	Significance	Direction
ALL (pre, post, follow)					
	Group	1.10	3, 12	.39	
	Time	2.27	6, 52	.05	Improvement
	Group by Time	.40	6, 52	.88	
Decoding (pre, post, follow)					
	Group	0.03	1, 14	.86	Treatment
	Time	5.66	2, 28	.009	No change
	Group by Time	0.35	2, 28	.71	
Sightwords (pre, post, follow)					
	Group	0.33	1, 14	.58	Treatment
	Time	1.18	2, 28	.32	Improvement
	Group by Time	0.01	2, 28	.99	
Comprehension (pre, post, follow)					
	Group	0.33	1, 14	.58	Control
	Time	0.42	2, 28	.66	Negative
	Group by Time	0.81	2, 28	.46	
ALL (pre, post)					
	Group	1.63	3, 51	.19	
	Time	10.65	3, 51	.000	Improvement
	Group by Time	0.61	3, 51	.61	
Decoding (pre, post)					
	Group	2.47	1, 53	.12	Control
	Time	22.76	1, 53	.000	Improvement
	Group by Time	1.55	1, 53	.22	
Sightwords (pre, post)					
	Group	5.03	1, 53	.03	Treatment
	Time	7.00	1, 53	.01	Improvement
	Group by Time	.000	1, 53	.99	
Comprehension (pre, post)					
	Group	0.72	1, 53	.40	Control
	Time	3.36	1, 53	.07	Negative
	Group by Time	.04	1, 53	.85	

Stage Two Results

Variables	Effect	F	Df	Significance	Direction
ALL (pre, post, follow)					
	Group	1.43	3, 42	.25	
	Time	7.70	6, 172	.000	Improvement
	Group by Time	0.94	6, 172	.47	
Decoding (pre, post, follow)					
	Group	1.79	1, 44	.19	Same
	Time	0.63	2, 88	.54	No change
	Group by Time	0.25	2, 88	.77	
Sightwords (pre, post, follow)					
	Group	4.28	1, 44	.04	Control
	Time	0.15	2, 88	.86	No change
	Group by Time	0.26	2, 88	.78	
Comprehension (pre, post, follow)					
	Group	2.06	1, 44	.16	Control
	Time	23.03	2, 88	.000	Improvement
	Group by Time	1.37	2, 88	.26	
ALL (pre, post)					
	Group	2.58	3, 61	.06	
	Time	8.41	3, 61	.000	Improvement
	Group by Time	0.73	3, 61	.54	
Decoding (pre, post)					
	Group	5.69	1, 63	.02	Treatment
	Time	.58	1, 63	.45	Improvement
	Group by Time	0.76	1, 63	.39	
Sightwords (pre, post)					
	Group	3.32	1, 63	.07	Treatment
	Time	.00	1, 63	.97	No change
	Group by Time	.18	1, 63	.67	
Comprehension (pre, post)					
	Group	5.58	1, 63	.02	Control
	Time	24.08	1, 63	.000	Improvement
	Group by Time	1.14	1, 63	.29	

Combined Results

Variables	Effect	F	Df	Significance	Direction
ALL (pre, post, follow)					
	Group	1.21	3, 58	.31	
	Time	5.68	6, 236	.000	Improvement
	Group by Time	1.58	6, 236	.15	
Decoding (pre, post, follow)					
	Group	1.78	1, 60	.19	Control
	Time	0.62	2, 120	.54	Improvement
	Group by Time	1.10	2, 120	.34	
Sightwords (pre, post, follow)					
	Group	3.01	1, 60	.09	Same
	Time	0.98	2, 120	.38	Improvement
	Group by Time	0.11	2, 120	.90	
Comprehension (pre, post, follow)					
	Group	3.06	1, 60	.09	Control
	Time	16.10	2, 120	.000	Improvement
	Group by Time	2.63	2, 120	.08	
ALL (pre, post)					
	Group	0.27	3, 116	.85	
	Time	4.44	3, 116	.005	Improvement
	Group by Time	0.60	3, 116	.61	
Decoding (pre, post)					
	Group	0.56	1, 118	.46	Same
	Time	6.79	1, 118	.01	Improvement
	Group by Time	0.28	1, 118	.60	
Sightwords (pre, post)					
	Group	0.52	1, 118	.48	Treatment
	Time	2.57	1, 118	.11	Improvement
	Group by Time	1.12	1, 118	.29	
Comprehension (pre, post)					
	Group	0.61	1, 118	.44	Control
	Time	5.18	1, 118	.03	Improvement
	Group by Time	0.64	1, 118	.43	

Stage 1 ABE

Variables	Effect	F	Df	Significance	Direction
ALL (pre, post, follow)					
	Group	NO cases			
	Time				
	Group by Time				
Decoding (pre, post, follow)					
	Group				
	Time				
	Group by Time				
Sightwords (pre, post, follow)					
	Group				
	Time				
	Group by Time				
Comprehension (pre, post, follow)					
	Group				
	Time				
	Group by Time				
ALL (pre, post)					
	Group	1.74	3, 24	.19	
	Time	4.28	3, 24	.02	Improvement
	Group by Time	1.54	3, 24	.23	
Decoding (pre, post)					
	Group	5.27	1, 26	.03	Control
	Time	5.07	1, 26	.03	Improvement
	Group by Time	0.74	1, 26	.40	
Sightwords (pre, post)					
	Group	3.31	1, 26	.08	Treatment
	Time	2.49	1, 26	.13	Improvement
	Group by Time	3.20	1, 26	.09	
Comprehension (pre, post)					
	Group	1.13	1, 26	.30	Same
	Time	4.85	1, 26	.04	Negative
	Group by Time	0.15	1, 26	.70	

Stage 1 ESL

Variables	Effect	F	Df	Significance	Direction
ALL (pre, post, follow)					
	Group	0.62	3, 9	.62	
	Time	1.94	6, 40	.10	Improvement
	Group by Time	0.89	6, 40	.87	
Decoding (pre, post, follow)					
	Group	0.07	1, 11	.80	Same
	Time	4.99	2, 22	.02	Improvement
	Group by Time	0.43	2, 22	.65	
Sightwords (pre, post, follow)					
	Group	0.18	1, 11	.68	Same
	Time	1.43	2, 22	.26	Improvement
	Group by Time	0.08	2, 22	.92	
Comprehension (pre, post, follow)					
	Group	0.02	1, 11	.90	Control
	Time	0.12	2, 22	.89	Improvement
	Group by Time	0.43	2, 22	.66	
ALL (pre, post)					
	Group	1.04	3, 17	.40	
	Time	5.42	3, 17	.008	Improvement
	Group by Time	0.83	3, 17	.50	
Decoding (pre, post)					
	Group	0.36	1, 19	.55	Treatment
	Time	17.56	1, 19	.000	Improvement
	Group by Time	1.55	1, 19	.23	
Sightwords (pre, post)					
	Group	2.43	1, 19	.14	Same
	Time	5.86	1, 19	.03	Improvement
	Group by Time	0.23	1, 19	.64	
Comprehension (pre, post)					
	Group	1.66	1, 19	.21	Same
	Time	1.38	1, 19	.58	Improvement
	Group by Time	0.00	1, 19	.95	

Stage 1 ABL

Variables	Effect	F	Df	Significance	Direction
ALL (pre, post, follow)					
	Group				
	Time				
	Group by Time				
Decoding (pre, post, follow)					
	Group	2.41	1, 1	.36	Same
	Time	0.71	2, 2	.59	Improvement
	Group by Time	0.15	2, 2	.99	
Sightwords (pre, post, follow)					
	Group	5.69	1, 1	.25	Treatment
	Time	0.16	2, 2	.86	Improvement
	Group by Time	1.74	2, 2	.37	
Comprehension (pre, post, follow)					
	Group	4.08	1, 1	.29	Treatment
	Time	0.58	2, 2	.63	Improvement
	Group by Time	1.33	2, 2	.43	
ALL (pre, post)					
	Group	0.79	3, 2	.60	
	Time	12.20	3, 2	.08	Improvement
	Group by Time	12.46	3, 2	.08	
Decoding (pre, post)					
	Group	0.50	1, 4	.52	Control
	Time	1.88	1, 4	.24	Improvement
	Group by Time	0.80	1, 4	.42	
Sightwords (pre, post)					
	Group	0.78	1, 4	.43	Treatment
	Time	0.13	1, 4	.74	Improvement
	Group by Time	1.13	1, 4	.35	
Comprehension (pre, post)					
	Group	0.23	1, 4	.66	Control
	Time	5.21	1, 4	.02	Negative
	Group by Time	1.69	1, 4	.26	

Stage 1 Low

Variables	Effect	F	Df	Significance	Direction
ALL (pre, post, follow)					
	Group				
	Time				
	Group by Time				
Decoding (pre, post, follow)					
	Group	800.33	1, 1	.02	Treatment
	Time	0.93	2, 2	.51	Improvement
	Group by Time	0.63	2, 2	.60	
Sightwords (pre, post, follow)					
	Group	3.49	1, 1	.31	Treatment
	Time	1.81	2, 2	.41	Improvement
	Group by Time	0.87	2, 2	.54	
Comprehension (pre, post, follow)					
	Group	7.83	1, 1	.22	Treatment
	Time	0.20	2, 2	.73	Improvement
	Group by Time	0.07	2, 2	.93	
ALL (pre, post)					
	Group	0.04	3, 8	.99	
	Time	2.52	3, 8	.13	Improvement
	Group by Time	0.86	3, 8	.50	
Decoding (pre, post)					
	Group	0.13	1, 10	.73	Same
	Time	9.42	1, 10	.01	Improvement
	Group by Time	0.07	1, 10	.80	
Sightwords (pre, post)					
	Group	0.14	1, 10	.72	Treatment
	Time	4.12	1, 10	.07	Improvement
	Group by Time	1.03	1, 10	.33	
Comprehension (pre, post)					
	Group	0.02	1, 10	.88	Control
	Time	0.39	1, 10	.54	Negative
	Group by Time	1.09	1, 10	.32	

Stage 1 Mid-range

Variables	Effect	F	Df	Significance	Direction
ALL (pre, post, follow)					
	Group	2.84	3, 4	.17	
	Time	2.00	6, 20	.11	Same
	Group by Time	1.28	6, 20	.31	
Decoding (pre, post, follow)					
	Group	0.04	1, 6	.84	Treatment
	Time	5.80	2, 12	.02	Improvement
	Group by Time	1.02	2, 12	.39	
Sightwords (pre, post, follow)					
	Group	3.64	1, 6	.11	Treatment
	Time	0.66	2, 12	.53	Improvement
	Group by Time	0.26	2, 12	.77	
Comprehension (pre, post, follow)					
	Group	0.11	1, 6	.78	Control
	Time	1.39	2, 12	.29	Negative
	Group by Time	0.06	2, 12	.94	
ALL (pre, post)					
	Group	2.05	3, 22	.14	
	Time	7.60	3, 22	.001	Improvement
	Group by Time	0.82	3, 22	.50	
Decoding (pre, post)					
	Group	2.11	1, 24	.16	Treatment
	Time	16.59	1, 24	.000	Improvement
	Group by Time	0.58	1, 24	.45	
Sightwords (pre, post)					
	Group	4.59	1, 24	.04	Treatment
	Time	2.58	1, 24	.12	Improvement
	Group by Time	0.56	1, 24	.46	
Comprehension (pre, post)					
	Group	0.01	1, 24	.91	Treatment
	Time	0.72	1, 24	.41	Improvement
	Group by Time	2.62	1, 24	.12	

Stage 1 High

Variables	Effect	F	Df	Significance	Direction
ALL (pre, post, follow)					
	Group	1.33	3, 1	.55	
	Time	1.17	6, 8	.41	Same
	Group by Time	0.80	6, 8	.60	
Decoding (pre, post, follow)					
	Group	0.56	1, 3	.51	Control
	Time	4.39	2, 6	.07	Improvement
	Group by Time	3.29	2, 6	.11	
Sightwords (pre, post, follow)					
	Group	0.29	1, 3	.63	Control
	Time	0.50	2, 6	.63	Improvement
	Group by Time	0.10	2, 6	.90	
Comprehension (pre, post, follow)					
	Group	0.01	1, 3	.97	Same
	Time	0.58	2, 6	.59	Negative
	Group by Time	0.22	2, 6	.81	
ALL (pre, post)					
	Group	0.05	3, 13	.99	
	Time	2.10	3, 13	.15	Improvement
	Group by Time	1.00	3, 13	.42	
Decoding (pre, post)					
	Group	0.13	1, 15	.73	Control
	Time	1.93	1, 15	.19	Improvement
	Group by Time	0.40	1, 15	.54	
Sightwords (pre, post)					
	Group	0.00	1, 15	.99	Treatment
	Time	0.54	1, 15	.48	Improvement
	Group by Time	1.90	1, 15	.19	
Comprehension (pre, post)					
	Group	0.08	1, 15	.78	Same
	Time	3.80	1, 15	.07	Negative
	Group by Time	0.32	1, 15	.58	

Stage 2 ABE

Variables	Effect	F	Df	Significance	Direction
ALL (pre, post, follow)					
	Group	0.21	3, 14	.89	
	Time	6.02	6, 60	.000	Improvement
	Group by Time	2.21	6, 60	.05	
Decoding (pre, post, follow)					
	Group	0.60	1, 16	.45	Treatment
	Time	4.43	2, 32	.02	Improvement
	Group by Time	2.08	2, 32	.14	
Sightwords (pre, post, follow)					
	Group	0.35	1, 16	.56	Control
	Time	2.61	2, 32	.09	Improvement
	Group by Time	5.28	2, 32	.01	
Comprehension (pre, post, follow)					
	Group	0.34	1, 16	.57	Treatment
	Time	14.59	2, 32	.000	Improvement
	Group by Time	0.57	2, 32	.57	
ALL (pre, post)					
	Group	0.22	3, 20	.88	
	Time	7.92	3, 20	.001	Improvement
	Group by Time	0.77	3, 20	.52	
Decoding (pre, post)					
	Group	0.16	1, 22	.70	Treatment
	Time	5.58	1, 22	.03	Negative
	Group by Time	1.32	1, 22	.26	
Sightwords (pre, post)					
	Group	0.03	1, 22	.87	Control
	Time	0.54	1, 22	.48	Improvement
	Group by Time	0.25	1, 22	.62	
Comprehension (pre, post)					
	Group	0.08	1, 22	.64	Control
	Time	5.19	1, 22	.03	Improvement
	Group by Time	0.54	1, 22	.47	

Stage 2 ESL

Variables	Effect	F	Df	Significance	Direction
ALL (pre, post, follow)					
	Group	5.94	3, 13	.01	
	Time	4.72	6, 56	.001	Improvement
	Group by Time	3.18	6, 56	.01	
Decoding (pre, post, follow)					
	Group	5.75	1, 15	.03	Treatment
	Time	0.68	2, 30	.51	Improvement
	Group by Time	4.63	2, 30	.02	
Sightwords (pre, post, follow)					
	Group	18.66	1, 15	.001	Control
	Time	1.96	2, 30	.16	Improvement
	Group by Time	2.29	2, 30	.12	
Comprehension (pre, post, follow)					
	Group	5.75	1, 15	.03	Control
	Time	12.38	2, 30	.000	Improvement
	Group by Time	1.76	2, 30	.19	
ALL (pre, post)					
	Group	7.18	3, 21	.002	
	Time	5.86	3, 21	.005	Improvement
	Group by Time	2.67	3, 21	.07	
Decoding (pre, post)					
	Group	14.07	1, 23	.001	Treatment
	Time	0.39	1, 23	.54	Improvement
	Group by Time	5.69	1, 23	.03	
Sightwords (pre, post)					
	Group	11.33	1, 23	.003	Treatment
	Time	3.24	1, 23	.62	Improvement
	Group by Time	3.24	1, 23	.52	
Comprehension (pre, post)					
	Group	15.97	1, 23	.001	Control
	Time	2.00	1, 23	.000	Improvement
	Group by Time	2.00	1, 23	.15	

Stage 2 ABL

Variables	Effect	F	Df	Significance	Direction
ALL (pre, post, follow)					
	Group	0.21	3, 7	.89	
	Time	2.33	6, 34	.06	Improvement
	Group by Time	0.70	6, 34	.65	
Decoding (pre, post, follow)					
	Group	0.12	1, 9	.74	Control
	Time	1.83	2, 18	.19	Improvement
	Group by Time	0.27	2, 18	.77	
Sightwords (pre, post, follow)					
	Group	0.38	1, 9	.74	Treatment
	Time	4.30	2, 18	.03	Improvement
	Group by Time	0.82	2, 18	.46	
Comprehension (pre, post, follow)					
	Group	0.13	1, 9	.74	Treatment
	Time	2.72	2, 18	.09	Improvement
	Group by Time	1.24	2, 18	.31	
ALL (pre, post)					
	Group	0.36	3, 12	.79	
	Time	3.50	3, 12	.05	Improvement
	Group by Time	0.78	3, 12	.53	
Decoding (pre, post)					
	Group	0.11	1, 14	.75	Treatment
	Time	5.51	1, 14	.03	Improvement
	Group by Time	0.05	1, 14	.82	
Sightwords (pre, post)					
	Group	11.33	1, 14	.003	Treatment
	Time	0.06	1, 14	.82	Improvement
	Group by Time	0.91	1, 14	.36	
Comprehension (pre, post)					
	Group	0.25	1, 14	.63	Treatment
	Time	8.11	1, 14	.01	Improvement
	Group by Time	1.78	1, 14	.20	

Stage 2 Low

Variables	Effect	F	Df	Significance	Direction
ALL (pre, post, follow)					
	Group	0.20	3, 8	.90	
	Time	3.05	6, 36	.02	Improvement
	Group by Time	0.90	6, 36	.51	
Decoding (pre, post, follow)					
	Group	0.34	1, 10	.57	Control
	Time	1.44	2, 20	.46	Improvement
	Group by Time	0.36	2, 20	.70	
Sightwords (pre, post, follow)					
	Group	0.01	1, 10	.94	Control
	Time	9.01	2, 20	.002	Improvement
	Group by Time	1.83	2, 20	.19	
Comprehension (pre, post, follow)					
	Group	0.04	1, 10	.85	Treatment
	Time	3.45	2, 20	.05	Improvement
	Group by Time	0.25	2, 20	.78	
ALL (pre, post)					
	Group	0.60	3, 13	.63	
	Time	3.87	3, 13	.04	Improvement
	Group by Time	1.00	3, 13	.43	
Decoding (pre, post)					
	Group	0.06	1, 15	.81	Control
	Time	4.66	1, 15	.05	Improvement
	Group by Time	0.38	1, 15	.55	
Sightwords (pre, post)					
	Group	11.33	1, 15	.003	Treatment
	Time	5.64	1, 15	.03	Improvement
	Group by Time	1.50	1, 15	.24	
Comprehension (pre, post)					
	Group	0.25	1, 15	.63	Treatment
	Time	10.00	1, 15	.006	Improvement
	Group by Time	0.19	1, 15	.16	

Stage 2 Mid-range

Variables	Effect	F	Df	Significance	Direction
ALL (pre, post, follow)					
	Group	0.84	3, 8	.51	
	Time	3.10	6, 36	.02	Improvement
	Group by Time	1.24	6, 36	.31	
Decoding (pre, post, follow)					
	Group	0.34	1, 10	.57	Control
	Time	1.32	2, 20	.29	Improvement
	Group by Time	0.36	2, 20	.70	
Sightwords (pre, post, follow)					
	Group	1.03	1, 10	.33	Control
	Time	4.74	2, 20	.02	Improvement
	Group by Time	1.14	2, 20	.34	
Comprehension (pre, post, follow)					
	Group	0.69	1, 10	.43	Treatment
	Time	9.46	2, 20	.001	Improvement
	Group by Time	0.28	2, 20	.76	
ALL (pre, post)					
	Group	1.41	3, 17	.27	
	Time	2.66	3, 17	.08	Improvement
	Group by Time	0.95	3, 17	.44	
Decoding (pre, post)					
	Group	0.00	1, 19	.98	Treatment
	Time	4.66	1, 19	.05	Improvement
	Group by Time	2.19	1, 19	.16	
Sightwords (pre, post)					
	Group	1.56	1, 19	.23	Same
	Time	1.04	1, 19	.32	Improvement
	Group by Time	0.03	1, 19	.88	
Comprehension (pre, post)					
	Group	1.72	1, 19	.21	Treatment
	Time	7.98	1, 19	.01	Improvement
	Group by Time	1.75	1, 19	.20	

Stage 2 High

Variables	Effect	F	Df	Significance	Direction
ALL (pre, post, follow)					
	Group	1.76	3, 18	.19	
	Time	5.42	6, 76	.000	Improvement
	Group by Time	0.93	6, 76	.48	
Decoding (pre, post, follow)					
	Group	0.02	1, 20	.89	Treatment
	Time	2.78	2, 40	.07	Improvement
	Group by Time	0.69	2, 40	.51	
Sightwords (pre, post, follow)					
	Group	3.59	1, 20	.07	Control
	Time	1.84	2, 40	.17	Negative
	Group by Time	0.42	2, 40	.66	
Comprehension (pre, post, follow)					
	Group	0.65	1, 20	.43	Control
	Time	14.59	2, 40	.000	Improvement
	Group by Time	1.45	2, 40	.25	
ALL (pre, post)					
	Group	1.47	3, 23	.25	
	Time	4.78	3, 23	.01	Negative
	Group by Time	0.69	3, 23	.57	
Decoding (pre, post)					
	Group	0.46	1, 25	.50	Same
	Time	3.98	1, 25	.06	Negative
	Group by Time	0.14	1, 25	.71	
Sightwords (pre, post)					
	Group	4.12	1, 25	.05	Same
	Time	2.02	1, 25	.17	Negative
	Group by Time	0.25	1, 25	.62	
Comprehension (pre, post)					
	Group	0.75	1, 25	.39	Control
	Time	7.35	1, 25	.01	Improvement
	Group by Time	1.84	1, 25	.19	

APPENDIX D.
Student Interview Form

CARI Project – AVC Calgary

ABL Student Questionnaire

Please mark "X" in the most appropriate box:

1. Student Information

This is my first time in the ABL program
- ☐ yes
- ☐ no

I would describe my use and understanding of the English Language as
- ☐ poor
- ☐ fair
- ☐ good
- ☐ very good

2. Computer Use

I would describe my skill at using the computer as
- ☐ poor
- ☐ fair
- ☐ good
- ☐ very good

I use the computer for (you may mark more than one)
- ☐ word processing
- ☐ accessing the Internet
- ☐ database, spreadsheet, graphics
- ☐ mathematical calculations

3. The Autoskill Program

Did you like the Autoskill program
- ☐ yes
- ☐ somewhat
- ☐ no

I found that Autoskill kept an accurate record of my progress
- ☐ none of the time
- ☐ some of the time
- ☐ most of the time
- ☐ all of the time

I found that I needed other materials (such as books) to help me understand Autoskill
- ☐ none of the time
- ☐ some of the time
- ☐ most of the time
- ☐ all of the time

I found the Autoskill stories
- ☐ very easy
- ☐ easy
- ☐ somewhat difficult
- ☐ difficult
- ☐ very difficult

I would have liked more material to read on Autoskill
- ☐ yes
- ☐ sometimes
- ☐ no

I found the Autoskill stories mostly
- ☐ boring
- ☐ interesting
- ☐ neither boring nor interesting

To what degree did Autoskill meet your needs?
- ☐ not at all
- ☐ somewhat
- ☐ mostly
- ☐ completely

I think Autoskill is best suited for students in (you may mark more than one)

- ☐ ABE
- ☐ ABL
- ☐ ESL
- ☐ elementary school
- ☐ junior high school
- ☐ high school

Overall, I would rate the Autoskill program as

- ☐ poor
- ☐ fair
- ☐ good
- ☐ excellent

4. Using Autoskill

How comfortable were you using the computer for Autoskill?

- ☐ not very comfortable
- ☐ comfortable
- ☐ very comfortable

Did Autoskill help you to learn how to use the computer?

- ☐ yes
- ☐ no

I found the placement tests on Autoskill

- ☐ very easy
- ☐ easy
- ☐ somewhat difficult
- ☐ difficult
- ☐ very difficult

To do the Autoskill placement tests I needed my instructor's help

- ☐ all the time
- ☐ most of the time
- ☐ some of the time
- ☐ none of the time

I found the Autoskill program modules

- ☐ very easy to use
- ☐ easy to use
- ☐ somewhat difficult to use
- ☐ difficult to use
- ☐ very difficult to use

To do the Autoskill program modules I needed my instructor's help

- ☐ all the time
- ☐ most of the time
- ☐ some of the time
- ☐ none of the time

Autoskill helped me to improve my reading skills

- ☐ very much
- ☐ somewhat
- ☐ not at all

Autoskill helped me most in these areas (you may mark more than one)

- ☐ vocabulary development
- ☐ comprehension
- ☐ rate of reading (speed)
- ☐ other (Please specify)

Autoskill has helped me to work more on my own

- ☐ yes
- ☐ no

Please provide brief answers to the following questions:

What did you like best about the Autoskill program?

What did you like least about the Autoskill program?

Would you recommend that AVC continue using Autoskill?

- ☐ yes
- ☐ No