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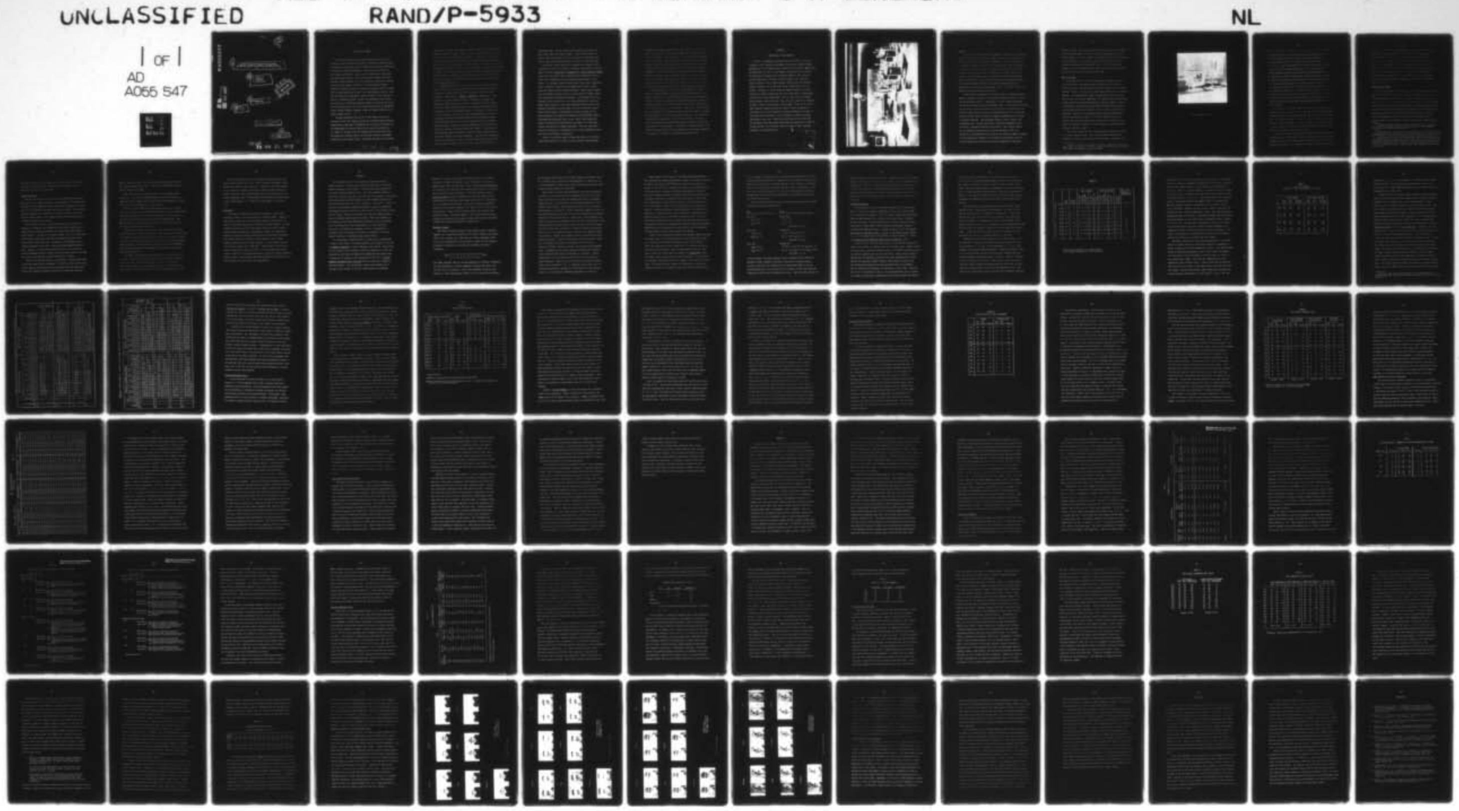

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INTERACTIVE CLASSROOM TELEVISION SYSTEMS:
EDUCATIONAL IMPACT ON PARTIALLY SIGHTED STUDENTS

T. K. Bikson
T. H. Bikson
S. M. Genensky

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PREFACE AND SUMMARY

An Interactive Classroom Television System (ICTS) is a way of creating a visual classroom environment for partially sighted students by making use of the magnification brightness and contrast capabilities of television cameras and monitors. More precisely, an ICTS is a multicamera, multimonitor closed circuit TV system with videotaping and videoreplay capacity. Such a system permits teachers and their partially sighted students to be in continuous two way visual communication with one another. Moreover, it allows partially sighted students to function visually in classroom situations that are closely akin to those experienced by their fully sighted peers; that is, they can read ordinary printed matter, look at pictures, write with pen or pencil, do workbook problems, consult the blackboard, draw or paint. Thus the use of an ICTS both prepares students for eventual matriculation into classrooms for the fully sighted and provides an appropriate visual aid which enables students to make the fullest possible use of their residual vision. → (cont on p 4)

The Rand Corporation has carried on ICTS research since 1973. During this time, with funding provided by the Rehabilitation Services Administration (RSA grant 14-P55846/9) and the Bureau of Education for the Handicapped (OE contract 300-75-0123), under the direction of Dr. Samuel M. Genensky, Rand has designed and constructed two ICTSs and placed and evaluated them in two different visually handicapped classrooms in Los Angeles County. This paper describes the activities undertaken to evaluate the educational impact of these ICTSs upon partially sighted elementary students. Chapter I provides a description of the two ICTS sites and their participants. Chapter II begins with a discussion of the evaluation design for the project, the kinds of assessments employed, and the data collection schedule. It then presents the results of the first project year (1975-1976) in three areas of evaluation. Chapter III, building on Chapter II, describes changes introduced into the evaluation procedures, and then examines outcomes for the second project year (1976-1977). The Postscript considers the rationale for, and some of the issues that arise with disseminating the ICTS.

In general, assessment of project outcomes over two years suggests that an ICTS has a strong positive impact on the educational experiences of partially sighted elementary school students in the three areas evaluated. With respect to academic achievement, examination of standardized test scores showed significant improvement in reading and mathematics during both years. However, the pattern of gains changed: in the first year, students improved more markedly in mathematics than in reading, scoring significantly higher in the former; but by the end of the second year, reading scores increased dramatically so that no substantial differences remained between the two achievement domains. We believe these results reflect the circumstance that, for visually impaired students, learning to perform computations is less difficult because it requires less scanning than does reading. A second year of ICTS experience enabled students to learn the visual scanning skills needed for advances in reading achievement. Two additional achievement results are noteworthy. First, for students similar in age, those who have had longer exposure to the ICTS score closer to grade normal on achievement tests. Second, higher grade students are farther from grade normal than lower grade students. These outcomes lead us to believe that early exposure to an ICTS is helpful in minimizing the risk of cumulative educational deficit related to visual impairment.

The project further undertook to evaluate two perceptual skills importantly involved in educational information processing for partially sighted students, visual motor integration and visual sequential memory. During the first project year, students showed significant gains in visual motor integration; visual sequential memory showed no such advance. In contrast, during the second year visual motor integration scores continued to improve but not dramatically; however, visual sequential memory evidenced significant gains. These results suggest that, as students initially learn to use the ICTS for academic tasks, their visual-motor coordination increases. But scanning via the X-Y platform is more difficult and, as we have hypothesized, requires a longer learning period. Thus visual sequential memory scores do not manifest significant positive change until the second year, during which reading (another scan-dependent activity) advances as well. These assumptions are supported by studying intercorrelations among achievement and perceptual skill scores. While visual sequential memory is associated with mathematics achievement, it is much more closely correlated with reading achievement. Thus the conclusions drawn from evaluation of achievement and of visually-dependent perceptual skills are mutually corroborative.

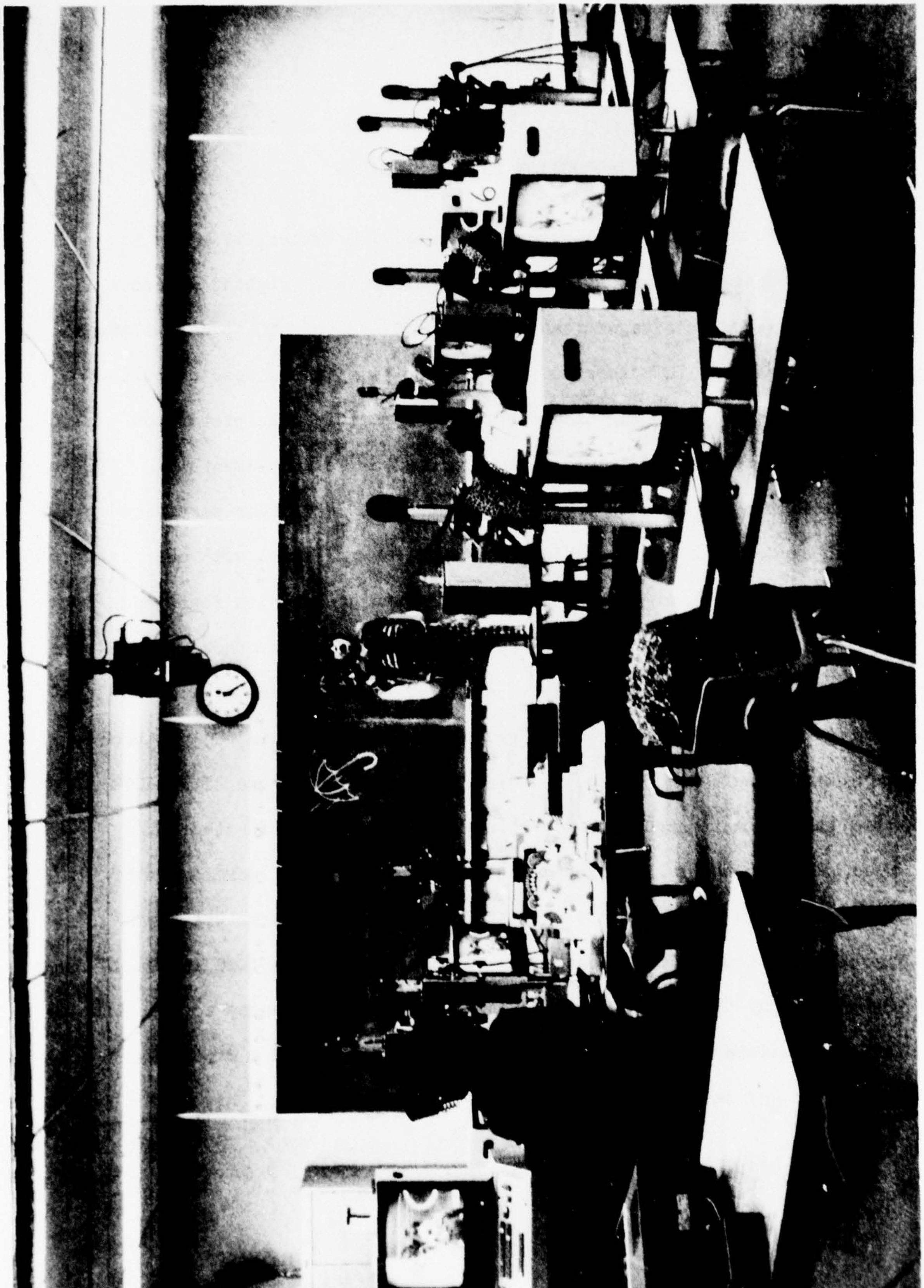
Finally, the project sought to assess the effect of the ICTS on psychosocial mediators of school success (attitudes toward academic evaluation, attitudes toward peers, and self attitudes). The first year's data indicated no overall improvement on any measures of self or social constructs. While data from the second year showed substantial positive change on some important dimensions such as self esteem and peer affiliation, attitudes related to test performance evidenced no improvement even though students' test performance had improved remarkably. We believe the failure experiences accumulated by many handicapped students tends to generate negative self and social attitudes in the academic setting which are difficult to overcome. More generally, we believe that psychosocial mediators of school success in the partially sighted is an area well worth further investigation.

In summary, the first two years of the demonstration project suggest that the ICTS has a strong and stable positive impact on the learning experiences of partially sighted elementary school students. Moreover, classroom observation data (reported elsewhere) indicate an extremely high level of on-task performance along with a sophisticated use of the ICTS as a tool, not a crutch. If the ICTS is as successful as it now appears, then we propose that the next step must be to promote the dissemination of ICTSs to other school districts. Most metropolitan areas with a population of at least 50,000 would, we believe, have a sufficient number of partially sighted children to justify the installation of such equipment. In this way, a large proportion of the severely visually impaired would be permitted to develop the capability for leading full educational, vocational, and social lives.

CHAPTER I

INTRODUCTION TO THE RESEARCH

An ICTS, or Interactive Classroom Television System, is a way of creating a visual classroom environment for partially sighted students by making use of TV's magnification, contrast and brightness capabilities. More precisely, an ICTS is a multicamera, multimonitor closed circuit TV system with videotaping and videoreplay capacity. The picture on the next page shows a 9-camera, 8-monitor system in an elementary school classroom. Such a system permits teachers and their partially sighted students to be in continuous visual communication with one another. Moreover, it allows partially sighted students to function visually in classroom situations that are closely akin to those experienced by their fully sighted peers; that is, they can read ordinary printed matter, look at pictures, write with pen or pencil, do workbook problems, consult the blackboard, draw or paint. Thus, use of an ICTS makes partially sighted students more aware of what is expected in classrooms for the fully sighted and, equally important, more aware of what they could be missing if they are placed in classrooms without appropriate visual aids. Behind the construction of the ICTS stands the philosophy that every person should have the opportunity to make the fullest possible use of residual vision in order to lead a maximally productive and satisfying life.



An 8-station ICTS

History

In 1973, The Rand Corporation was engaged in research on "Information Transfer Problems of the Partially Sighted," funded by the Rehabilitation Services Administration (RSA grant 14-P-55846/9), under the direction of Dr. Samuel M. Genensky. Early in that year Genensky sought RSA approval to construct and proof test an interactive classroom television system as part of that research project. Permission was granted by RSA, and our first ICTS was designed and constructed over the nine month period March - November 1973. That ICTS was installed in a classroom primarily for partially sighted children in the Madison Elementary School in Santa Monica, California in late November 1973. It has been in continuous operation in that setting since that fall.

Construction and operation of the ICTS had been a technical success. However, systematic study of its educational implications was not a part of the RSA-sponsored research. Consequently, in 1974 Genensky approached the Bureau of Education for the Handicapped (BEH) of the Office of Education; his goal was to ascertain whether that Bureau would be interested in supporting a research project aimed at determining how an ICTS helps in the teaching of basic skills to partially sighted elementary school children in classroom settings. BEH expressed interest in such a project, and in February 1975 a contract was signed by The Rand Corporation and by the Office of Education (Contract 300-75-0123). That contract called for the design and construction of a second generation ICTS to be installed in an elementary school classroom for partially sighted children; it also required an evaluation of the effect of that system as well as the first generation system on the learning experiences of partially sighted students. The second generation ICTS was completed in November 1975 and was immediately installed in the Killian Elementary School in Rowland Heights, California, where it has remained in continuous operation. At the termination of the project, educational evaluation data will represent approximately three academic years: 1975-1976 (although students at the first generation site had already had some ICTS experience); 1976-1977; and 1977-1978, the final year.

What is an ICTS?

As we have said, an ICTS is a multicamera, multimonitor closed circuit TV system. The system consists primarily of N stations,* a control console, a ceiling-mounted room-viewing camera, and a videotape recorder. Below is a picture of a single station that has the following features: a down-pointing TV camera equipped with a 5-to-1 zoom lens which in turn has close-up capability; a TV monitor mounted at eye level; a light source for illuminating reading and writing material; and an X-Y Platform, a moveable work surface that has margin stops in the x- or left-right direction and friction control in the y- or line-to-line direction. The X-Y Platform supports reading and writing materials below the down-pointing camera. In an ICTS classroom, N-1 of the stations are for use by students and the Nth station normally is for use by the teacher(s); however, it is not unusual to see the teacher's station in use by a student.

The control console for the classroom system is typically located at or near a teacher's desk. Both the first and second generation systems have control consoles which permit teachers to present on any

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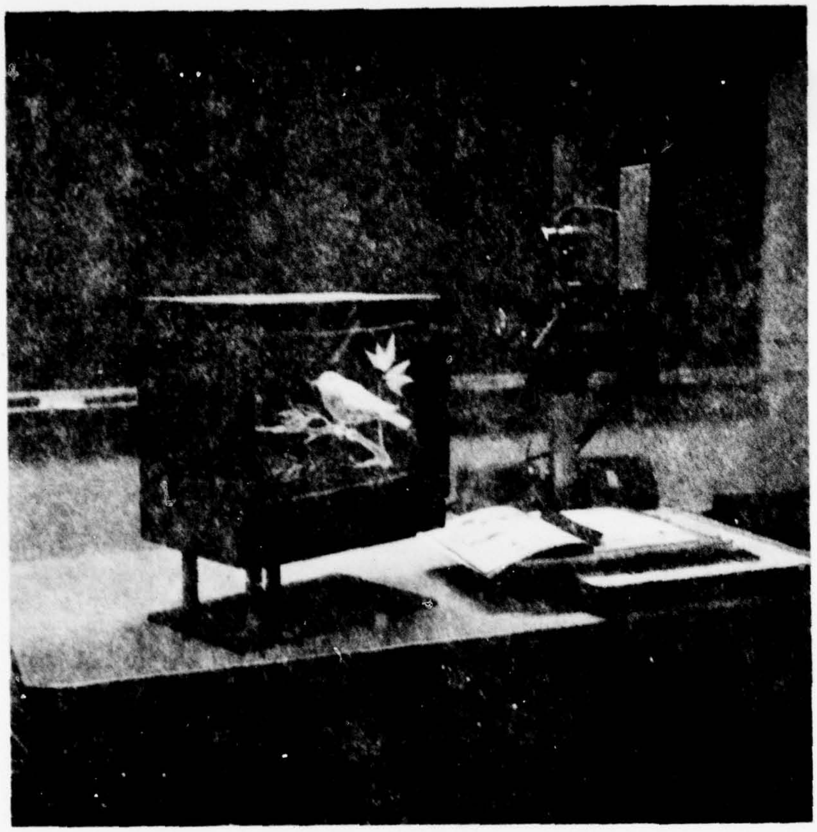
*A system could have any number of stations, depending on the anticipated number of students. Our first generation system has four stations, while the second generation system has eight.



An ICTS Student Station

one of the system's station monitors, independently of what is presented on any other monitor, (1) a full screen image of the output from any one of the system's cameras or from its videotape recorder; (2) a horizontally split image of the output from any two of these sources; or (3) a full screen superposition of the output from any two of these sources. With these system capabilities, for instance, partially sighted students can each work individually on their own materials or all read what the teacher is displaying from her desk; they can write solutions to arithemtic problems displayed on the board without having to recopy the problems themselves; and they can fill in the blanks on a superposed workbook page. In addition, the newer control console also permits the teachers to (4) present the same simple or composite image on all station monitors at one time via a special set of simple commands, or (5) allow each station's monitor to display a full screen image of the output from its own station camera via another set of simple commands.

The system's room-viewing camera is mounted on the ceiling of the classroom and is run remotely. It can pan and tilt, and hence can bring virtually any part of the classroom within the view of its 10-to-1 zoom lens. This enables students to look, for example, at the clock, at the calendar, at the blackboard, or at their teachers and classmates. Like all other cameras of an ICTS, the room-viewing camera can present both positive and negative images of what it sees.

Last, the videotape recorder permits teachers to record information displayed on any of the system's station monitors, and to record lessons prepared by one or more teachers with the help of one or more of the system's N+1 cameras. These materials can then be shown to one or more students, or can be shown and reviewed by one or more of the teachers. Moreover, the videotape recorder can record off the air programs in black and white or in color; these videotaped programs can then be shown on a black and white or color TV receiver in the classroom that, in turn, can be viewed by one or several students at one time. The number of students who can do this at one time depends upon the level of vision of the participating students. A more detailed description of the first and second generation ICTS is available in two reports published by The Rand Corporation (Genensky, S. M., et al, 1974,[7] Genensky, S. M., et al, 1977).[8]

Participating Students

All students eligible to participate in the ICTS project are partially sighted. For definitional purposes, this means that the visual acuity in their better eye, even with the help of ordinary corrective lenses, does not exceed 20/70* but is better than light perception or light projection.** Participating students also must have IQs that lie roughly between 65 and 130 and, although they may be multiple handicapped, their nonvisual handicapping conditions must not seriously interfere with their successful use of the equipment at their ICTS stations. When students in the schools housing ICTS classrooms meet these criteria, and if their parents

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*A person with visual acuity in the better eye that does not exceed 20/70 even with ordinary corrective lenses is unable to read newspaper column type with or without such lenses.

**Persons are said to have only "light perception" if, even with the help of ordinary corrective lenses, the vision in the better eye is such that they can only detect a light intensity when looking in a particular direction.

Persons are said to have only "light projection" if, even with the help of ordinary corrective lenses, the vision in the better eye is such that they can visually detect very bright areas in a scene (especially those that are sources of illumination), and if they can also detect opaque objects that cut off from his field of view all or part of the light from these bright areas in the scene.

and their teachers as well as members of the Rand project staff agree that they will benefit from an opportunity to participate, they are admitted as subjects in the BEH study.

Classroom Settings

The two ICTS classroom sites differ quite markedly with respect to physical setting, student population, and organization. The Madison site (housing the first generation system) consists of an 18-by-32 foot room with four ICTS stations, including the teacher's station. The equipment occupies approximately 50 percent of the room; the rest of the room contains student centers, with storage shelves along the perimeter and a carpeted open area in the center.

For the first two years of the study (1975-1976 and 1976-1977), subjects at the Madison site numbered five and three, respectively; in spring 1976, one subject matriculated and another moved away from the school district. The age of the subjects ranges from six to eleven years, and the nominal grade level distribution represented includes first, third, fourth, fifth, and sixth. In addition to ICTS subjects, the classroom regularly serves one to three other handicapped students as well. Moreover, at any given time the population of the classroom varies considerably because students from an adjoining resource room make use of the visual handicap classroom during part of the day.

There is one regular teacher in the classroom. She has participated in the ICTS study since its beginning. In addition, there is one regular aide, a mobility instructor for the functionally blind who makes daily visits, and a physical education instructor who visits the classroom weekly. Finally, several adult tutors give varying amounts of time to the class during the school year. Overall, the average adult-student ratio is about one to three.

This ICTS classroom is open from 8:45 to 11:30 for basic skill instruction. At 11:30 the students break for lunch, after which the partially sighted students attend regular classrooms appropriate to their grade level for such activities as music and art.

The Killian site (where the second generation system is located) involves a 32 by 64 foot room with eight stations, including the teacher's. Although the classroom is much larger, the equipment occupies about 50 percent of the available space as it does at the Madison site. The Killian classroom is fully carpeted, with the nonICTS area being used for student centers and storage shelves.

During the first year of the pr 'ect, eight students participated in the ICTS study. During the second year this number grew to eleven, with six returning subjects and five new ones. The age of the subjects ranges from five to twelve years, and nominal grade levels range from prekindergarten to fifth. As in the Madison classroom, this site also typically serves nonICTS students and accommodates an occasional student from an adjoining resource room.

Two regular teachers have been with this ICTS classroom since its inception. There are two regular aides and several student aides from the nearby junior and senior high schools as well. In addition, a mobility instructor and a speech therapist come to the classroom several times a week. The mean adult-student ratio is approximately one to two.

The Killian classroom is self contained, providing not only basic skills instruction but also a full range of learning experiences including physical education, art, and music. Subjects in the ICTS classroom do not, therefore, interact with normally sighted students during the regular class day. The classroom opens at 8:30, and students leave the room at staggered times. Prekindergarten and kindergarten students leave at noon, while grades 1 to 3 leave at 1:30 and grades 4 to 6 leave at 2:30.

This Paper

This paper describes the activities undertaken to evaluate the educational impact of an ICTS on partially sighted students. Chapter II begins with a discussion of the evaluation design for the project, the kinds of assessments employed, and the data collection schedule. It then presents the results for the first project year (1975-1976) in each of the three major outcome areas investigated. Chapter III, building on Chapter II, describes changes introduced into the evaluation procedures and focuses attention on classes of effect deemed to be of special interest given the results already obtained. It then examines outcomes for the second project year (1976-1977). Taken together, the first two project years suggest that the ICTS has a strong and apparently stable positive impact on the learning experiences of partially sighted elementary school students. The Postscript discusses dissemination possibilities for the ICTS after the final year of the demonstration.

CHAPTER II

The fundamental goal of the Interactive Classroom Television Systems project is to improve the educational experiences of partially sighted elementary school students. This goal has been implemented in two widely differing classroom sites: The first generation system is housed in a visually handicapped classroom serving a maximum of six students; the second generation system resides in a self-contained classroom for the visually handicapped and serves a maximum of 14 students. Because the project is multifaceted, assessing the extent to which its objectives are being met requires collection of varied sorts of data tapping distinct areas of effect. Where it is feasible, the data are treated statistically to determine significance of outcomes. Where such treatment is not feasible, project data nevertheless constitute rigorous documentation of procedures and results appraisable on a case study basis. Both sorts of information are regarded as useful contributions to evaluation where the purpose of evaluation is assumed to be the systematic reduction of uncertainty about program effects.

For convenience, program outcomes for students are conceptualized in terms of four areas. Of primary importance is the impact of the ICTS on academic achievement in basic elementary school skills. Basic skills, for the purpose of this evaluation, have been restricted to verbal and quantitative proficiency as measured by standardized achievement tests. A second area of concern is the relationship of the ICTS to visually dependent perceptual-motor processes such as visual-motor integration and visual memory. For the partially sighted student making use of residual vision by means of an ICTS, these processes are important mediators of information encoding and decoding and thus could have a substantial influence on learning. Next, the project is involved in examining what effect the ICTS has, if any, on self and social attitudes (for instance, self esteem and school affiliation) thought to be significant in students' school experiences. The final assessment domain, classroom behavior, seeks to determine the extent and organization of task-relevant activity when students make use of the ICTS. Task behavior is evaluated observationally. Because the classroom observation effort has been reported elsewhere (T. H. Bikson, 1977),[2] it will not be discussed here. Rather, this discussion treats only the first three evaluation areas. Following a summary of the overall research design, outcomes from the first project year in these three areas are presented. (Second year outcomes are presented in Chapter III.)

Evaluation Design

The overall evaluation design for the present project is properly regarded as a "one-group pretest post test design" (Campbell and Stanley, 1963)[4]. Such a design, as it represents the current assessment activities, can be systematized as follows (where X stands for the treatment, O stands for observations, and subscripts represent occasions of observation).

$$O_{pre} \,/\!\!-\!\!-\!\!-\!\!-\!\!-\!\!-\; X \;-\!\!-\!\!-\!\!-\!\!-\!\!-\; O_{post}$$

$$O_1 \quad O_2 \quad O_3 \quad O_4 \quad O_5 \quad O_6 \quad O_7 \quad O_8 \quad O_9$$

The schema indicates that pre- and post-measures are obtained, supplemented by other observations collected repeatedly throughout the school year when the ICTS is in operation. While this evaluation design has many features of "quasi-experimental" methods, such as time-series experiments and recurrent institutional cycle designs (Campbell and Stanley, 1963),[4] it is probably best classified as "pre-experimental." Because the use of a pre-experimental design raises serious methodological issues, these issues have been examined in some detail.

What renders the design pre-experimental rather than experimental is that it is a one-group study; an experimental version of the same study would employ two groups, the treatment group and a nontreatment comparison group. The description of the subject population for the proposed study, however, should indicate why the use of a comparison group design is not feasible. Briefly, comparison subjects could not be selected randomly but would have to be chosen by matching along numerous dimensions (chronological age, IQ, visual acuity, other handicaps, and verbal and quantitative achievement levels) which do not naturally covary. If appropriately matching subjects could be located, their very uniqueness would render their usefulness as comparison subjects questionable. Further, use of such subjects would not provide a no-treatment comparison population. Rather, these subjects would be drawn from the special education programs of various other schools; thus they would be recipients of unspecified and diverse treatments involving different teachers, different curricular contents, and different time-management plans. Consequently, any outcome comparisons between ICTS students and the matching group would be problematic to interpret. Finally, establishment of such a comparison group would still not provide a large experimental sample from which to obtain statistically generalizable results (maximum n = 40). A comparison group, then, would not contribute substantial information to the evaluation of the proposed project; it would make that evaluation experimental in name only.

Having looked at the reasons for choosing a one-group design, we then considered and weighed the potential threats to validity it involves. As Campbell and Stanley (1963)[4] have noted, there are two classes of threats to validity given a one-group as opposed to a two-group design: history-maturation confounds, and testing-instrumentation confounds. The project minimizes threats to internal validity by excluding sources of academic innovation in classroom sites other than the ICTS itself, and by attempting to insure that the history of the ICTS classroom is in no other respects atypic. On the other hand, visual impairment of subjects is regarded as posing a natural impediment to academic skills maturation, so that maturation is not a plausible rival hypothesis for explaining gains made with the ICTS in the present study. Both test reactivity and instrument decay, we think, are even less likely sources of systematic variation in outcomes given students' extensive preproject experience with test taking and our own efforts to hold circumstances of administration constant across occasions of testing.

Finally, while regression artifacts often threaten internal validity for either a one- or a two-group design in a field intervention, they do not arise as an alternative explanation here for two reasons. First, the study does not rely on mean scores for subjects as a group, since they are performing at quite different age and ability levels. Second, individual scores cannot be compared with appropriate population means, since the latter have not been determined. It is expected that subjects' achievement scores will change in the direction of grade norms. Such changes cannot, however, be interpreted as statistical regression toward a true population mean since initial depressed scores do not represent the extreme ends of a sampled normal distribution (therefore involving a greater proportion of sampling error) but rather the typical performance of a population of nonnormal subjects. Thus evaluation of subjects will focus on within-subject changes from one occasion of observation to the next, with consistent changes in the direction of grade-normal performance throughout the intervention being interpretable as performance gains rather than statistical artifacts.

With the general evaluation design so understood, data collection efforts reflect the schedule presented below.

O_{pre}	O_{post}
Fall 1975	Spring 1976
I_a (n = 5)	I_b (n = 5)
II_a (n = 8)	II_b (n = 8)
	1975-1976: n = 13
Fall 1976	Spring 1977
I_{a*} (n = 0)	I_c (n = 13); I_{b*} (n = 0)
II_{a*} (n = 5)	II_c (n = 6); II_{b*} (n = 5)
	1976-1977: n = 14
Fall 1977	Spring 1978
I_{a**} (n = 1)	I_d (n = 2); I_{c*} (n = 0); I_{b**} (n = 1)
II_{a**} (n = 2)	II_d (n = 5); II_{c*} (n - 4); II_{b**} (n = 2)
	1977-1978: n = 14

In this schedule, the Roman numerals I and II represent first- and second-generation sites; alphabetic subscripts indicate pre- and post-testing (a and b), with post test repetitions on a longitudinal basis (c and d); asterisks show entry of new subjects into the study, in some cases replacing students who exited from the demonstration class. There are some subjects for whom three years of evaluation data will be available, and others who participated in the project for only one or two years. The data presented below represent the first and second years of the demonstration, academic years 1975-1976 and 1976-1977. Because the measures are treated on a within-subject and within-year basis, scores from newly entering subjects are combined with those of continuing subjects for the second year analysis and discussion.

Academic Achievement

As we noted above, the first evaluation objective is to assess the effect of the ICTS on academic achievement in basic skill areas (verbal and quantitative achievement). For this purpose, standardized achievement tests are administered to all subjects on a pre-post basis. Subjects who are performing at the first grade level or above receive the Comprehensive Test of Basic Skills (CTBS) reading and mathematics subtests (from National Testing Service; v. reviews in Buros, 1972).[3] For students performing at preacademic levels, a subset of the CIRCUS battery (CIRCUS 1, 2, 5, 8) is administered (from Educational Testing Service; v. review in Proceedings of the American Psychological Association, 1973).[7]

Scores from the 1975-1976 administration of the CTBS are presented in Table 1 below, which is organized along the following lines. Subject numbers are given first, along with information about the subject's chronological age and "normal" grade at post test time (May 1976). While visually impaired students are not expected to perform at the level indicated by the norms derived from regularly sighted students, these figures provide a basis for interpreting obtained scores and estimating school year progress. Data for reading and mathematics are then given, in this order: the post test score is represented in terms of its grade equivalent and is followed by a number in parentheses representing the difference between the obtained score and the grade normal score for the subject; next the pretest score is given, in grade equivalent terms; and finally, the pre-to-post test change is displayed in terms of gains or losses in grade equivalents. The last column subtracts the mathematics score from the reading score, to establish whether subjects tend to achieve at systematically higher or lower levels in either skill area (a minus indicates superior performance in mathematics, while a plus shows relative superiority in reading).

The five subjects in the 100 series are Madison subjects, while subjects in the 200 series are Killian students. It should be noted that the pretest score for subject 205 is theoretical. This student bottomed out on the CTBS in the fall, but needed a first grade level test in the spring. Consequently, for data analysis purposes he was awarded a pretest score of 1.0, interpreted as very beginning first grade. The total number of subjects for whom CTBS data are available, then, is eight. Unless otherwise specified, statistical treatments are non-parametric and rely only on ordinal properties of the data.

Examining the pre-to-post changes was our primary interest. For this purpose, we employed a Wilcoxen matched-pairs signed-ranks test. In both reading ($T = 4.5$, $\underline{p} < .05$) and mathematics ($T = 3$, $\underline{p} < .025$), students' scores showed significant gains. Looking at post test scores, it is our view that by the end of the first year, students were performing acceptably near grade normal on the whole. There is a tendency for Site I subjects to be closer to grade normal at post test time in both skill areas, although the between-group difference does not reach statistical significance as assessed by a Mann-Whitney U test. This result is not surprising in view of the fact that the Madison classroom

TABLE 1

				CTBS READING			CTBS MATHEMATICS			POST TEST
		Age 5/76	Normal Grade	Post test score (distance from grade normal)	Pre test score	Pre-Post change	Post test score (distance from grade normal)	Pre test score	Pre-Post change	READING - MATHEMATICS
MADISON	101	11-7	6.9	5.4 (-1.5)	4.6	+.8	4.9 (-2.0)	5.2	-0.3	+.5
	102	11-3	5.9	1.8 (-4.4)	1.5	+.3	3.7 (-2.2)	2.9	+0.8	-1.1
	103	9-2	3.9	3.3 (-0.6)	3.6	-.3	4.0 (+0.1)	3.8	+0.2	-.7
	104	9-10	4.9	5.2 (+0.3)	5.8	-.6	5.9 (+1.0)	4.4	+1.5	-.7
	105	6-8	1.9	1.5 (-0.4)	0.6	+.9	2.1 (+0.2)	0.5	+1.6	-.6
KILLIAN	201	8-6	3.9	3.0 (-0.9)	2.3	+.7	2.5 (-1.4)	2.5	±0	+.5
	203	12-4	6.9	3.1 (-3.8)	2.3	+.8	3.3 (-3.6)	3.2	+0.1	-.2
	205	6-7	1.9	1.8 (-0.1)	1.0*	+.8	2.7 (+0.8)	1.0*	+1.7	-.9
	210	11-9	6.9	2.3 (-4.6)	2.3	±0	3.6 (-3.3)	1.6	+2.0	-1.3

*Theoretical beginning first grade score;
this student bottomed out on the Fall CTBS.

had had the ICTS a year longer than the Killian classroom. (As we shall see later, reading and mathematics achievement are both highly correlated with visually dependent skills; and the latter should be enhanced by ICTS use.) There is a similar tendency for students nominally in grades four through six to be farther from grade normal than students in grades one through three ($U = 4$, $p < .10$). This result reflects the cumulative aspect of educational deficits and suggests that it is important for partially sighted students to have access to an ICTS early in their school experience. Finally, the last column in Table 1 shows the relationship between reading and mathematics scores. This relationship was examined by means of a Wilcoxen T test, which indicated that ICTS students are significantly closer to grade normal in mathematics than in reading ($t = 5$, $p < .05$). We found this relationship to hold true of pretest scores as well despite the high correlation between mathematics and reading achievement. We believe that the relative superiority of these subjects in mathematics is accounted for by the fact that performing computations requires less scanning than does reading.

Information from the fall and spring administration of the CIRCUS battery to younger subjects in the Killian classroom is presented in detail in Tables 2A and 2B and summarized in Table 2. The CIRCUS battery chosen for evaluating preacademic levels of basic skills in students (the kindergarten and prekindergarten level) includes two "verbal" or pre-reading tests (CIRCUS 1 and 8) and two "quantitative" or pre-mathematical tests (CIRCUS 2 and 5). Table 2 gives total pre and post test scores for each subject in both skill areas, along with the pre-to-post change. Wilcoxen matched-pairs signed ranks tests indicated that subjects improved significantly on both verbal ($T = 0$, $p < .005$) and

TABLE 2

KILLIAN SUBJECTS
SUMMARY OF CIRCUS ACHIEVEMENT TEST SCORES

	TOTAL VERBAL			TOTAL QUANTITATIVE		
	Post Test	Pre Test	Pre-Post Change	Post Test	Pre Test	Pre-Post Change
204	14	12	+2	8	10	- 2
	15	12	+3	22	13	+ 9
206	28	19	+9	12	4	+ 8
	22	15	+7	28	22	+ 6
207	18	16	+2	18	18	±0
	20	16	+4	36	23	+13
208	23	18	+5	12	9	+ 3
	14	9	+5	28	20	+ 8

quantitative ($T = 2$, $p < .01$) assessments. No comparison can be drawn between outcomes in the two basic skill areas, however, since scores do not map on to a common grade equivalent scale (all these tests being normed below first grade level).

Because there is such a small number of subjects at the preacademic level in the Killian classroom, and because their achievement cannot be compared either with grade norms or with the performance of other subjects (since all Madison subjects are older), we have chosen to present a detailed descriptive account of their test performance rather than attempt any statistical analyses. Table 2A breaks down the two verbal achievement tests into their components in the following fashion. After the subject identification number, chronological age and grade placement, information is tabled in exactly the same manner for CIRCUS 1 (What Words Mean) and CIRCUS 8 (How Words Work). Initially, the total pretest score is given, followed by the percentile rank of that score in relation to national kindergarten percentile norms.* The next two columns give the total post test score and its percentile rank. Succeeding columns then present, for each of the three subparts of the test, the pretest score and post test score and their respective percentile ranks. The latter sort of information allows determination of precisely the areas in which students' verbal achievement is strong or weak. Finally, an interpretation of the configuration of obtained scores is derived from the test manual and reproduced below the student's outcome array. The comment above the dotted line refers to the pretest configuration, while the comment below the line describes the post test display.

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*Percentile rank indicates the percent of kindergarteners in the national sample who scored below the range in which the subject's obtained score fell.

TABLE 2A KILLIAN SUBJECTS: PRE/POST CIRCUS SCORE COMPARISONS: VERBAL ACHIEVEMENT TESTS

CIRCUS 1: What Words Mean

Subject	Age	Normal Grade	Total-pre	%-pre	Total-post	%-post	Nouns-pre	%-pre	Nouns-post	%-post	Verbs-pre	%-pre	Verbs-post	%-post	Modifiers-pre	%-pre	Modifiers-post	%-post
204	6	K	12	0	14	2	6	35	8	35	3	38	4	38	3	32	2	32
206	5	K	19	2	28	20	10	35	13	35	6	38	10	62	3	32	5	32
207	4	pk	16	0	18	2	12	35	8	35	2	38	5	38	2	32	5	32
208	5	K	18	2	23	11	12	35	7	35	2	38	8	38	2	32	8	68

CIRCUS 8: How Words Work

Subject	Total-pre	%-pre	Total-post	%-post	Verb Forms	%-pre	Verb Forms	%-post	Operators	%-pre	Operators	%-post	Syntax	%-pre	Syntax	%-post
204	12	0	15	1	3	32	3	32	4	35	5	35	5	28	7	72
206	15	1	22	39	5	32	8	68	7	65	8	65	3	28	6	28
207	16	9	20	16	6	32	5	32	6	35	8	65	4	28	7	72
208	9	0	14	1	2	32	5	32	2	35	5	35	5	28	4	28

SENTENCE REPORTS (pre / post)

Subject		CIRCUS 1: What Words Mean	CIRCUS 8: How Words Work
204	pre	Appears to lack confidence in receptive vocabulary skills; needs instruction and practice.	Appears to lack competence in receptive functional language, or had difficulty with test tasks; needs instruction and practice.
204	post	-same-	Responded correctly to most items involving discrimination between sentences with different structures; needs further instruction and practice in discrimination between verb forms and prep./neg./conj.
206	pre	Responded correctly to a number of the receptive vocabulary items, but needs more instruction and practice.	Responded correctly to most items involving prep./neg./conj.; needs more work with syntax and verb forms.
206	post	Generally competent in receptive vocabulary skills; needs additional help with nouns.	Generally competent in discrimination between verb forms and prep./neg./conj.; but had difficulty discriminating between sentences with different structures.
207	pre	Same as 206 pre test comment	Needs further instruction and practice in all aspects of receptive functional language assessed by CIRCUS 8.
207	post	Same as 206 post test comment	Responded correctly to most items involving prep/neg/conj. & those involving sentences with different structures; had difficulty discriminating between verb forms.
208	pre	Same as 206 pre test comment	Appears to lack competence in receptive functional language, or had difficulty coping with test tasks; needs further inst./practice.
208	post	Same as 206 post test comment	Same as 207 pre test comment

TABLE 2B KILLIAN SUBJECTS: PRE/POST CIRCUS SCORE COMPARISONS: QUANTITATIVE ACHIEVEMENT TESTS

Subject	Age	Normal Grade	CIRCUS 5: LETTERS AND NUMBERS																CIRCUS 2: HOW MUCH AND HOW MANY																SENTENCE REPORTS
			Total-pre	%-pre	Total-post	%-post	Capitals	%-pre	Capitals	%-post	Lower case	%-pre	Lower case	%-post	Numbers	%-pre	Numbers	%-post	Total-pre	%-pre	Total-post	%-post	Counting	%-pre	Counting	%-post	Relations	%-pre	Relations	%-post	Numbered concepts	%-pre	Numbered Concepts	%-post	
204	6	K	10	19	8	1	4	39	4	39	4	67	1	33	2	30	3	70	13	0	22	10	5	34	11	66	3	29	3	29	5	89	8	89	
			Generally competent in recognizing lower case letters, but needs additional help with capital letters and numbers.																Appears to lack quantitative competence or had difficulty coping with test tasks; needs further instruction.																pre
			Appears to lack competence in recognizing letters and numbers. Needs further instruction and practice.																Generally competent quantitative skills and understanding, needs additional help with relational terms.																post
206	5	K	4	1	12	19	2	34	7	61	1	33	3	33	1	30	2	30	22	10	28	29	5	34	8	34	9	29	11	29	8	89	9	89	
			Appears to lack competence in recognizing letters and numbers; needs further instruction and practice.																Needs further instruction and practice with quantitative concepts.																
			Generally competent in recognizing capital letters, but may need additional help with lower case letters and numbers.																Responded correctly to many of the quantitative items, but needs additional help with counting and relational terms.																
207	4	pk	18	58	18	58	8	61	9	61	5	67	5	67	5	70	4	70	23	10	36	61	6	34	12	66	8	29	12	71	9	89	12	89	
			Generally competent in recognizing letters and numbers.																Same as post-test statement of 206																
			Same as 207 pre-test comment																Generally competent in quantitative skills and uunderstanding. Subject may be approaching operations level of development.																
208	5	K	9	1	12	19	4	34	5	61	1	33	4	67	4	70	3	70	20	3	28	29	5	34	8	34	7	29	12	71	8	89	8	89	
			Same as 206 pre-test comment.																Same as 206 pre-test comment.																
			Generally competent in recognizing letters and numbers, but needs additional help with capital letters.																Responded correctly to many of the quantitative items, but needs additional help with counting.																

Table 2B breaks down the remaining two achievement tests, CIRCUS 5 (Letters and Numbers) and CIRCUS 2 (How Much and How Many), in exactly the same way. That is, absolute scores and percentiles based on national kindergarten norms are given for the total test and its three subparts on a pre-post basis; scores are followed by interpretive comments generated for each subject on the basis of the obtained outcome pattern.

In general, the outcome breakdown as well as the comments indicate that younger subjects are improving in most aspects of verbal and quantitative performance. More importantly, the post test percentile scores (indicating the number of kindergarteners in the national norming sample who scored below the decile range in which the subject's score fell) present a rather optimistic picture. Considering all 16 post test scores for the four tests, only three fell in the bottom 10 percent; six scores fell in the second decile; five scores fell in the third decile; and two scores were in the upper 50 percent. In view of the circumstance that the percentile norms were obtained from visually unimpaired subjects of the same age, along with the fact that Killian subjects had only a half year's use of the ICTS, we find the post test performance of our pre-academic subjects very promising.

Visually Dependent Skills

A second important evaluation objective is to track subjects' progress in visually dependent skill areas, including visual-motor integration and visual memory. We have hypothesized that these phenomena are implicated in information encoding, processing, and decoding when learning activities are visually mediated. Consequently, these phenomena should be closely related to academic achievement, especially for partially sighted students using the ICTS. In assessing visually dependent skills, three measures have been employed. The Developmental Test of Visual Motor Integration (VMI, Follett Educational Corporation, reviewed in Buros, 1972)[3] was given on a pre-post basis to all subjects (n = 13). One of two visual memory tests was also administered. Madison subjects and younger Killian subjects took See and Remember (CIRCUS 12, a visual recognition memory test) on a pre-post basis (n = 10). In addition, for comparison purposes, all subjects at the Killian site were given the Illinois Test of Psycholinguistic Abilities (ITPA, reviewed in Buros, 1972)[3] visual sequential memory subtest in the fall (n = 8). Because the ITPA seemed to tap aspects of memory not required in CIRCUS 12 and because it spanned a broader grade range, we decided to administer it to all subjects at both sites at post test time (n = 13). Results of evaluations of visually dependent skills appear in *Table 3.*

The first three columns of Table 3 present information regarding VMI scores, represented as age equivalents in months. Post test scores appear first followed by pretest scores, the third column indicating the pre-to-post test gain or loss. Investigating the relationship between fall and spring scores by means of a Wilcoxen matched-pairs signed ranks test established that a substantial improvement in visual motor integration had occurred ($T = 6$, $p < .005$) among subjects in both sites. Although subjects in the two sites did not differ with respect to amount of improvement over the academic year, Madison subjects' outcomes were significantly higher than outcomes for Killian subjects as determined by a Mann-Whitney U test ($U = 10$, $p < .085$). Because this post test difference cannot be attributed to age (both the youngest and the oldest subjects are in the Killian classroom, so that age is not a variable which statistically discriminates sites), we think it should be attributed to more extensive ICTS experience.

TABLE 3

VISUALLY DEPENDENT SKILLS

	VISUAL MOTOR INTEGRATION			ITPA**			CIRCUS 12*** (See & Remember)			POST TEST COMPARISONS			
	Post Test	Pre Test	Change	Post Test	Pre Test	Change	Post Test	Pre Test	Change	Months (CA) 5/76	CA-VMI	CA-ITPA	VMI-I&PA
101	104	86	+18	64			19	19	±0	139	-35	-75	+40
102	82	82	± 0	67			16	18	-2	135	-53	-68	+15
103	94	77	+17	125*			20	20	±0	110	-16	+15	-31
104	131	94	+37	125*			20	19	+1	118	+13	+ 7	+ 6
105	67	60	+ 7	82			19	19	±0	80	-13	+ 2	-15
201	82	70	+12	78	100	-22				102	-20	-24	+ 4
203	114	66	+48	78	94	-16				148	-34	-70	+36
204	49	57	- 8	67	52	+15	10	12	-2	82	-33	-15	-18
205	88	77	+11	74	74	± 0	17	17	±0	79	+ 9	- 5	+14
206	57	54	+ 3	125*	58	+67	13	15	-2	73	-16	+52	+68
207	63	52	+11	67	74	- 7	15	11	+4	65	- 2	+ 2	- 4
208	57	52	+ 5	58	37	+21	13	11	+2	68	-11	-10	- 1
210	94	88	+ 6	70	67	+ 3				141	-47	-71	+24

*Ceiling Scores

**ITPA was not administered to Madison subjects in Fall 1976.

***Circus was administered to Madison subjects and only to younger Killian students who took the Circus achievement battery.

Visual memory assessments are represented by the two middle sections of Table 3. First are ITPA scores, again given in age equivalents. While overall change data are not available, scores from the Killian site (n = 8) were examined on a pre-post basis using the Wilcoxen T test. This analysis did not indicate a statistically significant improvement in visual sequential memory during the school year as measured by the ITPA. Nor did a Mann-Whitney U test establish any between-site differences in visual memory outcomes, despite the Madison subjects' greater previous practice in visual information processing. The ITPA had been introduced into the evaluation because it appeared to tap more complex and sequential aspects of visual memory than CIRCUS 12 and because it had a broader age range. However, we were concerned about three features of the ITPA: (1) it does not involve association of verbal labels with visual stimuli; (2) it employs only abstract geometric shapes as items; and (3) it requires reproduction rather than simple recognition of the correct sequence. While these features render the test valuable for many experimental purposes, we were dubious about the extent to which they represent and measure the kinds of visual information processes required for effective ICTS use to enhance reading achievement. After discussing the CIRCUS 12 data, we will treat these questions in more detail as we examine the relationships among all the visual skill measures.

CIRCUS 12, See and Remember, is the visual memory test originally chosen for the evaluation. Table 3 presents post test, pretest, and change scores on this measure for 10 subjects. (Range of possible scores is 0 to 20; no age or grade equivalent scales are available for this test.)

Here change data also fail to yield statistically significant results, presumably because so many subjects are near or at ceiling. Post test scores on CIRCUS 12 do differentiate sites with Madison subjects exhibiting superior performance as indicated by a Mann-Whitney U test ($U = 1$, $p < .008$). This difference is, however, partially a function of age since the oldest Killian subjects were ineligible for CIRCUS 12. Interestingly, CIRCUS 12 visual memory scores correlated more closely with visual motor integration (rho = .92, $p < .01$) than with ITPA visual memory scores (rho = .48, $p \approx .10$).

The last section of Table 3 contains the following information. It gives each subject's chronological age (CA) in months at the time of post testing. The succeeding two columns, respectively, show the relationship between CA and VMI scores and between CA and ITPA scores. In each case, the age equivalent test score is subtracted from the chronological age; thus negative numbers indicate subjects are performing below the level represented by the chronological age while positive numbers indicate they are performing above age level. Finally, the last column subtracts ITPA scores from VMI scores to determine whether (as we had hypothesized) the ITPA is more difficult; here positive numbers indicate superior performance on the VMI.

First, we examined the relationship between CA and VMI scores using a Wilcoxen T test. This analysis established that ICTS subjects in both sites are performing below the level of their normally sighted age mates ($T = 6$, $p < .005$); the CA-VMI column yields only two positive scores. The same analysis establishes a similar but weaker relationship between CA and ITPA scores. That is, ITPA scores also tend to fall below age normal ($T = 21.5$, $p < .10$); but while the range of negative deviation is greater, the number of positive scores is also greater in the CA-ITPA column. The last column was similarly examined by means of a Wilcoxen T test. The results were nonsignificant ($T = 41$), suggesting that there is not a directional bias in the relationship between ITPA and VMI scores; that is, subjects' performance on the ITPA does not seem to be either systematically inferior or systematically superior to their VMI performance. We are thus obliged to reject the hypothesis that the ITPA is more difficult.

Finally, we undertook to investigate the association between these visually dependent skills and reading and mathematics achievement. For this purpose, we employed the following sorts of derived measures. To control for age differences, each subject's basic skill achievement at post test time was represented by the distance between the CTBS reading and mathematics scores and the grade normal score (v. Table 1); similarly, each subject's visual skills were represented by the distance between the VMI and ITPA scores and the age normal score (v. Table 3). A Spearman rank correlation ($n = 8$) established an extremely strong association between CTBS achievement and visual motor integration (rho = .99, $p < .01$). A similar but less strong correlation linked achievement with ITPA visual memory scores (rho = .83, $p < .05$). Because so few subjects took both CIRCUS 12 and CTBS, we were unable to test their association; however, the high correlation between CIRCUS 12 and VMI suggests that, if the latter is strongly related to achievement, so must the former be also. We conclude, then, that visual motor integration and visual memory are skills which, for partially sighted students, are importantly related to achievement and can be enhanced through ICTS use. It further seems to us that, although CIRCUS 12 and ITPA measure different aspects of visual memory, they both tap achievement-related features of visual information processing.

Self and Social Attitudes

Attitudinal information comprises the last major assessment area to be discussed in this chapter. We have assumed that while visual information processing skills are involved in achievement, academic progress is also mediated by psychosocial variables. We will treat below data representing factors affecting test performance and other relevant self and social attitudes.

It is well established in education research literature that the test-taking experience often contributes importantly to test scores. We had hypothesized that, for the subjects of the present study, test-taking has been frequently associated with failure and anxiety; such associations, however, can contribute negatively to test outcomes. We further conjectured that, if the ICTS enhances learning experiences, it could lead to changed expectations and changed test-taking attitudes and, subsequently, to better test performance. For this reason, we chose to administer on a pre-post basis the Inventory of Factors Affecting Test Performance (FATP). Ratings of behavior during achievement test-taking were collected from classroom teachers using a set of 14 three-point examiner rating scales adapted from the Stanford Binet Form L-M. Scores on the inventory may range from 14 to 42, with higher scores indicating more desirable behaviors in the achievement test situation. Table 4 presents total post test, pretest, and change scores for all subjects in columns one through three. The last three columns single out for attention the combined scores on items 9 and 10 from the inventory.

TABLE 4

FACTORS AFFECTING TEST PERFORMANCE

	TOTAL			ITEMS 9 & 10		
	Post Test	Pre Test	Change	Post Test	Pre Test	Change
101	36	36	±0	5	3	+2
102	27	26	+1	4	2	+2
103	26	25	+1	3	2	+1
104	32	33	-1	4	2	+2
105	32	27	+5	2	2	±0
201	31	31	±0	2	4	-2
203	26	23	+3	2	2	±0
204	16	25	-9	2	3	-1
205	27	31	-4	2	4	-2
206	23	26	-3	2	2	±0
207	28	32	-4	2	3	-1
208	32	25	+7	4	3	+1
210	26	28	-2	2	3	-1

A preliminary investigation of pretest data had provided only a weak positive correlation between fall achievement test scores and FATP ratings. Looking more closely at the rating scales, we found six items on which there was virtually no variation. This circumstance led us to believe that the common history of our subjects as visually impaired students had generated a rather invariant response to the test-taking situation that would not be easy to overcome. Among these responses, some could be viewed as positive and not needing any change (e.g., "fear of adult" and "compliance with adult" were uniformly rated in a favorable manner). Two, however, were uniformly awarded a negative rating ("sense of intellectual challenge" and "willingness to continue with test"); we therefore proposed to give special attention to outcomes on these items (9 and 10). We hoped to see some change in sense of challenge and willingness to continue, and consequently to find a changed relationship between these factors and achievement. It is not surprising, then, to find that the fall-to-spring change for the test as a whole is not statistically significant. However, substantial improvement on items 9 and 10 is evident among Madison subjects. To demonstrate this, because the range of scores was small, we recast the change data in binary form, asking simply whether the subject improved (received a positive change score) or not (received either a 0 or a negative score). A Fischer's exact test then established that Madison subjects, in contrast with Killian subjects, showed significant positive change ($p = .03$). It is presumably this difference on items 9 and 10 which acounts for the fact that, by post test time, Madison subjects are receiving total inventory scores systematically higher than scores received by Killian subjects

(Mann-Whitney $U = 9.5$, $p < .085$) despite the absence of between-group differences in the fall. Finally, at post testing a stronger positive correlation had been established between actual achievement as measured by the CTBS and factors affecting test performance ($rho = .43$, $p \cong .10$).

Self and social attitudes were assessed by means of two instruments, the Self Social Constructs Test (SSCT) and the Self Observation Scales (SOS). The Self Social Constructs Test (v. review in Walker, 1973)[12] is a nonverbal instrument which employs spatial symbols and their arrangement to represent self and social schemata. For the purpose of this evaluation, we sought to assess six constructs via such schemata: self esteem, social distance from significant others, scope of peer attachment, social interest, perceived inclusion, and perceived individuation. Table 5 presents data regarding three self-social constructs. self esteem, social distance (from peers and teachers respectively); and scope of peer attachment. In each case the post test score appears, followed by the pretest score and the fall-to-spring change. Data regarding social interest, perceived inclusion and perceived individuation have been omitted. These constructs did not show significant differences either between fall and spring scores, or between sites at either time. In part, such outcomes reflect the very small range of possible scores on these constructs (0-4 and 0-2); besides restricting the space for change, the limited range produces a great number of tied ranks which vitiates the effectiveness of ordinal statistics.

With respect to self esteem, an overall examination of post test outcomes in relation to pretest scores reveals no systematic difference. However, the change scores on this construct suggest that Killian subjects

TABLE 5

SELF SOCIAL CONSTRUCTS TEST

	SELF ESTEEM			SOCIAL DISTANCE FROM STUDENTS			SOCIAL DISTANCE FROM TEACHERS			ATTACHMENT TO PEERS		
	Post Test	Pre Test	Change	Post Test	Pre Test	Change*	Post Test	Pre Test	Change*	Post Test	Pre Test	Change
101	39	38	+ 1	2	7	-5	2	2	± 0	24	24	± 0
102	24	34	-10	7	10	-3	6	3	+ 3	23	18	+ 5
103	26	27	- 1	9	7	+2	12	4	+ 8	18	21	- 3
104	29	28	+ 1	2	5	-3	2	4	+ 2	24	24	± 0
105	20	23	- 3	8	6	+2	11	10	+ 1	21	23	- 2
201	28	20	+ 8	10	4	+6	7	9	- 2	21	14	+ 7
203	39	27	+12	2	5	-3	2	8	- 6	19	5	+14
204	23	33	-10	6	2	+4	5	2	+ 3	2	13	-11
205	34	24	+10	7	2	+5	2	2	± 0	23	3	+20
206	27	37	-10	7	9	-2	6	7	- 1	7	15	- 8
207	34	32	+ 2	3	4	-1	12	2	+10	15	14	+ 1
208	22	23	- 1	2	6	-4	2	5	- 3	16	12	+ 4
210	45	29	+16	2	9	+7	12	10	+ 2	19	18	+ 1
	(range: 8-48)			(range: 2-12)			(range: 2-12)			(range: 0-24)		

*Negative changes are representative of decreased social distance (i.e., favorable change).

experienced greater positive change in self esteem than Madison subjects (Mann-Whitney U = 11, $p \cong .11$). Consequently, Killian subjects tend to obtain higher post test scores, although this tendency is not statistically significant. Neither social distance measures exhibits significant fall-to-spring changes overall. However, a between-site comparison indicates that Madison subjects, in contrast to Killian subjects, perceive themselves as having become more distant from their teacher by post test time (Fischer's exact test, $p = .10$). We attribute this difference to the circumstance that in the spring the Madison class was being instructed by a substitute teacher, the regular teacher having been on leave from April to the end of the academic year. Finally, the attachment to peers measure shows the following interesting pattern. At post test time, scope of peer attachment is *significantly* broader among Madison than among Killian students (Mann-Whitney U = 6, $p < .03$). This result is to be expected since Madison subjects have been part of an ICTS group for a longer period and, in fact, are near ceiling on this measure. But examining the change scores reveals that fall-to-spring increases occur primarily among the Killian subjects, a trend that approximates statistical significance.

The second attitude instrument employed, the SOS, is a nationally normed verbal self report measure designed to assess psychosocial constructs thought to be related to school success (from National Testing Service; v. Katzenmeyer and Stenner, 1975).[11] Table 6 below presents two types of pre-post scores (T-scores and percentile ranks, respectively) for each of four socioemotional dimensions (self acceptance, social maturity, school affiliation, and self security in that order) tapped by the test. Difference scores represent fall to spring changes in T scores.

SOS: PRE/POST COMPARISONS

1975 - 1976

Table 6

100's = Madison Subjects
200's = Killian Subjects

SUBJECTS	SELF ACCEPTANCE			SOCIAL MATURITY			SCHOOL AFFILIATION			SELF SECURITY		
	T-scores	%	Difference	T-scores	%	Difference	T-scores	%	Difference	T-scores	%	Difference
101 pre	61	86		54	66		58	79		61	86	
101 post	65	93	+4	53	62	-1	59	82	+1	67	96	+6
102 pre	60	84		50	50		54	66		55	69	
102 post	54	66	-6	54	66	+4	59	82	+5	46	34	-9
103 pre	63	90		56	73		58	79		66	95	
103 post	56	73	-7	55	69	-1	55	69	-3	65	93	-1
104 pre	64	92		56	73		58	79		66	95	
104 post	65	93	+1	57	76	+1	59	82	+1	67	96	+1
105 pre	48	42		53	62		33	04		67	96	
105 post	64	92	+16	56	73	+3	57	76	+24	67	96	±0
201 pre	52	58		57	76		44	27		59	82	
201 post	57	76	+5	56	73	-1	31	03	-13	63	90	+4
203 pre	59	82		60	84		59	82		57	76	
203 post	60	84	+1	58	79	-2	61	86	+2	57	76	±0
204 pre	56	73		24	01		56	73		22	01	
204 post	55	69	-1	26	01	+2	52	58	-4	25	01	+3
205 pre	38	12		49	46		52	58		46	34	
205 post	55	69	+17	55	69	+6	43	24	-9	58	79	+12
206 pre	41	18		24	01		43	24		37	10	
206 post	43	24	+2	30	02	+6	55	69	+12	34	05	-3
207 pre	42	21		29	02		41	18		50	50	
207 post	40	16	-2	30	02	+1	28	01	-13	46	34	-4
208 pre	53	62		37	10		60	84		48	42	
208 post	53	62	±0	39	14	+2	46	34	-14	45	31	-3
210 pre	43	24		41	18		51	54		45	31	
210 post	51	54	+8	51	54	+10	46	34	-5	52	58	+7

An examination of fall and spring scores across sites (using a Wilcoxen matched pairs test) revealed slight change overall, an outcome consonant with conclusions drawn from the analysis of 1976-1977 Self Social Constructs Test data. Only social maturity scores indicated a significant gain ($p < .05$) during the school year, an outcome not specifically associated with the demonstration and probably reflective of normal social development with increasing school experience. Two SOS dimensions have some face relevance to self esteem as measured by SSCT, self acceptance and self security. Both dimensions seemed to indicate that Killian subjects experienced greater positive change, although only the score difference on the latter dimension is statistically significant (Mann Whitney $U = 6.5$, $p < .05$). Such a difference in extent of change corroborates SSCT results. However, on both SOS dimensions, the first generation site scores significantly higher at post test (self acceptance: $U = 6$, $p < .05$; self security: $U = 4.5$, $p \cong .01$). In contrast, the SSCT post test data generated no significant between-site differences, although the second generation site appeared to score somewhat higher. These discrepancies between the two socio-emotional assessments led us to explore their association. Using a Spearman rank correlation, a rho value = .04 characterized the relationship between self esteem (SSCT) and self acceptance (SOS), while self esteem (SSCT) and self security (SOS) correlated at .22; the average intercorrelation among these ostensibly similar constructs was .13. However, self acceptance (SOS) and self security (SOS) achieve a highly significant rho value = .81. We entertain the hypothesis that the two SOS self attitude dimensions are related to one another in part because of verbal method bias which operates in favor of older Madison subjects who are better readers. Because the SSCT is a nonverbal assessment, social desirability response biasing is minimized as is dependence on reading skill.

The two socially-oriented dimensions of the SOS, social maturity and school affiliation, were similarly investigated in relation to presumably relevant SSCT measures (scope of peer attachment, social distance from students, social distance from the teacher). Both SOS social dimensions yielded significant or nearly significant differences on post test scores favoring the Madison subjects (social maturity: $U = 11$, $p \cong .10$; school affiliation: $U = 5.5$, $p \cong .01$). A similarly significant difference between groups emerged at post-test on the SSCT measure of peer attachment. However, the SSCT peer attachment dimension shows an approximately significant rate of positive change favoring Killian subjects, a pre-post trend that does not appear in the SOS data. On the contrary, SOS data locate a significant difference in positive change scores only among Madison subjects and only on the measure of school affiliation ($U = 7$, $p < .05$). This result was surprising in view of the fact that Madison subjects had a substitute teacher for the last month of school (the time at which these assessments were made) and SSCT measures of social distance indicated Madison students felt significantly less close to their relatively new teacher at the end of the year. Again, we investigated these discrepancies by exploring patterns of correlations among SOS and SSCT constructs. The SSCT peer attachment measure was significantly and positively associated with the SOS measure of social maturity (rho = .66), and nearly attained a significant positive correlation with school affiliation (rho = .41). Social distance from students and teachers (SSCT) showed a negative relationship to school affiliation (SOS) as expected, but the correlation was not significant (rho average = -.29).

In many respects, then, the SOS and the SSCT provide somewhat corroborative assessments of similar psychosocial dimensions. However, the strength of the corroboration is not impressive, and is vitiated by instances in which the two instruments yield discrepant conclusions. These discrepancies notwithstanding, both sets of results suggest students are gaining in self esteem and advancing in peer relationships as well.

Conclusions from the First Year

Achievement evaluation results for the 1975-1976 academic year generated the following conclusions. First, cross-site comparisons of within-subject scores showed ICTS students improving significantly in both reading and mathematics as expected. Second, between-site comparisons of both pre-measures and post-measures in the two basic skill areas found students at the first generation site closer to grade normal than students in the second generation classroom. This direction of difference had been predicted on the basis of the fact that the ICTS had been in operation longer at the former site. We had further hypothesized that the initial between-site difference would decrease by post-test time; accordingly, no statistically significant differences between classrooms in terms of distance of student scores from grade normal remained at the end of the school year. Beyond these basic findings, two additional results are worth noting. Older students' achievement scores in both reading and mathematics were significantly more distant from grade normal than were younger students' scores. This outcome reflects the cumulative aspect of educational deficits and suggests the importance of the ICTS for partially sighted students early in their school experience. Another noteworthy outcome is that, despite the rather high correlation between reading and mathematics scores, subjects performed significantly better in mathematics than in reading. We have supposed that the relative superiority of ICTS subjects in mathematics is accounted for by the fact that doing computations requires less scanning than does reading.

Examination of data from assessments of visually dependent perceptual motor skills yielded similar, if less strong, conclusions. With respect to visual motor integration, ICTS students in both sites were performing below the level of their fully sighted age-mates. However, both groups made significant gains during the school year. Although the two groups did not differ in total amount of improvement over the year, post test scores for site I subjects were significantly higher than those for site II subjects. This discrepancy is probably attributable to more extensive ICTS experience at the first generation site. Visual memory data, in contrast, were less clear. Visual associative memory, as measured by CIRCUS 12, showed no significant gains during the school year, an outcome we believe is due to the occurrence of so many near-ceiling scores on the pretest. This assessment did, however, yield significant between-site differences favoring students in the first generation classroom (i.e., those who had been using the system longer). Visual sequential memory, as measured by the ITPA, did not yield any significant school year gains for students in either site; likewise, it did not establish any between-site differences. Controlling for age and grade level, a strong association was obtained between both sorts of visual memory and achievement test performance. We thus inferred that while the two measures tap different aspects of visual memory, both are representing achievement-related features of visual information processing in our subject population.

The third area of concern, attitudes relevant to school experience, was investigated using three types of measures. Attitudes toward test taking, rated by teachers using the Factors Affecting Test Performance scales, did not change substantially during the course of the year. Premeasures indicated ceiling and floor effects for many items. Among them, "sense of intellectual challenge" and "willingness to continue" were uniformly negative and were targeted for special attention. Students in the first generation site (but not in the second generation site) had improved significantly on these two items by the end of the school year. Self and social attitude dimensions were assessed by manipulation of geometric symbols representing the self and others (Self Social Constructs Test) and by verbal self report (Self Observation Scales). When the combined self attitude scores for the two sites were examined, no overall change appeared in either data set, but both instruments evidenced significant gains in self attitude among site II students when scores were analyzed on a between-classroom basis. However, this change did not overcome initial differences in self attitude favoring students in the first generation classroom. A similar pattern of results appeared in relation to social attitudes; that is, site I students obtained higher scores while site II students manifested greater positive change during the year.

In summary, the first project year established that, in many respects, participation in an ICTS classroom improves school experience for partially sighted students. This outcome, most evident in basic skill achievement, was substantiated by examination of change scores and by between-site comparisons. In general, students in both sites improved; while students in the first generation classroom who had used the ICTS longer showed initial advantages, students in the second generation site were observed in many instances to make greater gains during the year.

CHAPTER III

During its second year of operation, the primary aim of the Interactive Classroom Television Systems project remained unchanged--to improve the educational experiences of partially sighted elementary school students. While the extent of realization of project objectives in the first year was notable, a longer implementation period was required in order to determine whether initial advances would continue and whether a similar pattern of gains would reappear. The systems were housed in the same two classrooms as before, staffed by the same teachers. However, as the data collection schedule in Chapter II indicates, there was limited subject turnover at each site.

The evaluation procedures for the 1976-1977 school year adhered closely to those specified for the first year (v. Chapter II). The same analysis plan guided the investigation, and the three outcome domains were similarly assessed. However, within each evaluation area results from the preceding year provided a focus for our examination of subsequent data. In the domain of achievement evaluation, for example, the first year's data suggested that, while significant gains were made in both basic skill areas, students were more rapidly approaching grade normal in mathematics than in reading. Given the hypothesis that the greater scanning ability required in reading was responsible for this discrepancy, then if further ICTS experience provided students with greater scanning ability, stronger reading gains should be apparent during the second year. In addition, the importance of avoiding early educational deficits in basic skills implied we should monitor carefully the performance of younger students on the ICTS.

In the area of visually dependent perceptual and motor skills, outcomes at the end of the first school year indicated that students were making substantial advances in visual motor integration, a success not paralled in the visual memory data. Believing that visual associative memory scores failed to show significant change due to ceiling effects, we thought another test with younger subjects was requisite. No similar explanation, however, would account for lack of significant change in visual sequential memory. But if it, like reading, also depended on scanning ability, then the second year's ICTS experience might well generate advances in visual sequential memory as well as in reading.

Finally, the attitude domain seemed most recalcitrant to change on the basis of the previous year's results. School-relevant self and social attitudes did not show positive pre-post differences commensurate with achievement gains. We surmised that the common prior history of ICTS subjects as often-tested visually impaired students had engendered a rather invariant failure expectation that would not be easy to overcome. Beyond that, we began to suspect that self and social attitudes of partially sighted students are visually mediated--that the ability accurately to perceive and respond to others' feelings is an important part of psychosocial development which most likely involves successful affect encoding and decoding. Thus for partially sighted students, interpersonal competence might well rely on visual skills just as academic competence does. ICTS-based learning activities in the classroom had, however, focused primarily on instructional media and had not been explicitly deployed to enhance social perception and communication. It was therefore decided to assess facial affect encoding and decoding among ICTS subjects on a pre-test basis in the 1976-1977 school year.

Subsequent curricular plans would include specific attention to and practice in recognition and production of facial signs of emotion, with a post-measurement of affect encoding and decoding in the third project year. For this purpose, two new assessments were introduced. To measure affect recognition, the Inter-Person Perception Test (Heussenstam and Hoepfner, 1969)[10] was employed. Briefly, the test presents a number of stimulus photographs; these are faces of children and adults collectively representing a broad range of affect. The subject is asked to respond to each stimulus picture by selecting, from a row of photographs of another person, a second picture which shows the same feeling as the first. For exploring affect encoding, Ekman's facial affect production tasks were introduced (Ekman and Friesen, 1975).[5] These tasks require subjects to "make faces" representing different emotions (happy, sad, angry, afraid, surprised, disgusted) as well as a neutral face. Each state is photographed twice, and scored for appropriateness of expression on several dimensions validated in Ekman's research. These new assessments will, we think, contribute importantly to knowledge about mediators of self and social constructs among partially sighted elementary school students. Succeeding sections of this chapter present 1976-1977 results in the three outcome areas just discussed.

Academic Achievement

It will be recalled that academic achievement in basic skill areas is assessed using standardized achievement tests. Those who are performing at the first grade level or above received the Comprehensive Test of Basic Skills (CTBS) while those performing below first grade level are tested with a subset of the CIRCUS battery. Scores of older students are discussed first.

Table 7 presents academic achievement outcomes of higher grade level students for the 1976-1977 year in the following way. Subjects are first represented in terms of their chronological age and "normal" grade in order to provide a basis for interpreting subsequent information. The next column gives the reading achievement score at post test in terms of grade equivalent as measured by the CTBS, and is followed by a column representing the distance between the obtained score and a "grade normal" score. The third column under Reading presents the pre-test score in grade equivalent terms, and the last shows the change from fall to spring score in grade equivalents. Mathematics achievement data are tabled in the same way. The final column in the table shows the difference between reading and mathematics achivement scores. Means are given at the bottom of all distance and difference columns.

Examining the pre-to-post changes is our primary interest here. For this purpose, we employed a Wilcoxen matched-pairs signed-ranks test ($n = 10$). In mathematics, students' scores showed a significant increase from fall to spring ($T = 4$, $\underline{p} < .02$), gaining 8 months on average during a 10-month school year. This rate of achievement compares favorably with average school year gains for low income and minority students such as ours who do not have visual impairment. At year end, however, students remain significantly below grade normal ($T = 8$, $\underline{p} < .05$); on average they are 1.6 years behind the fully sighted norming sample for their grade level. In reading, students' scores improved even more dramatically from fall to spring ($T = 0$, $\underline{p} < .01$), gaining an average of 1.3 years in one school year. This rate of achievement is remarkable, since it is well ahead of the normal gain. While the students remain

Table 7

ACADEMIC ACHIEVEMENT

			CTBS Reading				CTBS Math				
1976-77 Subject No.	May 1977 CA	Grade Normal	Post Scores	Distance from Grade Normal	Pre-Scores	Pre- Post Difference	Post Scores	Distance from Grade Normal	Pre-Scores	Pre- Post Difference	Reading-Math. Post Scores
102	12-3	6.9	2.1	-(4.8)	1.8	+(.3)	4.0	-(2.9)	3.7	+(.3)	-(1.9)
103	10-2	4.9	5.1	+(.2)	3.3	+(1.8)	5.8	+(.9)	4.0	+(1.8)	-(.7)
104	10-10	5.9	6.3	+(.4)	5.2	+(1.1)	6.7	+(.8)	5.9	+(.8)	-(.4)
201	9-5	4.9	5.1	+(.2)	3.0	+(2.1)	3.4	-(1.5)	2.5	+(.9)	+(1.7)
203	13-4	7.9	4.[illegible]	-(3.1)	3.1	+(1.7)	3.0	-(4.9)	3.3	-(.3)	+(1.8)
210	12-8	7.9	3.5	-(4.4)	2.3	+(1.2)	4.4	-(3.5)	3.6	+(.8)	-(.9)
211	7-2	1.9	1.7	-(.2)	0.1	+(1.6)	1.3	-(.6)	0.1	+(1.2)	+(.4)
213	9-10	4.9	5.7	+(.8)	5.5	+(.2)	5.1	+(.2)	4.0	+(1.1)	+(.6)
214	8-3	2.9	1.9	-(1.0)	1.2	+(.7)	1.8	-(1.1)	0.1	+(1.7)	+(.1)
215	11-7	6.9	4.9	-(2.0)	2.2	+(2.7)	3.3	-(3.6)	3.6	-(.3)	+(1.6)
Means				$\bar{x}$ = -1.39		$\bar{x}$ = +1.34		$\bar{x}$ = -1.62		$\bar{x}$ = +.8	$\bar{x}$ = +.2

about 1.4 years behind grade normal in reading, these differences do not reach statistical significance (T = 35, p = n.s.).

These results are of considerable interest in indicating, first of all, that students continue to improve; the first year of intervention showed gains which basically held through the second full year. However, the pattern of gains changed. Initially the greatest improvement was in mathematics, and we hypothesized that mathematics scores were running significantly ahead of reading scores because computation does not involve scanning as reading does. Apparently a second year of ICTS experience enabled students to learn visual scanning skills so that the 1976-1977 pre-post change in reading was more substantial than the mathematics gain and far surpassed the previous year's reading gain. By spring 1977, *there was no longer* any significant difference between reading and mathematics achievement scores (T = 24.5, p = n.s.). We now believe that with an aid such as the ICTS, partially sighted students are not necessarily destined to lag behind developmental norms on tasks that require visual scanning, although it appears that acquiring such a skill requires 1 to 1 1/2 years. However, it seems important to obtain a third year of achievement data to confirm that the pattern of gains we have seen is stable.

Tables 8 and 8A, 8B below provide supplementary information about academic achievement in lower level subjects, i.e., those whose performance falls below the range of the CTBS and who must be tested with the CIRCUS battery (n = 4). These subjects are all members of the younger student subgroup at the second generation site. Table 8 gives total pre and post test scores for each subject in verbal and quantitative skills,

Table 8

KILLIAN SUBJECTS: SUMMARY OF CIRCUS ACHIEVEMENT TEST SCORES

		Total Verbal				Total Quantitative		
Subject No.	Circus	Pre	Post	Diff	Circus	Pre	Post	Diff
204	1	14	14	±0	2	22	27	+5
	8	15	16	+1	5	8	10	+2
207	1	18	29	+11	2	36	39	+3
	8	20	20	±0	5	18	19	+1
208	1	23	33	+10	2	28	35	+7
	8	14	20	+6	5	12	18	+6
212	1	22	30	+8	2	29	34	+5
	8	17	20	+3	5	17	19	+2

Table 8A

KILLIAN SUBJECTS: PRE/POST CIRCUS SCORE COMPARISONS - VERBAL ACHIEVEMENT TESTS

Subject No.	Age (5/77)	Pre 5(9*)/76	Post 5/77			
CIRCUS 1: WHAT WORDS MEAN						
204	7-9	14	14			
				Percentile Ranks:	(pre	2% scored in range; 0% scored below.
					(post	same
				Sentence Reports:	(pre)	Appears to lack confidence in receptive vocabulary skills. Probably needs further instruction and practice.
					(post)	same
207	6-4	18	29			
				Percentile Ranks:	(pre)	17% scored in range; 2% scored below.
					(post)	64% scored in range; 20% scored below.
				Sentence Reports:	(pre)	Responded correctly to a number of the receptive vocabulary items, but needs more instruction and practice.
					(post)	Generally competent in receptive vocabulary skills, but may need additional help with verbs and modifiers.
208	6-8	23	33			
				Percentile Ranks:	(pre)	17% scored in range; 11% scored below.
					(post)	64% scored in range; 60% scored below.
				Sentence Reports:	(pre)	Responded correctly to a number of the receptive vocabulary items, but needs more instruction and practice.
					(post)	Generally competent in receptive vocabulary skills.
212*	6-10	18	29			
				Percentile Ranks:	(pre)	17% scored in range; 5% scored below.
					(post)	64% scored in range; 39% scored below.
				Sentence Reports:	(pre)	Responded correctly to a number of the receptive vocabulary items, but probably needs further instruction and practice with nouns and verbs.
					(post)	Generally competent in receptive vocabulary skills.
CIRCUS 8: HOW WORDS WORK						
204		15	16			
				Percentile Ranks:	(pre)	14% scored in range; 1% scored below.
					(post)	14% scored in range; 9% scored below.
				Sentence Reports:	(pre)	Responded correctly to most items involving discrimination between sentences with different structures; needs further instruction and practice in discrimination between verb forms and statements involving prepositions/negation/conjunctions.
					(post)	Responded correctly to most items involving discrimination between verb forms, but probably needs further instruction and practice in discriminating between statements involving prep./neg./conj., and between sentences with different structures.
207		20	20			
				Percentile Ranks:	(pre)	76% scored in range; 16% scored below
					(post)	same
				Sentence Reports:	(pre)	Generally competent in discriminating between verb forms and between statements involving prep./neg./conj., but had difficulty discriminating between sentences with different structures.
					(post)	same
208		14	20			
				Percentile Ranks:	(pre)	14% scored in range; 1% scored below.
					(post)	76% scored in range; 16% scored below.
				Sentence Reports:	(pre)	Needs further instruction and practice in all aspects of receptive functional language assessed by CIRCUS 8.
					(post)	See above, pre-sentence report for No. 207.
212*		17	20			
				Percentile Ranks:	(pre)	14% scored in range; 9% scored below.
					(post)	76% scored in range; 16% scored below.
				Sentence Reports:	(pre)	Probably needs further instruction and practice in all aspects of receptive functional language assessed by CIRCUS 8.
					(post)	See above pre-sentence report for No. 207.

*Subject 212 entered 9/76.

Table 8B

KILLIAN SUBJECTS: PRE/POST CIRCUS SCORE COMPARISONS - QUANTITATIVE ACHIEVEMENT TESTS

Subject No.	Age (5/77)	Pre 5(9*)/76	Post 5/77

CIRCUS 2: HOW MUCH AND HOW MANY

204 — 7-9 — 22 — 27

Percentile Ranks: (pre) 15% scored in range; 10% scored below range.
(post) 64% scored in range; 19% scored below range.

Sentence Reports: (pre) Probably needs further instruction and practice with quantitative concepts especially relational terms.
(post) Generally competent quantitative skills and understanding, but may need additional help with relational terms.

207 — 6-4 — 36 — 39

Percentile Ranks: (pre) 64% scored in range; 61% scored below range.
(post) 17% scored in range; 83% scored below range.

Sentence Reports: (pre) Generally competent in quantitative skills and understanding. Subject may be approaching operations level of development.
(post) Very competent in quantitative skills and understanding.

208 — 6-8 — 28 — 35

Percentile Ranks: (pre) 64% scored in range; 29% scored below range.
(post) 64% scored in range; 61% scored below range.

Sentence Reports: (pre) Responded correctly to many of the quantitative items, but needs additional help with counting.
(post) Generally competent in quantitative skills and understanding; may be approaching operations level of development.

212* — 6-10 — 29 — 34

Percentile Ranks: (pre) 64% scored in range; 29% scored below range.
(post) 64% scored in range; 61% scored below range.

Sentence Reports: (pre) Generally competent in quantitative skills and understanding.
(post) same

CIRCUS 5: FINDING LETTERS AND NUMBERS

204 — 8 — 10

Percentile Ranks: (pre) 18% scored in range; 1% scored below range.
(post) 58% scored in range; 19% scored below range.

Sentence Reports: (pre) Appears to lack competence in recognizing letters and numbers. Needs further practice and instruction.
(post) Probably needs further instruction and practice in recognizing letters and numbers.

207 — 18 — 19

Percentile Ranks: (pre) 58% scored in range; 58% scored below range.
(post) 23% scored in range; 77% scored below range.

Sentence Reports: (pre) Generally competent in recognizing letters and numbers.
(post) Very competent in recognizing letters and numbers.

208 — 12 — 18

Percentile Ranks: (pre) 58% scored in range; 19% scored below range.
(post) 58% scored in range; 58% scored below range.

Sentence Reports: (pre) Generally competent in recognizing letters and numbers, but may need additional help with capital letters.
(post) Generally competent in recognizing letters and numbers.

212* — 17 — 19

Percentile Ranks: (pre) 58% scored in range; 58% scored below range.
(post) 23% scored in range; 77% scored below range.

Sentence Reports: (pre) Generally competent in recognizing letters and numbers.
(post) Very competent in recognizing letters and numbers.

*Subject 212 entered 9/76.

along with the pre-to-post change. For purposes of summary analysis, scores on the two subtests for each skill are pooled. Wilcoxen matched-pairs signed ranks tests indicated that subjects improved significantly on both verbal ($T = 0$, $p < .01$) and quantitative ($T = 0$, $p < .01$) assessments. No comparison can be drawn between outcomes in the two skill areas, however, since scores do not map on to a common grade equivalent scale (all these tests being normed below first grade level). These results are similar to the findings for the first year at the preacademic level, and suggest stable progress for the younger subjects.

Because the number of preacademic students remains so small as to preclude statistical analysis, we have continued the practice of representing their performance in detailed descriptive terms. Table 8A breaks down the two verbal achievement tests in the following way. After the subject identification number and chronological age, total scores for CIRCUS 1 pre test and post test are given; then the pre and post percentile ranks are noted; finally information is presented about the location of the subject's score (the percent of kindergarteners scoring below the range of the subject's score in the national norming sample), and about the distribution of the subject's abilities (given the specific pattern of items passed and failed in the subtest) for both the pre and post test. These data are followed by data from CIRCUS 8 arranged in exactly the same way. Table 8B presents information similarly organized for the two premathematical subtests.

In general, the pattern of scores and the interpretive comments indicate that younger subjects are improving in most aspects of verbal and quantitative performance. Post test percentile scores present a rather optimistic picture. Considering all 16 post test scores for the four tests, only two fell in the bottom ten percent; six scores fell in the second decile; one score fell in the fourth decile; and seven scores were in the upper 50 percent. This distribution represents quite an advance over the first year. Interestingly, the lower decile scores came primarily from prereading tests, only two scores from premathematics subtests falling below the 50th percentile. If the results for younger subjects parallel those for older ones, we should expect that reading skills take longer to develop, but that they will begin to catch up with quantitative skills during the last demonstration year.

Visually Dependent Skills

In the area of visually dependent skills, it will be recalled, we selected visual-motor integration and visual memory (both associative and sequential) for assessment. We have evaluated these skills because it is reasonable to think they are implicated in information encoding, processing and decoding when learning activities are visually mediated. Table 9 below represents outcomes for visual motor integration (measured by the VMI) and visual sequential memory (measured by that subtest of the ITPA). For purposes of comparison with age developmental scores, the table first presents subjects' chronological ages. Next are four columns representing ITPA data. The first of these columns gives the post test score in year-month equivalents. It is followed by the pretest score, and the pre-to-post difference, both of which are also given in terms of age-equivalents. The fourth column shows the distance between the ITPA age-score and chronological age. VMI data are organized similarly in the last four columns of the table.

Table 9

VISUALLY DEPENDENT SKILLS

1976-77 Subject No.	May 1977 CA	ITPA S '77 Post	ITPA F '76 Pre	ITPA Pre/Post Difference (Mo.)	ITPA and CA Difference (Mo.)	VMI S '77 Post	VMI F '77 Pre	VMI Pre/Post Difference (Mo.)	VMI and CA Difference (Mo.)
102	12-3	5-10	5-7	+3	-77	8-7	6-10	+21	-44
103	10-2	10-5	10-5+†	±0	+3	6-5	7-10	-17	-45
104	10-10	10-5+†	10-5+†	±0	±0	11-9	10-11	±10	+11
201	9-6	9-9	7-3	+30	+3	9-6	6-7	+35	±0
203	13-4	6-10	7-10	-12	-66	7-11	7-4*	+7	-65
204	7-10	6-2	5-7	+7	-20	4-9	4-4	+5	-37
207	6-5	10-5	6-2	+51	+48	5-3	5-3	±0	-14
208	6-8	6-2	4-4	+22	-6	6-10	5-7	+15	+2
210	12-9	7-10	7-3	+7	-47	9-4	6-5	+35	-41
211	7-2	5-10	4-7	+15	-16	5-0	4-4	+8	-26
212	6-10	6-6	5-7	+11	-4	5-0	4-9	+3	-22
213	9-10	10-5+	6-10*	+43	+7	9-6	6-7	+35	-4
214	8-3	5-10	6-6	-8	-29	5-0	5-7	-7	-39
215	11-8	10-5+†	9-9	8+	±0	6-10	8-7	-21	-58

*Indicates a correction of previously reported pre test scores.

†Indicates ceiling scores.

Visually related skill scores were examined using a Wilcoxen matched-pairs signed ranks test as before (but here n = 14, since subjects below and within the age range of the CTBS are both appropriately tested with the VMI and ITPA). An examination of VMI pre-post differences reveals that, while a preponderance of the scores are positive, the gain is not statistically significant ($T = 24.5$, p = n.s.). This result contrasts with data for the preceding year, which showed significant improvements in visual motor integration. Exactly the reverse set of comparisons comes from an examination of ITPA scores. The current year's data show a substantial improvement from fall to spring ($T = 11.5$, $p < .05$); however data for the preceding year do not reveal even approximately systematic gains. Over all, by spring 1977, subjects continued to score below age norms on the VMI ($T = 7$, $p < .01$) while they had closed the gap between them and their age mates on the ITPA ($T = 26.5$, p = n.s.).

The investigation of visually relevant skill scores, like the achievement study, suggests an interesting pattern of results which merits further research. We suspect that during the first year of intervention, students' visual motor coordination increased as they learned to use the ICTS for academic tasks. Because ciphering, unlike reading, requires eye-hand integration but not scanning, it is not entirely surprising that the first set of short-term outcomes showed gains in both mathematics achievement and VMI scores. As students continued to have academic experiences mediated by the ICTS, their scanning ability improved; at the same time, noticeable gains appeared in reading achievement and in visual sequential memory. These latter outcomes represent mastery of more difficult performance sequences for partially sighted students, we think. Exploring intercorrelations among achievement scores and visually dependent skill outcomes lends some support to this hypothesis.

SPEARMAN RANK CORRELATIONS (n=10)

	VMI	ITPA	READING	MATHEMATICS
VMI	--	.52	.73	.68
ITPA		--	.90*	.72
Reading			--	.78*
Mathematics				--

(All values are statistically significant; * indicates $p < .01$).

As the pattern of correlations suggests, while visual sequential memory is associated with mathematics achievement, it is much more closely correlated with reading achievement; and both reading achievement and ITPA scores showed most increase during the second year of intervention. We suspect this is because both reading and ITPA tasks involve visual scanning of a sort that is not required for performing mathematics or VMI tasks, as well as visual motor coordination which is a necessary condition for performing all of them; but the latter sorts of tasks, it should be noted, showed significant improvement even during the first year of ICTS-mediated learning. Interestingly, despite the established general association of mathematics and reading achievement (observed in our data as well), for these partially sighted students ITPA scores are better predictors of reading outcomes than are mathematics scores obtained from the same achievement test. A third year of evaluation data will permit us to be much more certain about the stability and generality of our conclusions.

The last table in this section, Table 10, presents pre and post scores along with pre-to-post changes for younger subjects on CIRCUS 12, the test of visual associative memory. Newly entering young subjects and older subjects who had not yet reached ceiling on this measure were tested ($n = 6$). A Wilcoxen T test indicated that subjects' scores were significantly higher in the spring than in the fall ($T = 0$, $p < .01$). This result is of interest since the previous year's data failed to show significant improvement in CIRCUS 12 scores despite a larger n. We had hypothesized that the lack of effect reflected the circumstance that scores were too near ceiling rather than lack of advance in visual associative memory. This hypothesis seems confirmed by the 1976-1977 CIRCUS 12 data, where subjects initially well below ceiling showed substantial gains. Comparing these outcomes with patterns of results described above for older students, it seems likely the younger group is currently mastering skills involved in recognizing and reproducing symbols. That is, they are advancing in prequantitative ability (v. CIRCUS 2, 5) because this skill area does not require scanning and sequential memory; rather it relies more on recognition memory and visual-motor integration. (Incidentally, these younger subjects are, on average, 22 1/3 months behind developmental age in visual motor integration.) If their experience replicates that of older students, we would expect the coming year to show ceiling effects for simple visual associative memory, and to show improvement in visual sequential memory along with improved reading skills.

Table 10

CIRCUS 12: SEE AND REMEMBER

	Post Test	Pre Test	Difference
204	10	10	0
207	18	15	+3
208	13	13	0
211	16	9	+7
212	17	11	+6
214	20	19	+1

Self and Social Attitudes

Attitudes and skills related to self and social constructs thought to mediate academic experience constitute the last set of outcomes employed to evaluate the project's impact in the 1976-1977 school year. We have assumed that, while the school progress of all children is importantly affected by social and psychological variables, such factors might be especially influential for handicapped students.

For instance, it has been established that the test-taking experience itself may contribute to the final test score. We had hypothesized that, for the subjects of this study, test-taking has been frequently associated with failure and anxiety, associations which would contribute negatively to test outcomes. We further supposed that, if the ICTS enhances learning, it could lead to changed expectations and changed test-taking attitudes, and subsequently to improved test performance. Thus the first attitudinal dimensions related to school success that we sought to measure were factors affecting test performance. Again we used scales adapted from the Stanford Binet Form L-M to rate behavior during achievement test taking on a pre-post basis. The current year's data, like those for 1975-1976, fail to indicate significant change on any factor assessed by the rating scales.

The distressing consistency in outcomes caused us to wonder whether they should be explained in terms of problems with the assessment method or in terms of real absence of change in attitudinal factors impinging on the test taking situation. Regarding the method, a study of judgments for fall 1975 indicated that the ratings themselves seemed to be reliable; that is, for the site II classroom, two teachers and a Rand classroom observer rated ten students highly consistently and without apparent halo effects. Teachers commented that while some items seemed more applicable than others, the instrument as a whole touched factors that importantly described the testing situation. Consequently, we regarded the instrument as a fairly good one. However, as we noted above, six of the 14 items exhibited little variance over subjects. Examining the content of these items led us to believe that a history of failure experiences resulted in an entrenched attitude toward the test-taking situation that would not be easy to alter. For example, "sense of intellectual challenge" (item 9) and "willingness to continue" (item 10) were uniformly awarded a very low negative rating. Subsequent to the collection of first year outcomes, subjects received an additional year of ICTS experience and their test performance improved markedly; however, they seemed to face testing with basically unaltered attitudes, as if to confirm the above conjecture. Perhaps the situation is best illustrated by one subject who gained at a rate of 1.8 grade equivalents in both reading and mathematics during year two as measured by the CTBS. Unmoved by his success, he drew a picture of a tombstone bearing his name and the inscription, "Died of testing 1977--Reincarnated when testing was over." Being able to write an inscription that would have greatly exceeded his capability at the beginning of the school year apparently did not generate the sort of success experience that would override a long history of prior academic frustration. Because of the apparent stability of scores representing factors affecting test performance, and their lack of association with obtained test scores, we have decided to discontinue this assessment for year three.

More encouraging results are provided in the evaluation of general self- and school-related attitudes. Such attitudes were assessed by means of two self-report instruments, the Self Social Constructs Test (SSCT) and the Self Observation Scales (SOS). The SSCT, it should be recalled, is a nonverbal instrument requiring subjects to arrange symbols representing self and social schemata; it taps six self-social constructs (self esteem, social distance from teachers and peers, social interest, perceived group inclusion, perceived individuation, and scope of peer attachment). Table 11 below provides pre, post, and change scores for measures of self esteem and scope of peer attachment, respectively. Supplementing the SSCT, the SOS is a verbal forced choice instrument requiring subjects to mark 'yes' or 'no' in response to items indexing self acceptance, social maturity, school affiliation, and self security. Table 12 represents pre, post, and change scores for each of these dimensions in the order given here. (Only self acceptance and school affiliation are discussed below. The remaining two dimensions showed no significant change.)

Table 11

SELF SOCIAL CONSTRUCTS TEST (SSCT)

	Self-Esteem			Scope of Peer Attachment		
	Post	Pre	Difference	Post	Pre	Difference
102	29	26	+3	17	19	-2
103	33	24	+9	5	12	-7
104	31	16	+15	24	24	0
201	44	32	+12	9	16	-7
203	29	30	-1	24	21	+3
204	24	41	-17	3	2	+1
207	36	36	0	19	22	-3
208	34	26	+8	24	24	0
210	34	31	+3	22	19	+3
211	36	28	+8	24	6	+18
212	22	20	+2	3	4	-1
213	40	31	+9	24	21	+3
214	48	38	+10	19	9	+10
215	42	27	+15	24	24	0
		(range = 8-48)			(range = 0-24)	

Table 12

SELF OBSERVATION SCALES (SOS)*

	Self Acceptance			Social Maturity			School Affiliation			Self Security		
	Post	Pre	Diff	Post	Pre	Diff	Post	Pre	Diff	Post	Pre	Diff
102	60	54	+6	59	57	+2	60	56	+4	58	54	+4
103	62	43	+19	57	50	+7	43	30	+13	66	69	-3
104	63	63	0	60	60	0	59	59	0	67	67	0
201	58	58	0	51	52	-1	24	30	-6	70	71	-1
203	59	61	-2	58	48	+10	39	60	-21	55	50	+5
207	61	49	+12	38	38	0	32	46	-14	52	51	+1
208	55	56	-1	24	27	-3	51	47	+4	36	34	+2
210	60	54	+6	54	53	+1	43	27	+16	56	58	-2
211	55	48	+7	33	28	+5	36	36	0	51	37	+14
212	58	49	+9	25	38	-13	38	43	-5	47	60	-13
213	61	55	+6	56	54	+2	38	41	-3	63	54	+9
214	57	56	+1	42	27	+15	50	56	-6	53	52	+1
215	62	57	+5	59	49	+10	50	51	-1	65	56	+9
$\bar{x}$	59.3	54.2		47.4	44.4		43.3	45.4		56.9	54.3	

*T-scores: scales are standardized with $\bar{x}$ = 50 and s.d. = 10.

Discussions of SSCT and SOS outcomes for the 1975-1976 school year, in Chapter II, indicated that no significant overall change was obtained for any dimension of either instrument during that year. In contrast, the second year's data show that subjects' self concepts have become substantially more positive. Using Wilcoxen matched-pairs signed-ranks tests we examined the SSCT self esteem scores and the SOS self acceptance scores for pre-to-post changes; both yielded significant fall-spring increases ($T = 15$, $p < .05$ and $T = 6$, $p < .02$, respectively). Because the two instruments are not highly correlated with one another, we think the result is a trustworthy one and give it considerable importance. It is not surprising that a second year of ICTS experience would be required to influence the self concept of visually impaired students. However, a third year of data will help determine whether this trend is a stable one. Scope of peer attachment (SSCT) and school affiliation (SOS) form another pair of dimensions examined for pre-post changes. In the 1976-1977 data, as in the previous year, both dimensions show basically positive differences which do not reach statistical significance. While the distribution of subjects precludes between-site comparisons, the classrooms appear to differ in essentially the same ways as before. That is, site I subjects (100 series) have higher peer attachment scores at pretest (allowing little room for favorable change) and show greater school affiliation. We attribute these differences to the first generation site's longer duration as an ICTS classroom and to the related stability of the subjects as a peer group.

Remaining dimensions of the SSCT are not tabled because they yield binary data resulting in a limited range of scores with little variance. For these reasons we cannot make use of ordinal properties and instead have approached the data in terms of binomial tests of the probability of positive or negative change over the school year. For the measures of social distance from teachers and peers, we first asked what is the probability of positive change as opposed to the combined probability of negative change or no change; posing the question in this way, we could not establish a significant tendency. On the other hand, we also asked what is the probability of negative change (increased social distance) as opposed either to no change or to decreased social distance? Here the binomial test established the significant likelihood ($p \cong .05$) that social distance would *either remain the same* or decrease from fall to spring. Pursuing a similar analytic strategy with social interest, perceived inclusion and perceived individuation, we obtained the following results:

- There is no significant likelihood that social interest will increase or remain stable over the year; however, there is a strong probability ($p < .01$) that it will either remain the same or decline.
- For perceived group membership it was equally likely that scores would remain the same/increase or remain the same/decrease from fall to spring.
- With respect to perceived individuation, binomial tests suggested the likelihood ($p = .02$) that students would either remain the same or would perceive themselves as more individuated (more different from the majority) as the school year progressed.

The social distance measures, combined with the SSCT and SOS results already discussed, suggest that students are feeling better about themselves and are feeling close to the others in their own classroom. However the assessment of social interest, perceived group membership and perceived individuation indicate that subjects nevertheless do not feel more integrated into major social structures. This latter finding probably reflects subjects' awareness of their status as special education students.

While the evaluations treated in the preceding part of this section have to do with attitudes thought to mediate academic success, those to be discussed next involve skills which we suppose to be in part visually based and to be implicated in the development of interpersonal competence for partially sighted students. In spring, 1977, we introduced into the evaluation the assessment of facial affect encoding and decoding on the assumption that social perception and communication are visually based skills that mediate interpersonal behavior for visually impaired students in somewhat the same way that visual symbolic capability mediates academic activity. If so, then to the extent that the ICTS can be used to facilitate affect encoding and decoding it may be instrumental in interpersonal as well as cognitive development for partially sighted students.

To measure facial affect recognition, we employed a short version of the Inter-Person Perception Test (IPPT), forms AA (adult stimulus faces) and AC (child stimulus faces). Adaptation of IPPT photographic materials for ICTS administration was accomplished without difficulty. However, administration of the full item set (40 adult-face and 40 child-face items) took too long for subjects' comfort and exceeded their attention span as well. Further, even with contrast-enhanced photographs, some of the items involved fine discrimination which exceeded students' visual capabilities. For these reasons, the test was reduced to a total of 20 items, 10 each from the adult and child forms. Items were selected for inclusion by administering the test to normally sighted adults; stimulus faces were chosen when all respondents scored correctly, with the constraint that sex and ethnicity be distributed as in the original item set. Table 13 below presents data collected from ICTS subjects in spring 1977 using the abbreviated IPPT.

Table 13

INTER-PERSON PERCEPTION TEST

Pre Test (Total Range: 0 - 20)

Subject Number	103	104	107	201	204	207	208	210	212	213	215	216	217
AA	3	5	3	8	0	3	5	6	3	6	7	3	7
AC	2	5	4	9	3	2	4	2	4	4	7	5	9
Total	5	10	7	17	3	5	9	8	7	10	14	8	16

For an idea of how subjects <u>ideally</u> might have fared on the original 80-item set, scores obtained from each form may be multiplied by 4 or total scores multiplied by 8; these figures may then be compared with test norms. For example, obtained averages for AA and AC were 4.8 and 4.6, respectively, in the ICTS population; were this performance representative of the unabridged test, the means would have been 19.2 and 18.4, respectively. In comparison, test norms for AA and AC are 23.6 and 21.6. Thus, even though total score estimates for the ICTS sample are high since items were removed from the test on the basis of visual difficulty rather than at random, the projected scores still fall short of national norms. On the other hand, it should be noted that the test norms were derived from adult rather than elementary-school-aged respondents. The adult norms suggest that form AA (adult faces) might be easier than form AC (child faces) for an adult population. However a Wilcoxen matched pairs signed ranks test established no difference between forms for the ICTS subjects ($T = 18.5$, p = n.s.). The revised IPPT will be administered to the ICTS population again in spring 1978, where the question of research interest will be whether a curriculum designed to include visual attention to facial affect among partially sighted students substantially improves outcomes on an affect decoding task.

In addition to affect decoding, an attempt was made to explore affect encoding among the ICTS students at the second generation site. We were interested in whether partially sighted students were able to produce conventional facial signs of six socially important affective dimensions: fear, disgust, anger, happiness, sadness, and surprise. Based on the work of Ekman and Friesen, an affect expression task was devised in which students had an opportunity to make each of these expressions twice, along with two neutral faces. The task was administered to 10 site II subjects along with matched normally sighted controls (students of the same age [+/- 8 months] and sex chosen from regular classrooms). Students were photographed (cf. Figs. 1-4 below) as each expression was elicited. Photographs are now being scored, using multiple criteria from Ekman and Friesen to determine whether a student "has the expression"; however, it is apparent from the photographs, even without systematic scoring, that partially sighted students are seriously behind their fully sighted age-mates in affect encoding with respect to the six dimensions explored.

NEUTRAL

HAPPY

SAD

FEAR

ANGER

DISGUST

SURPRISE

SUBJECT #204
GRADE K (1976-1977)
BIRTHDATE: 12-12-70

Fig. 1—ICTS Student

NEUTRAL

HAPPY

SAD

FEAR

DISGUST

ANGER

SURPRISE

CONTROL (FOR #204)
GRADE 1 (1976-1977)
BIRTHDATE 9-4-70

Fig. 2—Control Student

NEUTRAL

HAPPY

SAD

FEAR

DISGUST

ANGER

SURPRISE

SUBJECT #215
GRADE 5 (1976-1977)
BIRTHDATE: 9-24-65

Fig. 3—ICTS Student

NEUTRAL

HAPPY

SAD

FEAR

DISGUST

ANGER

SURPRISE

CONTROL (FOR #215)
GRADE 6 (1976-1977)
BIRTHDATE: 9-5-65

Fig. 4—Control Student

Four sets of photographs are provided above for illustrative purposes. Figures 1 and 2 represent a younger ICTS student and his matched control; Figs. 3 and 4 represent an older ICTS student and his matched control. Examination of these and other photographs in the affect encoding task supports our hypothesis that partially sighted elementary school students are less able to employ conventional facial signs of emotions than are their fully sighted peers, a circumstance which might adversely influence social competence. We will be interested to determine whether or not the ICTS curriculum, altered to include communication as well as recognition or affect, improves affect encoding outcomes for partially sighted students and decreases the difference between them and fully sighted controls.

Conclusions from the second year

In general, the assessment of 1976-1977 outcomes suggests that the ICTS continues to have a strong positive influence in all areas evaluated. With respect to achievement in basic academic skills, test scores indicated significant improvement in both reading and mathematics. But, while gains initiated during the first year held throughout the second year of intervention, the pattern of gains changed. That is, spring 1976 outcomes showed more marked improvement in mathematics than in reading, with students scoring significantly lower in the latter. In contrast, spring 1977 results indicated substantially greater improvement in reading than in mathematics so that no statistically significant differences remained between achievement scores in the two basic skill areas. Apparently a second year of ICTS experience enabled students to learn the visual scanning skills requisite for advances in reading achievement. In addition to overall progress in reading, a second area of special attention was the progress of younger preacademic students. As the discussion of achievement above noted, preacademic students seemed to be faring well. Of the 16 scores obtained from CIRCUS battery subtests for evaluating this group, only 9 fell below the 50th percentile on national kindergarten norms while 7 were above that mid-way mark. We are inclined, therefore, to believe that early exposure to an ICTS is helpful to younger elementary school students in minimizing risk of cummulative educational deficits related to visual impairment.

The investigation of two visually-dependent skill areas, visual-motor integration and visual memory, yielded an interesting and related pattern of results. Subjects' visual-motor integration scores continued to increase but the gains did not reach statistical significance. This result contrasts with data for the preceding year, when subjects showed significant improvement. Exactly the reverse set of comparisons come from an examination of visual sequential memory scores. While the 1976 outcomes failed to yield systematic advances, the 1977 outcomes manifest substantive gains. It seems likely that visual-motor coordination would increase as students learned to use the ICTS during the first year of the demonstration. But scanning, as we have seen, is more difficult and apparently requires a longer learning period. Thus visual sequential memory scores do not evidence significant positive change until the second year, during which reading (another scan-dependent activity) advances as well. These conjectures were supported by studying the intercorrelations among achievement and visually-dependent skill scores. While visual sequential memory is associated with mathematics achievement, it is much more closely correlated with reading achievement; and both reading achievement and visual sequential memory scores showed most improvement during the second year of intervention. Among the younger students, it should be added, visual associative memory scores also showed strong gains as well.

Finally, we were most encouraged by significant changes that occurred in the self and social attitude domain, since we believe such parameters are not easily altered in this research population. Attitudinal factors affecting test performance seem not to be influenced by actual test results, so the project was not able to generate a new success-expectancy as it had hoped to do on the basis of continued successful academic outcomes. However, self- and socially-oriented attitude dimensions such as self esteeem and peer affiliation exhibited fairly strong positive changes even when measured by very different methods. With respect to these constructs, the lack of significant correlation between methods for assessing them lends more confidence in the conclusions. In addition to the evaluation of self and social constructs, the project undertook to explore facial affect encoding and decoding among ICTS subjects. While only premeasures are currently available, these data suggest that partially sighted students may be handicapped relatively to fully sighted peers with respect to recognition and communication of affect. More generally, we believe that mediators of psychosocial development in the partially sighted comprise an area well worth further research.

POSTSCRIPT

In summary, the first two project years suggest that the ICTS has had a strong and apparently stable positive impact on the learning experiences of partially sighted elementary school students. In addition, a first look at 1977-78 pre-test data leads us to believe these effects will continue to the end of the demonstration. Further, classroom observation data (Bikson, T. H., 1977)[2] indicate an extremely high level of on-task performance among ICTS students. Part of this result is explained by a rather low student-teacher ratio; but of equal importance is the fact that these students can see their work, can accomplish it with greater ease, and can interact visually with one another and with their teacher in ways they could not without the ICTS. Finally, the students use the ICTS as a tool not a crutch. In other words, they continue to use their residual vision when they are off the system; they do not revert to behavior associated with the functionally blind.

If the ICTS experiment is as successful as it now appears, then we need to consider the next step--the dissemination of ICTSs to other school districts. A preliminary look at population statistics related to severe visual impairment indicates that any community with a minimum of 50,000 inhabitants would likely have a sufficient number of partially sighted children between the ages of five and eleven years to justify incorporating an ICTS with at least 4 stations in the school district visual handicap program (Genensky, S.M., 1978)[9]. Thus, we do not envision any difficulty in locating numerous other school districts of appropriate size with sufficient VH program interest for employing such a system.

The major remaining problem is that of guaranteeing a sufficiently large initial purchase of ICTSs to stimulate their production by quality manufacturers. The monitors, cameras, lenses, camera stands, videotape recorders, and X-Y Platforms used at our two experimental sites are either already being manufactured commercially, or could be copied with very little effort. However, a production design of the master control unit will require a moderate level of technical sophistication on the part of the manufacturer. The master control system is the nerve center of an ICTS; it is used to select the image on each of the system's monitors as well as to compose that image on each of the system's monitors as well as to compose that image. The two ICTSs currently in use were handcrafted at The Rand Corporation. However, the design details of the master control units used in these ICTSs are available to anyone who has need of them. Consequently, these control units could be produced by a private manufacturer given sufficient demand.

Based on previous experience with new equipment, our belief is that a manufacturer would need an initial guarantee of at least ten systems before undertaking their production. If that were to occur, then there would be 12 ICTSs, including the two already in operation, that could serve as models for potential user/customers. By potential users we mean other school districts whose VH personnel will recognize that an ICTS in their district would aid their partially sighted students in leading full productive lives. We recommend that federal agencies concerned with education for the handicapped undertake efforts to fund production and dissemination of at least ten new interactive classroom television systems for the partially sighted.

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