DOCUMENT RESUME

ED 377 898 JC 950 028

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TITLE	Enhancing the Academic Skills of Adolescent Students with Learning Disabilities through Computer-Assisted Instruction.
SPONS AGENCY	Nova Scotia Community Coll., Springhill. Cumberland Campus.
PUB DATE	Dec 93
NOTE	64p.
PUB TYPE	Reports - Research/Technical (143) -- Tests/Evaluation Instruments (160)
EDRS PRICE	MF01/PC03 Plus Postage.
DESCRIPTORS	Adolescents; Community Colleges; *Computer Assisted Instruction; Computer Networks; *Computer Software Evaluation; Foreign Countries; *Integrated Learning Systems; *Learning Disabilities; Mathematics Instruction; *Outcomes of Education; *Participant Satisfaction; Program Effectiveness; Reading Instruction; Student Attitudes; Two Year Colleges
IDENTIFIERS	*INVEST Computer Assisted Learning System; Nova Scotia

ABSTRACT

A study was conducted at the Cumberland Campus of Nova Scotia Community College to determine the effect of a computer-based learning system on the academic and personal growth of adolescents with learning disabilities. Eleven learning disabled students, with an average age of 16.1 years, and one observer were chosen to participate in an 8-week summer program utilizing the INVEST integrated learning system, a networked system of basic instructional software offering lessons in reading, writing, mathematics, and life skills. Results of the study, based on pre- and post-standardized tests and feedback from participants, parents, and the observer, included the following: (1) positive gains were registered in both reading and math, with the group's average reading score moving from below average (29th percentile) to average (40th percentile) and average mathematics score moving from the 32nd to the 49th percentile; (2) improvement in mathematics was more in numerical operations than in reasoning; (3) 70% of the participants thought that the computer approach was better than traditional high school courses, and 80% indicated that they had learned more than with traditional methods; (4) the instructor indicated that the system accommodated a wider range of learner levels than traditional curricula; and (5) parents of the participants reported positive changes in attitudes toward school work. Contains 16 references. Tables, graphs, and the questionnaires are appended. (KP)

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ENHANCING THE ACADEMIC SKILLS OF ADOLESCENT STUDENTS WITH LEARNING DISABILITIES THROUGH COMPUTER-ASSISTED INSTRUCTION

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ACKNOWLEDGEMENTS

Throughout this project, many individuals and institutions have made significant contributions to its success. The financial support of the Pictou and Cumberland Campuses of the Community College System of Nova Scotia made this project possible. Thanks are extended to Mr. George Laird, Principal, and to Ms. Margaret Norton, Vice-Principal of the Cumberland Campus of the Community College System for their vision and leadership in the implementation and ongoing evaluation of integrated learning systems. Thanks also to Mr. Andrew Moore, Instructor for his unlimited support and encouragement to his students, his enthusiasm and his teaching excellence. The positive support of the entire staff of the Cumberland Campus has made involvement in this project an enjoyable experience.

Thanks are also extended to Mr. Frank Barteaux, Superintendent, and to the administrative staff of the Cumberland District School Board. In particular, the support of Ms. Donna Fraser, Supervisor of Special Services, Mr. Bill Campbell, Prinicipal of the Springhill Junior-Senior High School, and to Mr. Barry Kelly, Resource Teacher is recognized.

The ongoing support of Mount Allison University and the Centre for Learning Assistance and Research is gratefully acknowledged. Mrs. Ellen Wilson is thanked for her contribution as psychometrist and for the graphics in this report. Two Mount Allison B. Ed. students contributed to the early development of this project: Ms. Holly Miller and Ms. Heather Janes. A third student, Ms. Beth Mosher, was most helpful with testing.

A special thanks is extended to Dr. Joe Murphy, Dalhousie University. His insightful comments and advice during the preparation of this report were most helpful.

Finally, the support of the parents and the students themselves must be acknowledged. That these students would sacrifice their entire summer break in order to improve their learning skills speaks highly of their commitment to their education.

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PREAMBLE

In the Spring of 1992, the Cumberland Campus of the Nova Scotia Community College System assumed a leadership role in the provision of services to adults seeking academic upgrading. In part, this was accomplished through the installation of a major learning laboratory employing an integrated learning system(ILS). As importantly, the College took the position that there was a significant need for the ongoing evaluation of its programs and, in particular, of its computer-assisted learning programs. In the Summer/Fall of 1992, a jointly-sponsored program with Employment and Immigration Canada evaluated the effectiveness of the Josten's INVEST ILS program with 14 adults returning for academic upgrading(Wilson, 1992). The significant gains in academic skills as well as positive personal growth reported by participants has since led to the integration of the ILS laboratory with more traditional upgrading experiences at the college. A further indication of the success of that program has been the completion of the high school equivalence examinations by 9 of 14 participants in the pilot project, despite entering average reading skills at the grade 8 level and mathematical skills at the grade 7 level. As well, the College has assumed a leadership role in the region though the offering of consultative services and direct training of instructors in the area of integrated learning systems.

That initial ILS project led the community college to an interest in knowing whether and to what extent ILS approaches could be of value to other young adult/adult students at risk. Would such groups respond to an ILS approach in a manner which would approximate or perhaps enhance the academic and personal growth associated with more traditional teaching methods? For some time, there had been concern at the college for the provision of appropriate services to the growing numbers of students with learning disabilities who were seeking admission to the college. At least one participant in the previous project had a well-documented learning disability. The academic and personal growth of that participant had been positive and commensurate with that of other participants. For these reasons and others to be outlined in the body of this report, this led to the position that the ILS approach could have particular value for persons with learning disabilities.

In the Winter and Spring of 1993, the College initiated discussions with the local school board to determine whether there would be an interest in pursuing a joint project which would lead to the piloting of the ILS system with high school-aged students with learning disabilities. Under the leadership of the Cumberland Campus and with the sole financial support of the Community College System of Nova Scotia, this project was undertaken.

ENHANCING THE ACADEMIC SKILLS OF ADOLESCENTS WITH LEARNING DISABILITIES THROUGH COMPUTER-ASSISTED INSTRUCTION

PURPOSE OF THE STUDY

The purpose of this study was to determine whether and to what extent an integrated learning system approach to upgrading in basic subject areas would be effective in enhancing the academic growth of adolescents with learning disabilities. A secondary purpose was to determine whether some aspects of personal growth may be enhanced as a result of participation in this approach to learning.

BACKGROUND TO THE PROJECT

Students with learning disabilities have been described as those children and adolescents with at least average potential to learn but for whom academic achievement in the core areas of learning including reading, mathematics and writing fall far short of their potential. Many adolescents with learning disabilities have yet to master higher level skills involved in reading, mathematics and written expression. Adolescents with learning disabilities have been found as a group to have as much as four-year delays on standardized achievement tests(Shepard and Smith, 1983). In the area of reading, it has been suggested that the higher order reading deficiencies of adolescent learning disabled students can be traced to continuing deficits in lower order skills of reading(Snider and Tarver, 1987). That is, many adolescents with learning disabilities have persisting problems in essential reading skills including basic sight vocabulary, word attack skills, reading rate, memory for sounds, ability to generalize to words with similar orthography, phoneme segmentation and vocalization during silent reading(Boder,

1971; Horn, O'Donnell and Vitulano, 1983; Snider and Tarver, 1987). Even if decoding is automatic, many students with learning disabilities tend not to monitor their reading for comprehension(Bos and Filip, 1984). Relatively higher levels of achievement in the area of mathematics than for reading for adolescents with learning disabilities have been reported. However, other researchers have suggested that mathematical achievement peaks at approximately the 5th grade level(e.g., Cawly and Miller,1989). Relatively little research exists regarding the types of mathematical errors made by adolescents with learning disabilities, but it is evident that they continue to experience difficulties with computation operations, choice of rules, problem-solving, spatial errors and attending to details(e.g., Algozzine, O'Shea, Stoddard and Crews,1988; Sharma, 1981)

There is growing evidence that the academic difficulties experienced by students with learning disabilities is cumulative in nature such that the gap between achievement and potential grows from childhood to adolescence. These growing gaps in academic skills experienced by adolescents with learning disabilities may occur for several reasons. First, there is evidence to suggest that the time-on-task in learning activities of adolescents with learning disabilities is significantly less than for non-disabled adolescents(McKinney and Feagans, 1983). Second, as noted earlier, persisting deficiencies in lower order skills in reading and mathematics may impose limitations on the acquisition of higher-level skill development(Snider and Tarver, 1987). Third, there is some evidence to suggest that students with learning disabilities require additional trials in order to learn specific skills. If persons with learning disabilities require significantly more exposure and practice to learn skills, not only can this lead to continuing deficits but also to a widening gap between the academic skills of students with and without learning disabilities. Finally, opportunities to overcome academic deficiencies of students with learning disabilities may be lessened because of the extent and focus of resource support services through the school years. As the child progresses through the school system, the opportunities for significant amounts of practice on deficient skills lessens. School-based resources for students with learning disabilities tend to be concentrated more on the earlier rather than on the later school years. And, at the secondary level, resource teachers tend to focus more time on the day-to-day content of the student's academic courses than on remediation of basic skills.

Not only might these relative deficits increase but academic growth may plateau. Despite continued educational experiences, growth may not continue to occur in basic academic skills. Early in high school, there is growing evidence that many students with learning disabilities plateau at the 4th or 5th grade level(Schumaker, Deshler, Alley and Warner, 1983; Warner, Schumaker, Alley and Deshler, 1980).

Finally, as young adults and adults with learning disabilities, it has been found that as a group they drop out of school more frequently, experience higher levels of unemployment as well as higher levels of underemployment when compared to their peers of similar backgrounds and experiences. Thus, adolescents with learning disabilities represent a group at significant risk for lifelong problems.

Computer-assisted instruction(CAI) may be beneficial to the skill deficiencies of the adolescent with learning disabilities for several reasons. CAI provides opportunities to individualize programs and to delineate specific skill deficits far more quickly and with more clarity than can a teacher whose time and resources may be limited. Immediate and ongoing feedback to the student on his/her performance can be provided. The opportunities for practice can be far greater than can be provided through direct instruction from resource teachers who serve large numbers of students. Most newer CAI systems provide a large array of lessons which focus on specific skills. Thus, variety and range of materials are far greater than those to be found in most resource situations. The CAI learner situation can be far less threatening to the student with learning disabilities who has likely experienced many failure situations. The visual and auditory cuing available with CAI may be of benefit to students with learning disabilities who may have differing learning styles. Finally, there is evidence that computers can sustain the attention of learners for longer periods of time and have a strong interest value. As a teaching tool for the resource teacher, the opportunities for employing computer-assisted systems to the needs of students with learning disabilities are many.

Of the models of computer-assisted approaches, Integrated Learning Systems(ILS) are particularly well-suited to students with learning disabilities. A diagnostic-prescriptive approach is utilized whereby the student is placed in a set of activities within core academic areas and progresses through a series of activities based upon his or her performance. The instructor can control and individualize the program by branching to more challenging lessons,

slowing the pace or altering the types of lessons provided. For students not performing adequately, the system not only can take the student back, but also can branch to related activities to ensure understanding. Finally, ILS approaches can produce reports custom-made to the individual student which will be of value to regular classroom teachers, resource teachers as well as for parent information.

The use of computers in education has been common practice for the past twenty-five years. The last ten years has seen what may be termed a 'microcomputer revolution' particularly in the public schools. Despite its history, the impact of this technology on such matters as student achievement, attitudes and learning time remain largely unclear. The application of computers to education has been primarily for skill building in mathematics and language arts. Results of studies of computer-assisted instruction(CAI) which have examined the effects of computer-based drill and practice have led to the general conclusion that substantial gains in achievement scores do occur primarily in mathematics and less consistently in areas of language learning. For students with learning disabilities, there have been far fewer studies. In those studies, CAI approaches have been included as part of other resource-based activities. Therefore, the effects attributable to CAI relative to other activities has been difficult to discern.

In summary, there is strong evidence to suggest that adolescents with learning disabilities are at significant risk for school failure. The reasons for this are many but there would appear to be strong support for the position that basic academic skill deficits contribute significantly to this and that those deficits increase over the person's school career. And, there is some suggestion that academic skill development may plateau for persons with learning disabilities. Not only are persons with learning disabilities at risk for school failure, but consequently for becoming school dropouts, underemployed and unemployed.

The present study was designed to determine whether adolescents with learning disabilities would experience positive academic and personal gains over an intensive 8-week summer program which focused on reading and mathematical skill development emphasizing an integrated learning system approach.

DESCRIPTION OF THE INTEGRATED LEARNING SYSTEM

The INVEST System software was developed by Josten's Corporation. The hardware contains a Fileserver and twelve computers. The system is networked together using twisted pair cabling and Novell support software. The Fileserver is a 386 model 80 with an extended memory. The student stations are 286 computers. Each student station is equipped with a peripheral called a digi-speech adaptor. The digi-speech adaptor controls the voice and microphone components of the system. A microphone and headset allow each student to hear and to reply to some of the lessons sent across the network. Given the age and academic level of the students in this project, use of the microphone and headset were minimal. Each student station is fixed with a personal boot disk and station bootup number. Two peripherals called CD-Roms are also linked to the Fileserver. One central printer is used to print for all computers. The twelve stations are placed around the perimeter of the laboratory with four tables boxed in the middle of the laboratory for off-line work.

Software

There are two main vehicles of software in the Josten's learning system: INVEST and The Basic Learning System. INVEST consists of a program that has a three-tier construction(See Appendix A). Tier 1 is Literacy Basic(Levels 1-3), Tier 2 is Adult Basic Education(Levels 4-8), and Tier 3 is Advanced Literacy(Levels 9-12). There are approximately 5,000 on-line lessons with over 1500 hours of computer-based curriculum in the entire INVEST curriculum. For this study, only the INVEST learning system was employed.

The Curriculum

Each curriculum level contains a number of different lesson strands in the content areas of Reading, Writing, Mathematics, and Lifeskills(See Appendix B). Students in the INVEST system are tested in two different ways in each individual lesson strand. Each student receives a pretest and a posttest. The pretest evaluates prior knowledge in a particular subject area while the posttest evaluates mastery of the concepts learned in the lesson strand. Students must achieve a mastery percentage before they can continue with their learning. The mastery

percentage is set by the instructor. If a student reaches the mastery percentage on the pretest, then the student is skipped through the lessons on this particular strand. If mastery is not achieved, the student goes through the lessons until the posttest is reached. If mastery is not achieved on the posttest, the student returns for further remedial lessons.

The system also "recognizes" when a student is having difficulties in a particular lesson. Each student is thoroughly evaluated in each lesson. If a student does not meet the mastery level, the system will lock the student out of the lesson depending on the criteria set by the instructor. The instructor may set the computer to lock a student out of a lesson after the first, second, or third unsuccessful attempt. In such a case the prompt "No Lessons To Work On -- See Your Instructor" will be given to the student. If a student does exceptionally well in a series of lessons, the system can also move the student forward. This function is termed, 'Intelligence Branching. Again, the criteria for this function can be controlled by the instructor. For purposes of this study, mastery level was set at 85%.

METHODOLOGY

SAMPLE SELECTION

Students with learning disabilities at the end of grades 9 and 10 were targeted for this study. All nominees were taken from a single junior-senior high school with a combined population of440 students. Students with learning disabilities were nominated by resource teachers, regular classroom teachers and by school administrators. From an initial pool of nominees, school records, comments of resource and regular teachers and individual test results were used to determine the presence of a well-documented learning disability. Following nomination, further screening occurred. Sample size was limited to twelve based on the number of student stations available. Eleven parents received a letter sent from the school principal which outlined the program and the commitment required of the students if they chose to take part(see Appendix C). Nine responded positively. The same letter was then sent to two additional parents who responded positively. Eleven were chosen for the program.

The twelfth member of the group was a participant observer. The use of a participant observer was decided upon for several reasons. There was a need to gain first-hand, "objective" insights into the day-to-day operation of the ILS from a participant's perspective. The innovative nature of the project indicated a need for regular feedback on participant adjustment and concerns. It was unclear whether students could sustain their attention to the computer for the proposed lengths of time. And, it was unclear whether participants of this age group would be forthcoming in sharing their experiences. Finally, it was thought that the participant observer might provide leadership to the group. This person was a male student with a learning disability who was graduating from Grade 12 at the same high school from which the sample was selected. He had been nominated by the principal in consultation with the External Evaluator. The External Evaluator met weekly with the participant observer. As well, the participant observer kept a regular journal in which he included his thoughts and reflections on the experience. Although the Instructor was aware of the presence of the participant observer, the participants in the program were unaware of the role played by the participant observer.

As the program was to be full-time and to involve the entire summer break, two incentives were offered to students to encourage full participation in the program. Students received an honorarium for participation. This decision was arrived at for several reasons. Involvement in the program negated any opportunity for full or part-time employment. For most of the participants, summer employment was a necessity. The short duration of the program required full-time attendance if gains were to be realized. And, payment made it possible to place demands on the students regarding attendance. Students were allowed to miss up to a maximum of 3 days after which they would lose payment for each subsequent absence. If they missed more than 5 days, they were dropped from the program with no remuneration. Honoraria were paid during the second last week of the program(90%) and the remainder at three-month followup(10%). If they completed the program under the conditions outlined above, the second incentive was the awarding of an unassigned credit towards their high school diploma.

The final study group consisted of 11 students of which there were 8 males and 3 females. The average age was 16.1 years(range 15.3 - 17.0 years). The participant observer was 18.0 years of age

PROGRAM EVALUATION

A multifaceted evaluative strategy was adopted. The relatively short duration of the program raised the likelihood that academic growth may not be reflected in change scores on standardized achievement tests alone. Thus, both formal and informal measures of achievement were employed. Information from participants, the instructor, the participant observer, parents and teachers were also sought.

Measures of Achievement

In the areas of reading and mathematics, an individual and a group achievement test were administered during the first week of the program and re-administered within two weeks of program completion. The *Wechsler Individual Achievement Test*(Psychological Corporation, 1992) is a recently developed comprehensive battery for assessing the school achievement of children aged 5 years through 19 years 11 months. This measure was chosen as it appears to be

a well-standardized individualized measure of academic achievement for the age group under study. The test includes measures of mathematics, reading, language and writing. On pretest, the complete test battery was administered. On posttest, only those subtests judged to measure skills relevant to the INVEST Curriculum were administered. These included *Reading Comprehension*, *Mathematics Reasoning*, and *Numerical Reasoning*. A second measure of achievement was the group-administered Canadian Edition of the *Differential Aptitude Tests, Form A*(Bennett, Seashore and Wesman, 1988). Two subtests were administered. *Verbal Reasoning* is a measure of the ability to understand concepts framed in words. According to the Manual, the test measures, "Evaluation of the student's ability to think constructively, to find commonalities among apparently different concepts, and to manipulate ideas on an abstract level"(p. 7). *Numerical Ability* measures "Understanding of numerical relationships and facility in handling numerical concepts"(p. 8). As well, the INVEST system generates multiple reports on the progress of each participant. Growth reports for each participant by subject area are reported. Information from growth reports indicates the grade level of objectives met by participants on a weekly basis.

Other Measures

The *Program Evaluation Questionnaire(PEQ)*was developed to provide participants with an opportunity to evaluate all aspects of the ILS program(See Appendix D). Answered anonymously, it included eighteen closed-ended questions. On 8 of the questions, a place for written comments was provided. The *Computer-Assisted Learning Student Evaluation* was developed and administered by the Instructor at the mid-point of the program. It consisted of 12 open-ended questions which were answered anonymously(See Appendix E). The purpose of this questionnaire was to gain information regarding student attitudes towards the program and for students to raise any problems or concerns. Student and instructor diaries were also kept. Each student was given a disk and asked to keep two files. The first file was confidential and was used to encourage students to write on a regular basis. The second file was an interactive teacher-student file in which students were encouraged to write to the instructor on a weekly basis in order to express questions or concerns, progress, etc. The instructor responded to each writing of the student. The instructor diary contained daily observations and reflections on the program, the participants, and any other matters which were considered to be of importance. The participant observer also kept a diary and met weekly with the External Evaluator. A meeting was conducted on the last day of the program by the Counsellor at the community

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college. The External Evaluator was present as recorder but played no role in the discussion. The nine questions from the *Computer-Assisted Learning Student Evaluation* were used to initiate discussion. Parents were invited for interviews at the half-way point of the program. Anecdotal comments were recorded. Parents were contacted by phone at 3-month followup by the Instructor. Finally, the Evaluator kept a diary regarding visits to the classroom, observations, and comments by instructors and students.

PROCEDURE

Curriculum Implementation and Pretesting

The INVEST program can be used with a broad range of learners in a number of curricular areas. Given that the program would last only 8 weeks, decisions were made as to which curricular areas to include and which amounts of time would be devoted to each area. Priority was given to two areas of the curriculum, Reading and Mathematics with less importance attached to Writing skills. Relative ratios by area were determined in order to plan the time to be spent on the computer over the 8-week program. The determination of a weekly schedule was made in conjunction with the Instructor. During Week One(July 5 - 9), students were pretested on both individual and group measures. Also, a two-day orientation to the INVEST system and baseline testing on the system in Reading and Mathematics was carried out. As well, a parent information session was held.

On the last day of Week One, a problem arose with the file server. This resulted in a system failure which was not repaired until July 21. Initial baseline test data on the system was also lost. Formal work with the INVEST system did not occur until 22 July, 1993. Baseline testing was redone on July 22. The program continued until 2 September, 1993 with September 3 being devoted to posttesting. Table 1 presents the daily/weekly schedule which was followed for the 6 remaining weeks of the program. For four days of each week, 3 hours were spent doing Reading activities on the system and 2 hours on Mathematics. One additional half hour was spent in off-line instruction and workbooks in either Reading or Mathematics. In the first week of program, the off-line activities were found to be less successful when done as a larger group of 10. At least 4 of the participants exhibited attentional problems which appeared enhanced during off-line activities. As a result, the group was divided and taken off in groups of five for this half-hour each day. Off-line Reading and Mathematics activities were

alternated on successive days throughout the program. The other half-hour each day was devoted to writing activities. Students were encouraged to make daily entries to their computer journals and to write through the use of the INVEST Topic Choosers. A different topic was given each session and students generated stories about it.

Since the relative time allotted to Writing was minimal, formal evaluation of this component was not undertaken. The Evaluator visited the program on a weekly basis. These visits were sometimes announced and sometimes unannounced. Attempts were made to visit at differing times during a day, and on differing days each week. During each visit, at least one-half hour was spent in the classroom.

RESULTS

Attendance for the 8-week program for the total group averaged 97.09 %. Discounting days of testing and down times, students were on the computer for a total of 23 full days and 6 half days. Figure 1 depicts the number of hours and percentage of time by curricular area for the program.

One male participant developed an illness two and one-half weeks after program initiation. This illness prevented the student from continuing in the program. As well, the participant observer's results are not included in the analyses. The results are based on 10 program participants.

On the *Wechsler Intelligence Scale for Children-III*, the mean Full Scale IQ was 92.78(range 84-101), the mean Verbal IQ was 92.00(range 79-101), and the mean Performance IQ was 95.33(range 86-107).

Measures of Achievement

Table 2 presents the mean pretest and posttest raw scores for the group on both achievement measures. Derived scores are also included. Raw scores were used for all statistical comparisons. Because of the small sample size and the possibility that the assumptions underlying the use of parametric tests might be violated, the Wilcoxon Signed-Ranks Test was employed for all comparisons. This statistic was chosen as it takes into account not only the direction of changes but also the magnitude of the changes for each paired observations(Huck, Cormier and Bounds, 1974, p. 204). On the *Wechsler Individual Achievement Test*, significant positive changes were reported for *Reading Comprehension*($p < .05$) and for Numerical Operations($p < .05$), but not for *Mathematics Reasoning*. On the *Differential Aptitude Test*, significant positive changes were found on both *Verbal Reasoning*($p < .05$) and on *Numerical Ability*($p < .005$). Growth reports were generated from the INVEST system to describe growth in the areas of Mathematics and Reading. Since baseline testing placed participants at differing entrance points in the Reading and Mathematics curricula and because each participant grew at a different rate, group-based statistical analyses were

considered inappropriate. Figures 2 and 3 present the intraindividual growth patterns expressed in grade levels for Reading and Mathematics respectively. Expressed as grade scores, these two figures depict the differences between the lowest-level objectives attempted by the student at program initiation to the highest level objectives completed by the student at exit. Entrance points ranged from Grade As a group, the highest levels obtained on 'average' was Grade 9.2 for Reading and 9.9 for Mathematics.

Program Evaluation Questionnaire

Regarding the content of the program, participants rated the on-line computer program higher than the off-line workbook activities. On-line Mathematics was rated as Excellent or Above Average by 70% of participants Eighty percent felt that they were better in mathematics as a result of the program. On-line Reading was rated as Excellent or Above Average by only 40% of participants, but 70% felt they were better readers as a result of the program. Individual comments by participants were diverse. Generally speaking, there were more favorable comments regarding Mathematics than Reading. Notable comments included: "I know how to do math. I can figure things I couldn't before," and "I feel I have accomplished a great amount in Mathematics." For Reading, students said that they were not used to reading for that long each day. Sixty percent found writing to the Instructor to be beneficial. The comments from participants were very positive. "It lets you talk to the Instructor as another person instead of (as) a student. The Instructor doesn't show any authority when this takes place." "It gave the student as well as the Instructor the chance to express personal concerns." Regarding the organization and delivery of the program, certain features stand out. Most(80.0%) felt that the length of the program, the length of time spent with the instructor, and the length of time spent on vs. off the computer was appropriate. For the amount of time spent on the computer at a single time, a diversity of responses occurred. However, 90% felt that at least 2 hours at a single time was acceptable. In fact, 3 of 10 participants thought that 'all day' was appropriate.

When compared to regular high school courses, 70.0% thought the computer approach was a better approach. Interestingly, only one participant rated the program to be less effective than regular high school courses. This was also supported by the finding that all but one participant felt that the amount of work deserved the equivalent of a high school credit. Said one participant, "I think it deserves a credit because we do three times the work in one day here than one day at the high school," and "Because in 10 weeks we did as much work as we would in a

full school year." Seventy percent said that they liked using the computer approach as much as or more than traditional teaching with only 30% favoring it more. However, 80.0% felt that they had learned more using the Integrated Learning System than by traditional methods of teaching.

All but one of the participants would recommend the program to their friends, and the other one said "Yes and No" with the concern being whether they(others of their age) could handle the length of time on the computer in reading and mathematical activities. Of the positive responses, the following comments were representative: "It is a good course...It is a new experience, a new way to learn....It helps you understand better....It's a way to find out what you yourself are capable of or what areas you need to work on to improve your work ability." However, one participant noted that "It leaves you with no time with your friends," and " Yes(I would recommend it) but I would tell them what they are getting into. It is very tiring, hard on the eyes." Over 90% said they would have either some or a strong interest in taking part in further related programs.

The decision to pay participants for taking part in the program was supported by 70.0%. For those who favored payment, comments supported its need if offered during the summer break and the otherwise loss of spending money. For those who would have participated without payment, the following were among the reasons given: "Because it helps me understand better.....Because I am really glad that my reading skills improved. I knew that they would."

Regarding the personal effects of this program, 60% reported that they were more confident, more able to concentrate and more highly motivated learners as a result of the program, as well as more able to get along with their peers." However, only 2 of 10 thought they had become better learners.

Finally, participants were asked how the program might be improved. For the Invest Program itself, more variety in lessons, less repetition, more Canadian content and the length of some lessons were suggested. Frustrations appeared to focus more on the Reading strand than Mathematics. Also, inclusion of different subjects was mentioned. Some preferred a later start each day, a longer lunch break, shorter days and better lighting.

Instructor Observations

The observations of the Instructor provided valuable insights. First, it appeared that the role of teacher as a motivator of learners and of keeping students on task was less than in traditional teaching. On-line, more student control and responsibility appeared to result. The Instructor found that the system allowed him to accommodate a wider range of learner levels. For some students, problems in maintaining attention were lessened when on the computer, but heightened when returning to workbooks or to work with the Instructor. The Instructor also commented on the problems for the period when the system was down. The level of concentration and attention to task lessened considerably after the second day of traditional teaching. The Instructor also found a significant difference in motivation and attention from the morning to the afternoon sessions with mornings being far more productive. Unlike a previous group of adults, the Instructor thought that the individual stations should be separated and for some of the students a more private, enclosed station would be more effective. Relative to that same reference group, the Instructor found the students with learning disabilities to engage in less cooperative learning as very little sharing occurred. This approach provided the Instructor with more exact monitoring capacities for each student's progress and for any point in time. The Instructor was able to "customize" the curriculum for a small number of students during the last two weeks of the program. This proved to be very effective in helping students to overcome specific problems. Finally, as a mechanism to provide specific and detailed information to teachers and parents regarding student progress, the Instructor found the system to be very valuable.

Mid-Point Evaluation and Group Evaluation

Since the mid-point and final group evaluation employed the same questions, the information has been combined. Only information which differs from or is in contrast to that previously discussed in relation to the *Performance Evaluation Questionnaire* will be addressed. Many felt that the computer made them work harder because even a small error led to failure. The computer also made them more careful. They found it challenging but fun; at other times, it was boring for some. As far as helping when they went back to school, they felt that they had set higher goals, their math was stronger, it gave them confidence, and that they were now writing more. Some found it tiring to be on the computer all of the time as reading was a necessary part of all activities including Mathematics. While observing, the following

comments appeared to reflect general agreement among participants. The likes and dislikes by participants regarding the ILS were very diverse. This occurred not only between subject areas, but clearly within as well. Mathematics was enjoyed relatively more than Reading components of the program. They felt frustrated when they didn't get 85% and when they made small errors and did not progress to the next level. They felt they learned to be more careful of their answers. Some liked the reading and some liked the fact that they didn't have to write things down all the time. The computer approach was judged to be valuable. Again, all participants highly recommended the program.

Participants were asked how they might improve the program. Among the points made were the following: (1) Change the order of activities(e.g., Reading vs Mathematics) each day, (2) More Canadian content, (3) Allow to set daily goals to work towards, (4) Break down some of the larger lessons. As well, a number of physical changes were recommended including later starting time, longer breaks including lunch and air conditioning.

Participant Observer

Weekly meetings with the External Evaluator were invaluable to the project. Of particular value was the gauging of participants' reactions to the period in which the system was down. It was a critical period in the program as the system had been well-received, orientation activities and pretesting completed, and they were awaiting the first 'official' day on the system. It was essential to know how participants' interests and motivations were being influenced by the delays. With this information, the instructor was able to plan activities more effectively. As well, through the participant observer, it became known that there were several ways to 'cheat' the system. For example, participants had found ways to skip through certain lesson strands. Diary comments appeared to be direct, honest and insightful. Most importantly, they validated the anonymous views expressed by other participants. As a participant, however, it should be noted that the participant observer's gains in academic areas were less relative to those of most other participants.

Parent Feedback

At mid-point and at followup, feedback from parents to the Instructor were overwhelmingly positive. All parents reported more positive changes in attitudes towards school work. At mid-point, they reported that the students were enjoying the program and were positive in their appraisal of it. One parent indicated that each morning she was being 'pushed' to get ready earlier in order for her son to get to the program long before it started. One particular comment made by several parents was that their son/daughter had begun to show an interest in reading at home. Where students had previously never read at home, they were now reading the newspaper and magazines. On followup, there was unanimous support that the program had been a successful both academically and personally. All participants were doing much better in school since the end of the program. Many parents took the opportunity to share with the Instructor examples of their son's or daughter's recent achievements on tests, exams, and assignments. All parents highly recommended the program. An overwhelming concern expressed by parents was for the program to have continued during the school year as they felt that their son or daughter could make further gains.

DISCUSSION

In judging the value of the INVEST program, both quantitative and qualitative data must be considered. Standardized testing revealed that positive gains were made in the areas of Reading and Mathematics with the extent of the gains greater in Mathematics. In the area of Reading, the significant *DAT Verbal Reasoning* results moved students from the 29th to the 40th percentile relative to the standardization sample. This positive growth represents a move from below average to average group performance. Using the significant results for *Reading Comprehension* of the *WIAT*, expressed as standard scores, the mean gain relative to the standardization sample was from 92.3 to the 98.1. In the area of Mathematics, both measures involving numerical operations were significant and demonstrated positive growth from below average performance on the *DAT*(32nd percentile) to average performance(48th). Similarly, standard score improvement from 91 to 99 occurred on the *WIAT*. However, it is evident that the improvement in mathematics was more in numerical operations than in numerical reasoning. It is not clear whether gains did occur in mathematical reasoning or whether they were simply not demonstrated in the achievement measures used. For example, in a previous study with adults in a similar 14-week INVEST-based program, significant growth in numerical reasoning did occur(Wilson, 1992). Whether this difference occurred due to time in program, test instrumentation, or other factors cannot be delineated. However, it is interesting to note that the clear gains in Mathematics were made despite relatively less time being spent in this curricular area than in Reading.

A matter of some concern were the findings relative to the *Wechsler Individual Achievement Test*. Unlike the *DAT* results on pretest, the present sample did not demonstrate the expected deficits associated with samples of students with learning disabilities on the *WIAT*. And, the *WIAT* results were not consistent with information obtained from previous assessments of this sample of students. However, the IQ measures of this sample closely approximated those reported for a learning disabled sample reported in the*WISC-III* manual(p. 213). Thus, the apparent inflated achievement scores could not be explained by higher than expected potential to achieve with consequent higher achievement scores. Rather, it may reflect characteristics of the tests and/or their predictive value with students of this age. For example, none of the three *WIAT* subtests are timed whereas the *DAT* subtests are times. Thus, the *WIAT* tests may be considered more as 'power' tests than those of the *DAT*. It is interesting to note that 9 of 10

students showed change in a positive direction in Reading and 8 of 10 in a positive direction for Mathematics. Despite higher entering achievement levels, the WIAT measures do appear to be stable and do reflect growth in the areas of the INVEST program. To date, validation studies with samples of persons with learning disabilities have been minimal.

A particular advantage of the ILS approach for adolescents with learning disabilities has been demonstrated through the growth reports as depicted in Figures 2 and 3. At baseline testing, the system accurately pinpoints deficiencies. Thus, participants are required to fill gaps before attempting higher level objectives. In reading, half of the participants entered the program at objectives below the grade four level. This finding is consistent with researchers such as Snider and Tarver(1987) who has argued that it is earlier persisting deficits among those with reading disabilities which limit growth in higher order skills of reading. This finding would also bring the results of the *Wechsler Inidividual Achievement Test* into further question. Of even more interest is the fact that 8 of 10 participants entered the program at objectives below the grade four level in mathematics. Although studies to date have not addressed this issue, it would appear that the argument for cumulative deficits as an explanation for the lack of continued growth in mathematics for adolescents with learning disabilities is supported by these findings.

The consensus of the participants as indicated in the post-evaluation questionnaire, the group discussion, the interim evaluation and the diaries suggest that there were many positive features to the INVEST Program which could be of value to the teaching of adolescents with learning disabilities. A consistently higher rating for Mathematics suggests that the application of the INVEST program to Mathematics would lead to substantial gains if used appropriately. Of particular interest is that the amount of time over which gains occurred was considerably less than for Reading. Despite not rating Reading as highly, there were also significant gains for most participants. One comment appears to summarize the feelings of participants towards the Reading, "I have reading problems and I therefore hate to read. And we did a lot of that, but it was worth it." Despite high ratings with regard to the amount learned, ILS effectiveness when compared to traditional teaching found that only 3 of 10 participants would rather have the ILS alone. Consistent with an earlier study with adults(Wilson, 1992), this study supports the position that the use of ILS approaches is clearly that of a teaching tool rather than as a replacement for a teacher. It should be noted that this project attempted to determine the extent to which an ILS approach could be used exclusively. The results do indicate that students can

sustain their attention to an ILS approach for substantial periods of time. In fact, almost every participant(9/10) was comfortable with at least two hours at a single sitting. A comment from one participant's diary may help to understand why students rated this approach highly in terms of gains relative to traditional approaches: "I'm really amazed that all the students are keeping intact with the program so far in the summer. That's saying alot for something like this because very few teachers have something positive to say or make you feel good about what your doing." Individual attention, encouragement and positive reinforcement can be provided through ILS in conjunction with teaching. A second comment given in response to whether credit should be given may also be valuable: "I think it deserves a high school credit because we do three times the work in one day here than one day in high school."

This approach appears to lead to positive outcomes where other CAI approaches with adolescent students with learning disabilities have had less positive results(e.g., Farmer, Klein and Bryson, 1992). Members of the group were meaningfully engaged in academic tasks for most of the time spent in the classroom. In fact, students commented that they were not used to reading that much at school. Unlike an earlier study with adults returning for academic upgrading(Wilson, 1992), students of this age were not as focused nor as self-motivated. However, given corrections for time spent in program, the results for this group were as favorable. The overwhelming recommendation of the present participants to others of their age in support of this program speaks to the positive manner in which the program was viewed by participants. The comments of the participant observer over the course of the program also offered validation to the effectiveness of the approach.

An aspect of this program's success can be seen in the attendance rate which exceeded 97%. This was not anticipated prior to program initiation. Although loss of payment could result if abused, few participants were in danger of losing pay for absences. Given the hot conditions of the classroom, the relinquishing of the entire summer vacation, and the often cited loss of time with their friends, the students continued to attend faithfully. In fact, some participants chose to miss one or two days just prior to program completion. Said one participant to the External Examiner, "Just don't tell any of my friends that I came every day. It wouldn't be good for my reputation."

From observations and comments from the Instructor and as noted in the previous study, several additional advantages to the program should be noted. First, the program allows the instructor to pinpoint areas of relative weakness, and to assign lessons specific to overcoming that weakness. Second, if used appropriately, the system should allow the instructor to devote his time and attention to matters of instruction for which the teacher is most effective--modelling, explanation, the development of higher level thinking skills and, of course, one-to-one and small group teaching. In other words, the system has the potential to make the instructor more effective and efficient. Finally, the full use of the ILS allows the Instructor to engage in efficient curriculum tailoring to the individual's needs and to the ongoing reporting of progress in efficient and individualized ways for a variety of consumers.

A final consideration is the overwhelmingly positive response of parents to this program. As a group, parents of students with learning disabilities have often been placed in adversarial positions in dealing with schools. Services to students with learning disabilities are often viewed as insufficient. Rarely have programs been unanimously viewed as positive academically and personally for their sons and daughters. From their perspective, discernible gains were realized in ways in which only parents can measure. The unanimous recommendation of this group for this program to be continued is encouraging.

CONCLUSIONS

In conclusion, Integrated Learning Systems can be of significant value in the academic upgrading and personal growth of adolescents with learning disabilities at the early high school level. Using the INVEST integrated learning system, this study has shown that gains can be achieved in the areas of Reading and Mathematics over a relatively short(six weeks) but intensive time period. Evidence from a variety of sources indicating the positive growth in both academic and personal areas strongly supports the broader application of these systems to this 'at-risk' group. It is important to note that the use of an ILS approach for adolescents with learning disabilities should not be seen as a 'total' approach to meeting their academic needs. Basic skill strategy development represents but one component of a comprehensive approach to enhancing the learning skills of adolescents with learning disabilities. The concurrent need for the development of learning strategies, content-related strategies, social development, and motivation cannot be underestimated. Because these systems have the potential for extended use beyond the school day, require minimal supervision and will be more readily available in the future, schools need to begin to plan for the extended and integrated use of these systems. Finally, this study once more supports the position that integrated learning systems are a valuable adjunct to teaching, but are not a replacement for good teaching. In a previous report, it was stated that the Integrated Learning System "Should allow the Instructor to devote his/her time and attention to matters of instruction for which the teacher is most effective--modelling, explanation, the development of higher level thinking skills and, of course, one-to-one and small group teaching. In other words, the system has the power to make the instructor more effective and efficient"(Wilson, 1992, p. 9). Computers are there to assist not to replace the teacher.

LIMITATIONS OF THE STUDY

Kellman(1990) has outlined the current lack of effective evaluation of existing integrated learning systems. Among the concerns raised are the following: studies are commissioned by the ILS companies themselves; unfavorable results are not released; children in the primary grades are used such that development could be responsible for positive changes rather than the system; and most importantly, that important variables are not controlled including teacher involvement, time on task, and frequency of exposure. In concluding this report, it is important to note that this study has attempted to control for all of the above. As well as the 'independent' funding, this study has clearly defined the role and involvement of the teacher, the time on task and frequency and duration of exposure to the system. However, Kellman(1990) has also noted the need for control groups. The limitation of this study may be the lack of a comparable non-treatment group. The site of the ILS lab in a more rural community restricted the availability of subjects and negated the possibility of a non-treatment control group. For this study, it may be particularly unfortunate because a non-treatment control group would lend further credibility to the present findings. Furthermore, a non-treatment contol group may have 'lost' further ground due to the lack of school involvement over the summer break. In a non-published report, Backman(1992) found that students at a residential school for students with learning disabilities lost up to two years in mathematics with lesser losses in Reading from Spring to Fall testing. As well, the need to use a comprehensive set of measures of academic growth which relate more directly to the content of the INVEST program and which include both power and speeded measures is recommended. Since informal followup has provided some evidence that there has been positive growth and transfer from this program experience, there is a need to determine how and to what extent the ILS approach can be integrated into resource programming for adolescents with learning disabilities. For these reasons, further evaluative studies on other groups of students with learning disabilities will be required.

RECOMMENDATIONS

The following recommendations are made:

1. That the use of the INVEST integrated learning system be employed for learning skill enhancement in Reading and Mathematics for adolescents with learning disabilities. Particular use of the system for Numerical Operations and Reading is supported.

2. That the use of the INVEST system be considered as an important adjunct to the provision of resource services to adolescents with learning disabilities. However, the use of this system should be integrated into a comprehensive approach which addresses all of the needs of the adolescent with learning disabilities.

3. That further application of the INVEST Program to persons with learning disabilities be accompanied by ongoing evaluation in order to determine how and to what extent this valuable resource can be of value.

4. That further studies consider the inclusion of non-treatment control groups and consideration inclusion of a participant observer.

5. That the modes of delivery of the program and the physical arrangements of the laboratory reflect the learner and personal needs of the adolescents with learning disabilities being served.

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LIST OF TABLES

TABLE 1: DAILY/WEEKLY TIMETABLE BY CURRICULAR AREA

Monday to Thursday

TIME	ACTIVITY
8:30 - 10:30	Reading
10:30 - 11:00	Workbooks/ Off-Line Instruction
11:00 - 12:00	Mathematics
12:00 - 12:30	Lunch
12:30 - 1:30	Reading
1:30 - 2:00	Writing/Journal Writing
2:00 - 3:00	Mathematics

Friday

TIME	ACTIVITY
8:30 - 10:30	Reading
10:30 - 11:00	Workbooks/ Off-Line Instruction
11:00 - 12:00	Mathematics

TABLE 2: PRETEST AND POST-TEST RAW AND DERIVED SCORES ON ACHIEVEMENT MEASUR

VECHSLER INDIVIDUAL ACHIEVEMENT TEST	PRETEST	POST-TEST	PRETEST	POST-TEST	WILCOXON TEST*	
	RAW SCORES		STANDARD SCORES		PAIRED OBSERV-ATIONS	SIGNIF-ICANCE
	$\bar{X}$ (s.d.)	$\bar{X}$ (s.d.)	$\bar{X}$	$\bar{X}$		
Reading Comprehension	27.50 (3.27)	29.40 (3.31)	92.30	98.10	8	0.046
Mathematics Reasoning	40.70 (2.21)	40.80 (3.01)	100.00	100.30	5	n.s.
Number Operations	33.50 (3.21)	35.80 (2.10)	91.50	99.90	10	0.023

DIFFERENTIAL APTITUDE TEST	PRETEST	POST-TEST	PRETEST	POST-TEST	WILCOXON TEST*	
	RAW SCORES		PERCENTILES		PAIRED OBSERV-ATIONS	SIGNIF-ICANCE
	$\bar{X}$ (s.d.)	$\bar{X}$ (s.d.)	$\bar{X}$	$\bar{X}$		
Verbal Reasoning	16.00 (4.37)	20.10 (7.59)	29.00	40.50	10	0.037
Numerical Ability	16.20 (5.88)	20.90 (3.35)	32.00	48.00	9	0.008

* Based on raw scores

TABLE 3: RESULTS OF THE *PROGRAM EVALUATION QUESTIONNAIRE*

PROGRAM CONTENT & DELIVERY

	Excellent	Above Average	Average	Below Average	Poor
Reading on Computer	20.0%	20.0%	50.0%	10.0%	0.0%
Mematics on Computer	50.0%	20.0%	20.0%	10.0%	0.0%
Workbooks on Mathematics	10.0%	10.0%	50.0%	30.0%	0.0%
Computer Journals	20.0%	30.0%	40.0%	10.0%	0.0%

Do you think that the 8-week course should have been

longer?	10.0%
about this length?	80.0%
shorter?	10.0%

The amount of time spent on the computer each day should have been

more	10.0%
less	10.0%
about the same	80.0%

The amount of time spent on the workbooks should have been

more	0.0%
less	10.0%
about the same	90.0%

The amount of time spent with the instructor should have been

more	20.0%
less	0.0%
about the same	80.0%

How much time could you comfortably spend on the computer at one time?

30 minutes	0.0%
1 hour	10.0%
2 hours	40.0%
3 hours	20.0%
all day	30.0%

Did you find that writing to the instructor by computer to be of benefit?

Yes	60.0%
No	40.0%

PERCEIVED ACADEMIC/PERSONAL GAINS

As a result of this course, do you feel that you are

	Yes	No	No Response
a better reader?	70.0%	30.0%	
better in mathematics	80.0%	20.0%	
a better learner?	70.0%	20.0%	10.0%
more able to get along with others?	60.0%	40.0%	
a more confident learner?	60.0%	40.0%	
more able to concentrate?	60.0%	40.0%	
a more highly motivated learner?	60.0%	40.0%	

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TABLE 3: RESULTS OF THE *PROGRAM EVALUATION QUESTIONNAIRE*(CONT'D)

INVEST(ILS) VS. TRADITIONAL TEACHING APPROACHES

Using this computer approach, I feel I learned

more than by traditional ways	80.0%
as much as by traditional ways	0.0%
less than by traditional ways	20.0%

Compared to regular high school courses, do you feel that this computer approach is

better	70.0%
about the same	20.0%
not as effective	10.0%

I liked using this computer approach

more than learning by traditional ways	30.0%
as much as learning by traditional ways	40.0%
less than learning by traditional ways	30.0%

INTEREST/MOTIVATION

With the amount of work you did, do you agree that this course deserved a high school credit?

Yes	90.0%
No	0.0%
Yes & No	10.0%

Would you have completed the course if you were not paid?

Yes	30.0%
No	70.0%

If given the chance to do further courses that were set up like this one, would you have

a strong interest in taking part?	50.0%
some interest in taking part?	40.0%
no interest in taking part?	10.0%

PERSONAL RECOMMENDATION

Would you recommend this program to others of your age?

Yes	90.0%
No	0.0%
Yes & No	10.0%

LIST OF FIGURES

Figure 1: Cumulative time & percentage of time by curricular area

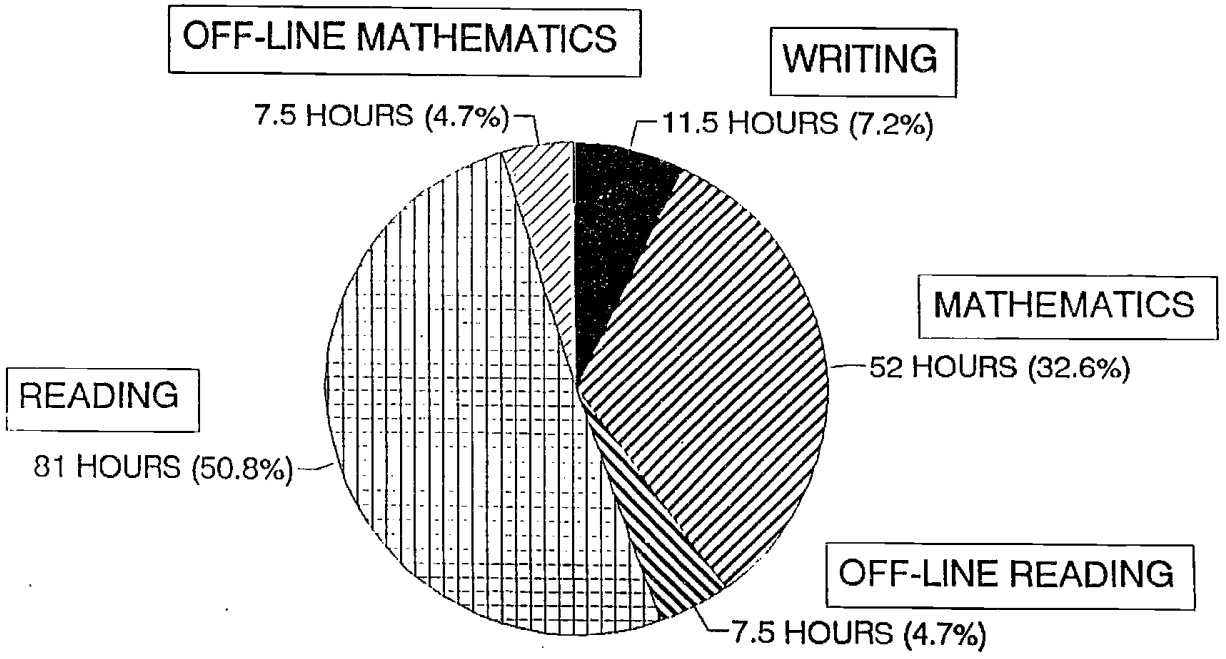


Figure 2: Critical ranges of intraindividual growth patterns in Reading expressed as grade equivalent objectives at entrance and exit

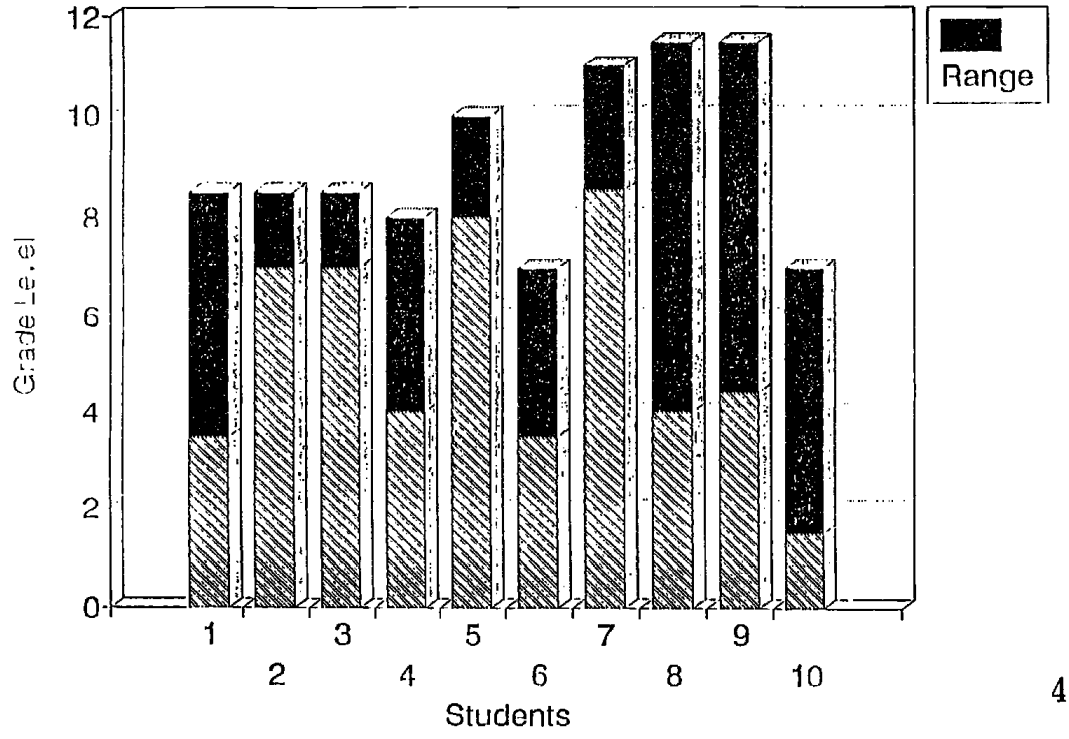
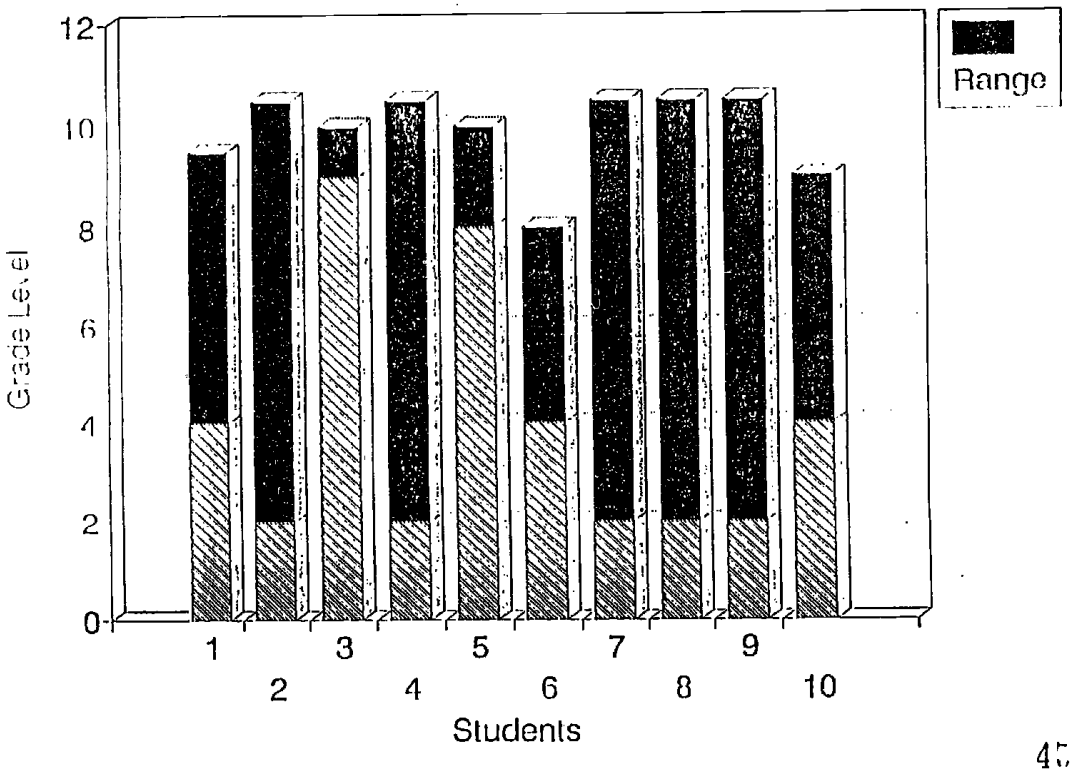


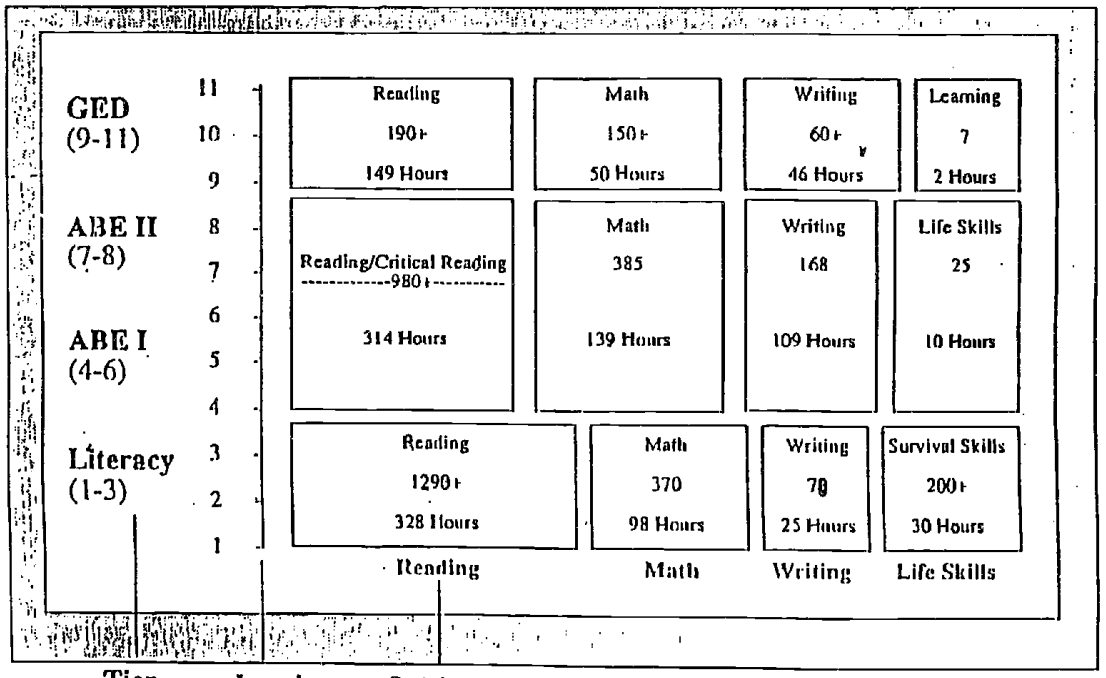
Figure 3: Critical ranges of intraindividual growth patterns in Mathematics expressed as grade equivalent objectives at entrance and exit



APPENDIX A

INVEST - CURRICULUM OVERVIEW

Invest - Curriculum Overview
Number of On-Line Lessons – 3.0
Number of Hours



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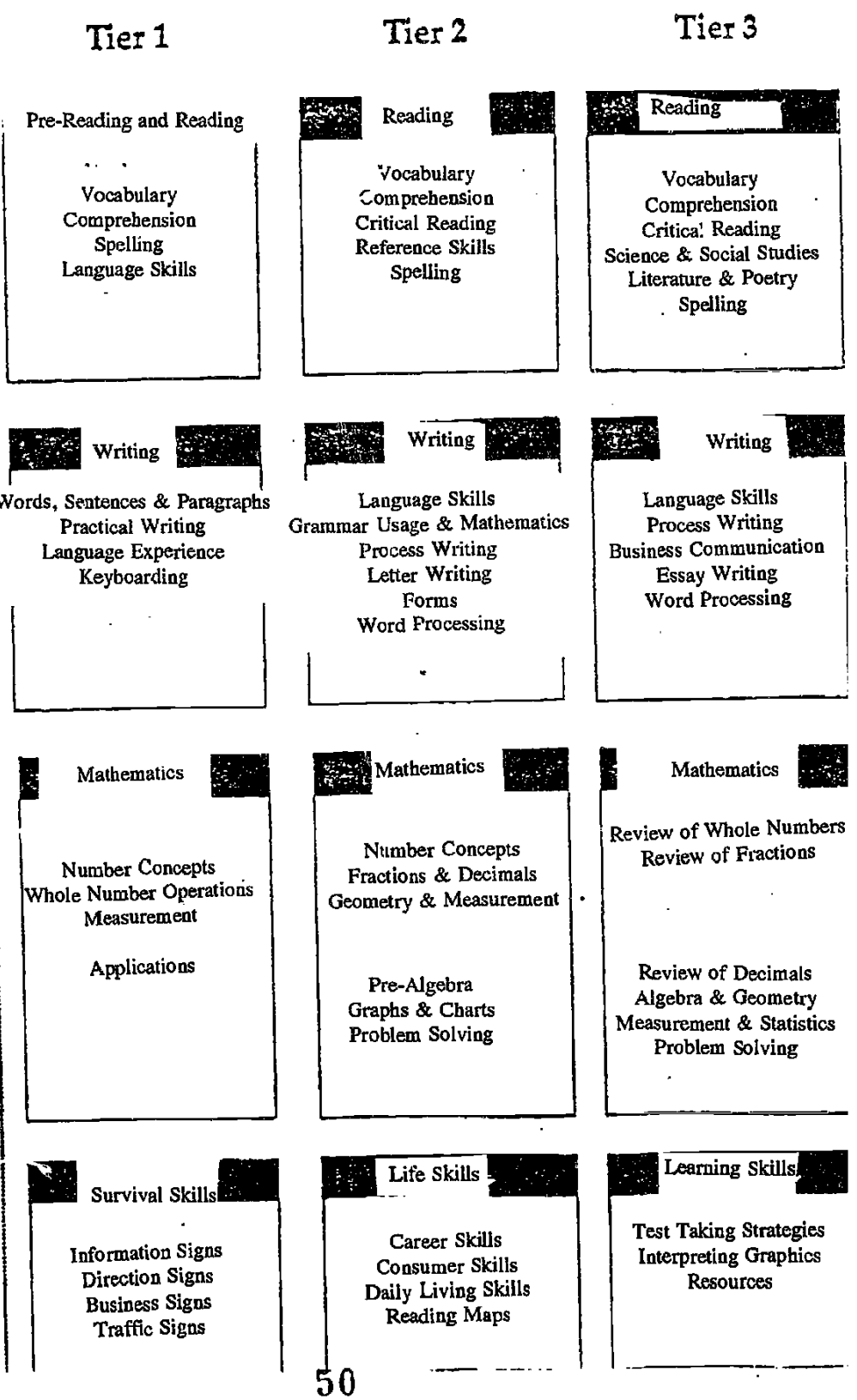
APPENDIX B

INVEST - PROGRAM DESCRIPTION BY TIER

of INVEST's three of learning evement incorporates skills instruction in ing, writing and ematics. At the Tier 1 Tier 2 levels, learning s are also integrated the curriculum. The plexity and variety of on content changes from level to the next, giving ents a progressive, llenging program of learning self-improvement.



APPENDIX C

LETTER TO PARENTS

Nova Scotia
Community College

Cumberland Campus

1 Main Street
PO Box 550
Springhill
Nova Scotia
B0M 1X0
902 597-3737
Fax 597-8548

Our file no:

June 23, 1993

COPY

Dear Parent or Guardian:

This summer the Nova Scotia Community College, Cumberland Campus, is undertaking a ten-week Research Project commencing the week of July 5-9. This project will be carried out in cooperation with the Cumberland District School Board and Mount Allison University.

The purpose of this project is to determine whether a computer-based learning system can be successful in raising the learning skills of students in their early high school years. Based on teacher recommendations and school performance, your son or daughter is a possible candidate for this project.

The College will be offering a financial incentive to students participating in this project. Remuneration will be at the rate of $115.00 per week based on attendance and participation. To qualify students must be prepared to participate in the entire program and to attend at all times.

We trust that this project may be of interest to your son or daughter. Details of the program are enclosed and we would welcome your son or daughter as a possible candidate in this exciting research project.

Yours truly,

George R. Laird

GRL/wk
cc - Dr. Lex Wilson, Mount Allison University
- Mr. Bill Campbell, Principal, SJSH

Nova Scotia
Department of Education

COPY

INVEST
A COMPUTER-BASED LEARNING SYSTEM FOR HIGH SCHOOL STUDENTS

A RESEARCH PROJECT

WHAT IS THE INVEST SYSTEM?

The Invest Program is a computer-based learning system which allows the student to enter the program at the point where his or her present learning skills are based. Students work at their own pace using a prescriptive, individualized curriculum. The Invest System has over 4,000 lessons and covers a very wide-range of difficulty levels.

WHY WOULD I WANT MY SON OR DAUGHTER TO PARTICIPATE?

The Invest Program has been shown to be effective in raising the skills of persons in the areas of language, writing and mathematics. The Program has been found to be highly interesting to students because each student works individually and at his or her own pace. Each student works to improve him or herself. He or she is not in competition with others but with himself or herself.

HOW WILL MY SON OR DAUGHTER BE INSTRUCTED?

Each day your son or daughter will receive instruction through the computer in the areas of reading, mathematics and writing skills. These computer sessions will be 40 minutes in length and will be followed by periods of independent work from workbooks. An instructor will be available to each student at all times and will help with any problems as well as to assist in using the Invest Program.

WHERE ARE THE CLASSES AND WHAT ARE THE HOURS OF INSTRUCTION?

Classes will be held in the Invest Lab at the Cumberland Campus of the Nova Scotia Community College in Springhill. Classes will begin promptly at 8:30AM and end at 3:30PM. On Fridays, classes will end at 12:30PM for the day. Students will receive ten minute breaks in the morning and afternoon and a 40 minute lunch break.

WHAT ABOUT MEALS AND TRANSPORTATION?

Students will be expected to provide their own lunch and transportation to and from the Campus.

WHAT ARE THE CONDITIONS FOR RECEIVING CREDIT AND REMUNERATION?

Both the high school credit and allowances are based upon attendance and active participation. Students will receive $23.00 per day (or $115.00 per week). To be eligible for these benefits the following conditions must be met:

(1) Agree to actively participate each day of the program and

(2) Miss no more than five days over the length of the program.

Participation means coming each day prepared to work and actively involving oneself in all aspects of the program. It also means taking part in some additional testing at the beginning, at the end of the program, and, briefly, after the students return to school in the fall.

Students may miss up to two days (for illness, etc.) without losing their pay for the day. For missing three to five days, the student will lose a day of remuneration for each day's absence. If a student misses more than five days he or she will be understood to have withdrawn from the program and will not be eligible for any remuneration.

Payment of the remuneration for nine weeks of the project will be made during the week of September 10, 1993. Payment for the last week of the project will be made at the end of November.

HOW CAN I GET MY SON OR DAUGHTER INVOLVED?

Complete the attached consent form and return it by Tuesday, June 29, 1993. Selection of the final group will be made by Friday, July 2, 1993. The project will commence July 5, 1993, and concludes with post-testing of students the week of September 7-11, 1993.

SPRINGHILL
JUNIOR-SENIOR HIGH SCHOOL
Office of the Principal
P. O. Box 1060, Springhill, Nova Scotia, B0M 1X0

COPY

June 23, 1993

Dear Parent or Guardian:

The Cumberland District School Board and the Springhill Senior High School are participating in the Nova Scotia Community College, Cumberland Campus, Research Project to be conducted this summer.

Your son or daughter has been nominated as a possible candidate to take part in this research project. Because he or she will be required to give up their summer break and possible employment, two incentives will be offered. Students who complete the program successfully will be granted the equivalent of a credit towards their high school completion. Also, students will receive an allowance of $115 per week based on attendance and participation.

To be accepted for this research project, the students must be prepared to actively participate in all aspects of the program.

Please review the enclosed documents thoroughly. If it is your desire that your son or daughter be considered for this project, please complete the attached PARENT RELEASE FORM and return to my office by Tuesday, June 29, 1993. Successful applicants will be contacted shortly thereafter.

If there are any questions, please feel free to contact me.

Sincerely,

W. K. Campbell

William Campbell, Principal
Springhill Senior High School

BC/ga

cc: Mr. G. Laird, Principal, NSCC, Cumberland Campus
Dr. Lex Wilson, Mount Allison University

COPY

INVEST

A COMPUTER-BASED LEARNING SYSTEM
FOR HIGH SCHOOL STUDENTS

A RESEARCH PROJECT

PARENT RELEASE FORM

I _____ , agree to allow my son/daughter
(Parent/Guardian)

_____ to participate in the RESEARCH
(Name of Son/Daughter)

PROJECT as a student in the INVEST PROGRAM.

It is my understanding that for my son/daughter to receive a high school credit and remuneration, he/she will be required to actively participate in the program and miss not more than 5 days of classes.

_____
(Signed by Parent/Guardian)

_____
(Signed by Student)

_____
(Today's Date)

APPENDIX D

THE *PROGRAM EVALUATION QUESTIONNAIRE*

THE INVEST SUMMER PROJECT

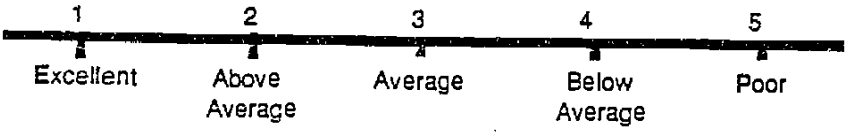
PROGRAM EVALUATION QUESTIONNAIRE

THE PURPOSE OF THIS QUESTIONNAIRE IS TO EVALUATE THE INVEST COMPUTER PROGRAM.
ALL OF YOUR ANSWERS WILL BE HELD IN CONFIDENCE.
THANK YOU FOR COMPLETING THIS QUESTIONNAIRE.

1. I liked using this computer approach
   - ___ more than learning by traditional ways
   - ___ as much as learning by traditional ways
   - ___ less than learning by tradiitional ways

2. Using this computer approach, I feel I learned
   - ___ more than learning by traditional ways
   - ___ as much as learning by traditional ways
   - ___ less than learning by traditional ways

3. RATE EACH PART OF THE INVEST PROGRAM USING THE SCALE BELOW:



Reading on Computer ___
Mathematics on Computer ___
Workbooks on Mathematics ___
Writing on Computer ___

4. Do you think that the 8 week course should have been
   - ___ longer?
   - ___ about this length?
   - ___ shorter?

5. The amount of time spent on the computer each day should have been
   - ___ more
   - ___ less
   - ___ about the same

6. The amount of time spent in the workbooks should have been
   - ___ more
   - ___ less
   - ___ about the same

7. The amount of time spent with the instructor should have been
   - ___ more
   - ___ less
   - ___ about the same

8. How much time could you comfortably spend on the computer at one time?
   - ___ 30 minutes
   - ___ 1 hour
   - ___ 2 hours
   - ___ 3 hours
   - ___ all day

9. If given the chance to do further courses that were set up like this one, would you have
   - ___ a strong interest in taking part?
   - ___ some interest in taking part?
   - ___ no interest in taking part?

PLEASE COMMENT: _____

_____
_____
_____

10. Compared to regular high school courses, do you feel that this computer approach is
    - ____ better
    - ____ about the same
    - ____ not as effective

11. As a result of this course, do you feel that you are

	Yes	No
a better learner?	___	___
a better reader?	___	___
better in mathematics?	___	___
more able to get along with others?	___	___
a more confident learner?	___	___
more able to concentrate?	___	___
a more highly motivated learner?	___	___

12. Did you find that writing to the instructor by computer to be of benefit? If so, how?
    PLEASE COMMENT: _____

_____
_____
_____

13. Would you recommend this program to others of your age?
    - ___ Yes
    - ___ No

WHY OR WHY NOT? _____

_____
_____
_____

14. Were there parts of the program that you found frustrating? If so, please explain.

PLEASE COMMENT: _____

15. If this program were offered again, what would you want to see changed?

PLEASE COMMENT: _____

16. With the amount of work you did, do you agree that this course deserved a high school credit?

PLEASE COMMENT: _____

17. Would you have completed the course if you were not paid?

PLEASE COMMENT: _____

18. Was there anything you thought should have been asked that wasn't, or anything that you think is important for us to know about the program?

PLEASE COMMENT: _____

APPENDIX E

THE *COMPUTER-ASSISTED LEARNING STUDENT EVALUATION* FORM

Computer Assisted Learning Student Evaluation
August 6, 1993

We are at a natural evaluation point in our class. I think we have accomplished a great deal and should be proud of ourselves. At this point, it would be helpful to me to get some feedback on the previous classes.

1. What activities do you enjoy most in this program?

2. What activities do you enjoy least?

3. What did you feel you learned from the classes?

4. What did you expect the classes to be like when you started?

5. Did it turn out the way you expected? Why or why not?

6. Are there any suggestions you could make for the next few sessions?

7. What do you think are the strengths and weaknesses of this type of learning ?

8. What is your goal in relationship to education and this program?

9. Would you consider this program to be effective in regards to upgrading. (yes) or (no). Why?

10. Would you recommend this program to others?

11. Do you feel the time spent on the computer is too much, too little or just fine?

12. Do you feel the time spent working off the computer is too much, too little or just fine?

Thank you for completing this survey