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ABSTRACT

This report describes the implementation and evaluation activities of the University of Illinois Computer-Based Education Research Laboratory's demonstration of computer-delivered elementary reading and mathematics instruction in classroom settings using the PLATO system. Seven chapters include introductory material providing a context for the demonstration and an introduction to the PLATO system; descriptions of the Computer-based Education Research Laboratory, the curriculum project, and the evaluative data sources for reading and mathematics; implementation of the demonstrations; classroom activities presented from the role perspective of teachers, students, and classroom observers; the implementation of PLATO, depicted from both chronological and cross-sectional perspectives; achievement and attitude scale results; and the various test item results. Appendices contain five papers on pilot year analysis of the project; the demonstration year statistics; and all of the data collection instruments used during the project. (RAO)

The PLATO Elementary Demonstration
Educational Outcome Evaluation

Final Report

VOLUME I

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Chapter I

Introduction

1.1 Context

In 1972, the National Science Foundation awarded a contract to the Computer-based Education Research Laboratory (CERL) of the University of Illinois to develop and demonstrate computer-delivered elementary reading and mathematics lessons in classroom settings using the PLATC system (Programmed Logic for Automatic Teaching Operations). This report describes the demonstrations and evaluation activities and gives the results of the evaluation activities carried out by the Educational Testing Service (ETS). Detailed data including item level results are contained in Volume II.

This introductory chapter serves to provide some of the context of the demonstration and to introduce the reader to PLATO.

New Media, Teaching Machines, and Computer-aided Instruction

Elementary and secondary education are large-scale, labor-intensive activities. The American tradition of increasing productivity through applications of technology has proved effective in other communications industries. Repeated attempts have been made to improve the productivity of education through the application of devices intended to help the teacher and other school staff use time more effectively, reach more students, or arrange more individualized experiences and interactions for each student.

Although it is fashionable to point to the fiasco of teaching machines in the 60's--adopted in a wave of industrial activity which "burgeoned, skyrocketed, and finally plummeted" (Armsey and Dahl, 1973)--as evidence that schools resist technology, a broader view attests that such resistance is not necessarily the fate of technology applications. Schools have welcomed cost-effective innovations that relieve staff of routine duties, (e.g., duplicating equipment, computer scheduling), make available otherwise difficult-to-provide experiences (e.g., films, recordings), or raise the capacity to individualize instruction while leaving the teacher in control of the learning process (e.g,, paperback books, individualized reading systems).

Innovations that claim to replace less routine functions of teaching must, however, undergo considerably more scrutiny before being accepted. Teachers may see the routinization that accompanies standardized procedures as changing the nature of the task or trivializing it. Hence, standardized tests, programmed learning, and instruction by television meet considerable resistance when they are presented as replacing, rather than supplementing, central aspects of the teacher's role.

The strength of interactive computing, on the other hand, is that it offers the possibilities of presenting either new material or review and exercises tailored in pace, content, and complexity to the individual student's learning performance; and of giving immediate feedback, personalized to whatever extent is deemed helpful. When there are suitable display and audio capabilities, it is technically possible, in fact, to simulate many aspects of the teacher's presentation of lessons and extend the teacher's capability to provide immediate individuated feedback to numerous individuals simultaneously.

Such active engagement, responding, and receiving results are crucial aspects of learning. Even if it were possible for the teacher to devote full time to providing feedback to individual children, a child in a class of 24 could receive only 15 minutes of individual attention in a 6-hour day. Thus any device capable of taking over the more routine aspects of posing questions, judging the answers, and providing reinforcement or correction could, in theory, free the teacher for dealing with unique student characteristics, for leading group interaction, and for numerous other activities involved in diagnosis, advising, and the development of social skills and motivation. Computers, in fact, had been used in this drill-and-practice mode with teacher acceptance and had yielded measurable improvements in the learning of mathematics (Suppes and Morningstar, 1969).

Tutorial CAI systems like PLATO, however, attempt a more ambitious goal. Here, the computer not only reviews and provides practice on material already presented by the teacher but presents new material when the student is judged ready for it. Thus it potentially replaces a central aspect of the teacher's role. Issues of the integration of teacher-presented and computer-presented material now become crucial. Without increasing class size, there seem to be but two ways to demonstrate increased productivity of achievement or of desired attitudes: the teacher must reallocate time to teaching material not covered by the computer-based lessons, or the teacher-computer team must show significant acceleration in learning of material taught jointly.

Difficulties in Assessing the Impact of New Media

The effect of technological innovations on productivity in elementary schools has been difficult to assess for a number of related reasons. To the extent that technology relieves the teacher of preparation, feedback, and set-up duties normally performed outside of class hours, time may be released for personal pursuits which may have no effect on quality of teaching. Furthermore, without such reorganizations as lengthening the school day or increasing pupil/professional staff ratio, it would be necessary to demonstrate that pupils learn more in the same class time or the same amount in less time if increased productivity is to be shown. But since individual teachers make decisions as to the reallocation of any class time saved--extra remedial or enrichment work in reading in some cases, more science or social studies in others, or more discussion of feelings in others--a systematic result of such reallocations is not likely to be evident. Thus the apparent narrowly defined replicability of CAI treatments may in fact be largely illusory unless the use of reallocated class time is taken into consideration.

In large-scale studies, with random assignment of classrooms to differing treatments, it is reasonable to assume that uncontrolled variations in the contexts and implementations of treatments tend to average out, rather than to systematically bias results in favor of one treatment. In small studies, with self-selected teachers, one does not have the luxury of this assumption. Every effort must thus be made to document the varieties of implementation and to assess the importance of the many likely departures from the ideal of ceteris paribus, if concl sions concerning the effectiveness of the nominal treatments of interest are to be drawn.

The PLATO Demonstration

In the years leading up to the PLATO demonstration, a number of different computer-assisted drill-and-practice applications in elementary schools in a number of states were evaluated and, except for some evidence that the impact on mathematical concepts was not as great as that on computation, showed striking positive influences on mathematics and language arts achievement (Vinsonhaler and Bass, 1972).

Feldhusen and Szabo (1969), going so far as to label CAI an "educational heart-transplant," noted that the empirical research was nevertheless inadequate because CAI systems are so often being developed simultaneously with the evaluation. Nevertheless they made the following positive remarks:

> The evidence clearly indicates that CAI will teach at least as well as live teachers or other media, that there will be a saving in time to learn, that students will respond favorably to CAI, that the computer can be used to accomplish heretofore impossible versatility in branching and individualizing instruction, that true natural instructional dialogue is possible, and that the computer will virtually perform miracles in processing performance data.
>
> What will be needed in CAI research will be systematic analyses of basic instructional variables and individual differences with subjects who have transcended CAI's newness and with hardware and software that is fully debugged... For the present we must conclude that CAI has accomplished the feasibility stage (p. 271).

Feldhusen and Lorton (1970) reviewed papers by Zinn, Stolurow, Oettinger, and others, and concluded by recommending moving from teletype to electronic display, developing one set of programming languages compatible with authoring in several instructional modes, and developing some lengthy courses to serve as vehicles of research and as models of CAI potential. Rigney (1973) echoed this call by pointing to the need for a CAI "test bed."

Against this background of optimism, there were a few notes of caution, such as Gentile's (1967) observation that what kinds of programs to write in order to use the equipment efficiently was an almost untouched problem, Oettinger and Marks' (1969) myth-deflating Run, Computer, Run, and Butman's arguments that CAI could not be cost-effective in traditional elementary instruction under any circumstances likely to be achieved in the near future. However, the claimed demonstrated practicability of drill-and-practice CAI, the growing utilization of computers for administrative jobs in the schools, and the increasing use of time-sharing terminals to teach secondary students <u>about</u> computing, made a field demonstration of tutorial CAI seem a feasible idea whose time had come. This, then, was the climate of opinion surrounding National Science Foundation personnel and many of their advisors at the time of the initiation of the PLATO demonstration.

1.2 Description of the PLATO System

For almost two decades, the University of Illinois has been the site for the development of the PLATO system. In the current application, PLATO IV, the system comprises a central computer (Control Data Corporation's CYBER 73) at Urbana-Champaign and nearly 1000 Magnavox terminals located throughout the country. Other PLATO systems are in operation at several universities, and CDC has begun marketing operations aimed at leasing access to PLATO systems for commercial and governmental training purposes. The CDC system uses CRT terminals rather than the plasma panel. Consistent with its philosophy of development, CERL has already developed prototypes of new generations of terminals.

The Illinois PLATO IV student-author terminal is centered on an 8 1/2-inch-square plasma display screen. Printed messages are written on this screen at the rate of 180 characters per second. Graphs and partially animated line drawings are displayed at the rate of 60 connected lines per second. The panel has an "inherent memory" which makes it possible to have graphs, figures, and special characters displayed continuously by the panel without "refresh" signals until information to selectively erase one or a set of the 262,000 tiny glowing orange dots making up the display is transmitted from the central computer. In addition, characters and modifiable graphics segments are stored in addressable memories in the terminal. The display panel has a 16 by 16 grid of infrared light beams surrounding its surface, the computer sensing

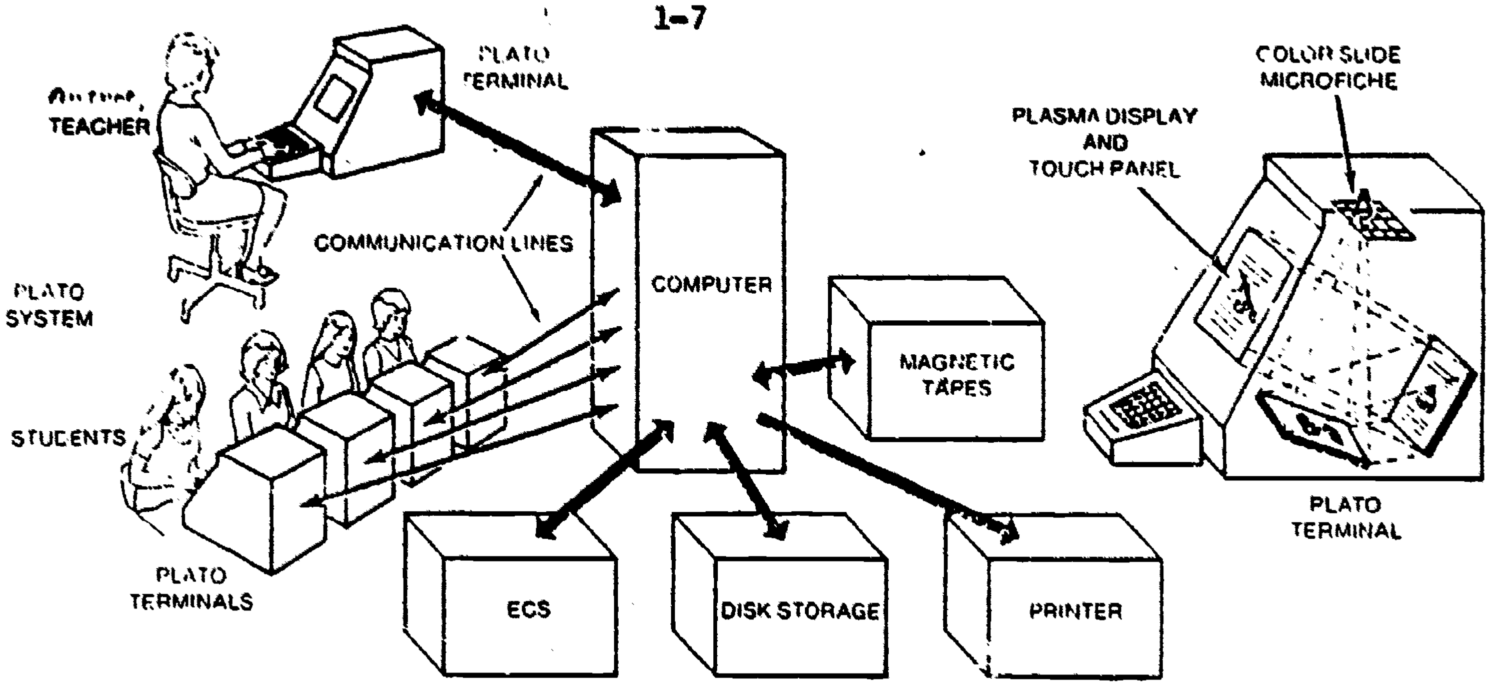


Figure 1.1.1
System Configuration

Figure 1.1.2

Terminal

when beams are interrupted by a pointing finger. In addition to the touch panel, audio equipment utilizing student-changed floppy discs with the capacity to deliver 23 minutes of random-access audio messages is available, as is a slide selector rear-projecting through the plasma panel and allowing superimposed slide images and display graphics. These two latter devices are used by the PLATO Elementary Reading Project. The student communicates with the central computer via a full keyboard of alpha-numeric characters or by touching portions of the screen. Lesson materials for use on the PLATO system are written in the TUTOR programming language. Any PLATO terminal can also be used as an authoring terminal, making possible revision, testing, and interactive or note communication with any individual who uses the system. In the instructor mode, lesson activity may be monitored, lessons may be prescribed for students, and records may be reviewed. Lessons reside in a 2 megaword extended core storage (ECS), and once a lesson has been copied and "condensed" into ECS, any number of students can work through the lesson at their own pace, the system keeping separate records of its interaction with each and retaining specified parts of this information in the student's individual record file. The system controls access to lessons by students, authors, and instructors and has provision for the design of complex routing, with systems to deliver lessons in sequences adapted to the performance of individual students in a course or strand.

1.3 The Strategy of the Evaluation

Evaluators have been traditionally called in to evaluate the impact of a product which has presumably already gone through the development phase. Increasingly, the desire for monitoring and obtaining early assessments of the potential value of large-scale and costly developments brings evaluator and developer into contact while the development process is at its height. The siting of the PLATO elementary demonstrations in schools near the research engineering system and curriculum development laboratory, simultaneous development, production, implementation, revision, and evaluation provided a made-to-order arena for the playing out of the tension between formative and summative evaluation.

Summative issues appropriate to a product or equilibrium process are such questions concerning accessibility, implementation, and outcome, such as:

1. How well does it work?
2. How difficult is it to use?
3. Do teachers and students like it?
4. How well does it teach?
5. What does it teach?
6. Whom does it teach?
7. What is its impact on the classroom?

Formative questions, such as "Which features of the lessons need improvement?" "How can we modify lessons or their sequencing to be more effective?" or "What help do teachers need to use the system more effectively?" usually come before summative questions. From the point of view of the developers and, initially, of the sponsor and his consultants, these questions were not as appropriate as the pre-formative questions, "How can we develop and debug the system and first-draft lessons so that we can deliver instruction at all?" Formative questions could be asked after first drafts existed, and summative questions were premature. This tension between formative and summative approaches persisted throughout the endeavor.

Lesson and course materials were being developed at the same time as educational effects were being measured, and indeed new lessons, revisions of old lessons, and new decision rules for routing students were still being introduced as the final year's posttesting took place.

PLATO and the curricula continue to undergo modification, but we now feel we have answers to certain summative questions. The strategy of the evaluation evolved as a response to the challenge of learning about the effects of a rapidly evolving system.

All parties concerned seriously underestimated the magnitude of the effort involved in designing and programming a full year's reading and mathematics curriculum. Lessons varied greatly within the reading and mathematics curriculum components as to teaching strategy, employment of reinforcement, method of handling wrong responses, verbal demands, use of illustrations, and step size. A major issue, then, was "is the evaluation expected to make inferences from the effectiveness of these first-draft lessons to some generalized effectiveness of the system?" These inferences were not attempted.

What was attempted was an evaluation seen as appropriate to the task of gaining information concerning our seven questions in a continually evolving implementation, in circumstances under which random assignment had not been achieved. Although standardized and specially developed curriculum-referenced achievement tests and attitude questionnaires were employed in a pre-post treatment vs. comparison paradigm, the analysis and interpretation of the results went beyond estimating an average "treatments effect." Because of the small number of classrooms involved, the fact that PLATO teachers were self-selected, the frequent interactions of teachers and children with the developers, and the resulting modifications of the treatments, conclusions concerning overall effects are subject to myriad plausible alternative explanations. Teacher differences in curriculum emphasis and in effectiveness were seen as foremost among these threats to generalizability.

The approach to this problem, which motivates the descriptions, case studies, data summaries, analyses, and interpretations presented in this report, is straightforward in conception, if sometimes complex in execution:

1. Obtain as much prior information as possible about teachers and children.
2. Obtain extensive process information concerning what actually occurred in classrooms during the course of the implementation.
3. In analysing posttest results, use as covariates as much prior information as can be quantified, in an attempt to make apparent treatment effects disappear.
4. Pay particular attention not only to main effects, but to school-by-treatment statistical interactions, which signal atypical contrasts between results for PLATO and "control" teachers in a given school.
5. In interpreting results, use the process information to determine if a particular effect or interaction could likely have been due to causes other than the treatment, and place most weight on those effects which occurred in areas in which teacher curriculum emphasis and effectiveness were, to the best of available knowledge, comparable.
6. Provisionally accept results which prove resistant to the above "explaining-away" procedures.

Since any result in this (or even in a truly experimental) approach is susceptible to revision if some unmeasured or uncontrolled-for influence is found to have differentially affected the groups, it was important to obtain as many types of process information as possible. For this reason, extensive resources were devoted to classroom observation, teacher and developer interviews, teacher logs, curriculum questionnaires, and numerous site visits during the course of the demonstration. This information contributed to case studies and process descriptions as well as to the interpretation of test results. Although the attempt was made to sift information from all these sources, not all of these voluminous data were appropriate for inclusion in this report, nor did all prove to be equally relevant for the purposes of describing the demonstration or interpreting its results.

Recognizing the possibility that classroom differences can influence outcomes, we thus attempted to go beyond hoping that these disturbances would "average out," to investigate those circumstances in which PLATO appeared to have varying effects and to make a judgment as to which of those circumstances were the most appropriate for drawing conclusions. We have attempted to provide sufficient descriptive and process information to allow others to exercise their professional judgment concerning the situations to which these results may be generalized. We do not claim that this approach answers the question, "What can PLATO do?" We hope it casts light on the variety of circumstances under which it appeared to do, and on those in which, in our judgment, it can be expected to do, certain things and communicates what those circumstances and outcomes are.

As the demonstrations evolved, developments led to the agreement to focus the PLATO achievement outcome evaluation on mathematics in grades 4-6, and to focus on process, rather than achievement outcomes in reading. The descriptive data thus became our principal outcome measure for PLATO elementary reading. As the structure of this report is intended to emphasize, however, the evaluators consider the characterization of what happened to children and teachers in classrooms to be as important an outcome for both projects as is any measure of final status, and thus to stand on its own, apart from its value in clarifying the interpretation of other outcomes.

References

Armsey, J. W., & Dahl, N. C. An inquiry into the uses of instructional technology. New York: Ford Foundation, 1973.

Butman, R. C. CAI -- there is a way to make it pay (but not in conventional schooling). Educational Technology, 1973, 13(12), 5-9.

Feldhusen, J. A., & Szabo, M. The advent of the educational heart transplant, computer-assisted instruction: A brief review of research. Contemporary Education, 1969, 40, 265-274.

Feldhusen, J. H., & Lorton, P. A position paper on CAI research and development. A Series Two Paper from ERIC at Stanford. Stanford, CA: Stanford University, 1970. [ED 036 204]

Gentile, J. R. The first generation of computer-assisted instructional systems: An evaluative review. Audiovisual Communication Review, 1967, 15(1), 23-53.

Oettinger, A. G., & Marks, S. Run, computer, run. Harvard Studies in Technology and Society, No. 1. Cambridge, Mass.: Harvard University Press, 1969.

Rigney, J. W. A discussion of behavioral technology laboratories CAI projects in relation to a CAI test-bed concept (NPRDC Report TR-73-71). San Diego: Navel Personnel Research and Development Center, 1973.

Suppes, P., & Morningstar, M. Compter-assisted instruction. Science, 1969, 150, pp. 572-576.

Vinsonhaler, J. R., & Bass, R. K. A summary of ten major studies on CAI drill and practice. Educational Technology, July 1972, pp. 29-32.

Chapter 2

CERL, The Curriculum Projects, and the Evaluation

2.1 CERL and the NSF Contract

In the fall of 1971, the Computer-based Education Research Laboratory (CERL) at the University of Illinois submitted a solicited proposal to the National Science Foundation (NSF) for the Demonstration and Evaluation of the PLATO IV Computer-based Education System. The proposed work was embedded in past accomplishments of considerable magnitude.

Early history. Since 1959, work had been underway at the University of Illinois on increasingly sophisticated computer-aided instructional systems under the generic acronym of PLATO. From the initial PLATO system, a single terminal combining photographic slides with graphics generated by the early ILLIAC computer, through PLATO III, a 20-terminal cathode-ray system capable of simultaneously delivering different lessons to different students, the system continually grew in response to new applications. Interested University of Illinois faculty developed lessons, and the Coordinated Science Laboratories' engineers and systems people developed hardware and authoring facilities (the CATO and TUTOR languages, tape and disc storage systems, and interfaces with more sophisticated computers) in response to needs as they arose in varied pilot uses.

CERL was established in 1967 as a special unit of the Graduate College. The National Science Foundation and the Advanced Research Projects Agency (DOD) began supporting hardware development for a projected PLATO IV system, as well as further trials of PLATO III. CERL's original projections, with optimistic assumptions concerning amount of use of single lessons, future hardware cost declines, and the availability of the channel 5-6 gap on TV coaxial cables for inexpensive communication, suggested that a system supporting 4096 terminals could be cost effective, delivering instruction at 34¢ per hour (Bitzer and Skaperdas, 1968). A 1971 demonstration of the pilot plasma system in Washington generated interest and further funding from the National Science Foundation, the Advanced Research Projects Agency, and the University, to build and demonstrate an operational PLATO IV system. The National Science Foundation supported PLATO demonstration in elementary schools and community colleges (Murphy and Appel, 1977).

The PLATO system was intended as an educational and communications tool. An early and continuing vision was one of close working relations among engineers, system programmers, curriculum designers, and faculty and students, all contributing their perspectives and skills to the evolution of the system and shaping its development by the real-life demands of educational settings. The early users of the system were, not unexpectedly, faculty and graduate students at the University of Illinois. The development of courseware followed a somewhat different pattern from that of hardware and software development. The latter was mostly the effort of CERL staff, using resources sought and marked for that purpose. There was no comparable staff for curriculum development during the early years of CERL and no resources of comparable magnitude earmarked for curriculum design. The faculty who worked with PLATO did so out of personal interest, often on their own time, occasionally on departmental time. The procedures for the preparation of instructional materials thus proceeded informally for some time.

This mode of operation was quite successful. A small number of faculty became grounded in the processes of courseware development and produced some exemplary materials. CERL thus provided the facility for curriculum development and responded through system modification to the needs of instructional users, but it did not engage in or sponsor the design of curriculum. The essential contact between users and CERL staff was over system capabilities, not over the educational value of the materials produced, which remained in the purview of the instructor. CERL did not foster any particular approach to writing lessons, other than looking with disfavor at "page-turner" lessons that did not exercise the capabilities of the system. Rather, it encouraged taking various approaches to the use of PLATO, as that provided the best stimulus for the further evolution of the system. With few exceptions, these experiences with the use of the system did not result in the development of integrated sets of materials for longer courses of instruction; more importantly, they did not entail the systematic introduction of materials into varied instructional settings.

During this period expectations were also set regarding the use of the TUTOR language. Observation of interested members of the university community working with the system led to the generalized assumption that most teachers with motivation would be able to learn how to program with relative ease and write lessons from which students would learn. Again, attention was limited to the process of programming and lesson design, with less emphasis on the pedagogic questions inherent in such an effort.

The January 1972 contract between CERL and NSF was the result of an iterative process that involved months of negotiations and a critical review of the first CERL proposal by several candidates for the task of evaluation. With the successful development of the prototype terminal, CERL was encouraged to undertake more systematic curriculum development and to demonstrate the feasibility and cost effectiveness of its implementation in the field. CERL was urged to focus on community colleges and elementary schools in its proposal to go forward with the demonstration. These two large populations of students were seen as representing greater need and as presenting a greater educational challenge than did the university and nursing students with whom much of the developmental work had been done.

For the elementary school component of CERL's initial proposal, (Summer 1971) 313 terminals, 37 in Champaign-Urbana and 32 in each of three urban (tentatively Chicago) schools, were to be installed by September 1973. Simultaneously with these system development activities, curriculum development was to lead to complete K-2 reading and grade 2 and 3 mathematics curricula by September 1973, to be followed by curricula for additional grades leading to complete K-6 curricula for both subject areas by September 1975. It was envisioned that all of this could be accomplished by two authoring teams of from four to five full-time-equivalent senior authors and three full-time graduate assistants. Initial plans called for separate terminal rooms in participating schools, with classes of children coming to these rooms for 15 minutes of reading instruction in kindergarten to 30 minutes in each of the two curricula in grades 4 to 6. The goals were to contribute to:

1. Increasing the rate of acquisition of basic skills
2. Decreasing the percentage of student failures in the acquisitions of needed skills
3. Preparing students for subsequent learning
4. Maximizing individual potential.

It was acknowledged that the cost would represent an increase over that of conventional instruction without changes in years of schooling or teacher/pupil ratio, and the initial objective was stated as accomplishing substantial increases in effectiveness at modest cost increase.

It was also suggested in the proposal that an external evaluation be conducted, which would include:

1. Direct comparison of the mastery of subject matter or skills of students in conventional courses and those taught in part by PLATO
2. Assessment of student attitudes toward participation in alternative modes of instruction
3. Assessment of additional roles or options made available to teachers or students due to access to PLATO.

It was anticipated that pilot evaluation could take place in 1973-74 and that summative evaluation with 500 students in four years of each curriculum would be concluded in 1974-75. The need was stressed for anticipating changes in evaluation strategies as objectives changed, even during the course of the demonstrations.

Negotiations with NSF led to the scaling down of hardware (199 terminals) and of curriculum development expectations, but simultaneous system and curriculum development was retained.

The 1972 contract specified that reading curricula were to be prepared for grades 1 and 2 for the first demonstration period slated for the 1973-74 school year. At the same time, mathematics curricula for grades 2 and 3 were to be tried out, in each case involving 240 students at each grade level distributed among four schools. For the second demonstration period, the 1974-75 school year, grade 4 mathematics and grade 3 reading materials were to be added.

The curriculum was to be delivered via student terminals--99 of which were to be installed in elementary schools by the end of the 1972-73 school year, thirty-five in Urbana-Champaign elementary schools and 64 in Chicago public schools. By September 1974, another 25 would be installed in Urbana-Champaign, and 75 additional terminals would be in place in Chicago schools.

The contract also specified the addition of extended core storage capacity to accommodate the additional terminals, computer software development, and also educational liaison and teacher/author training necessary for implementing the demonstration. The schedule is reproduced below:

January 1972 - April 1972	(a)	Develop cooperative educational program with participating school districts involving commitments to participate in educational plans; plan field test and evaluation programs.
April 1972 - July 1972	(b)	Complete memoranda of understanding with elementary schools participating in the field test program.
July 1972 - August 1972	(c)	Conduct one teacher/author training workshop for staff at public schools.
September 1972 - May 1973	(d)	Develop plans and operating procedures with participating institutions regarding institutional programs and data collection for the educational and economic evaluations.
September 1972 - May 1973	(e)	Continue teacher training program through the use of the student consoles initially installed at participating institutions.
June 1973 - August 1973	(f)	Conduct teacher training workshops for elementary school staff.
September 1973 - May 1975	(g)	Provide assistance and coordinating functions at the participating institutions relative to: (1) the incorporation of the PLATO instruction into the on-going educational program, (2) the operation and use of the PLATO system, (3) continued training and education of teachers, and (4) the acquisition of data for the economic and educational evaluation.

Milestones for the development of the curriculum were also set down. They called for the development and two complete revisions ("editions") of complete grade 1-5 reading and K-6 mathematics curricula between January 1972 and September 1975.

Thus, CERL, with its engineering laboratory tradition of creative hardware and software development by individuals and problem-oriented small groups, found itself committed to curriculum development of complete elementary courses. For a medium as yet untried in elementary schools, development required the coordination of sizeable groups of authors and student programmers, further coordinated hardware and system development, teacher recruiting and training for a large number of classrooms, and tight production schedules. Such an elaborate effort was not in keeping with CERL's previous history. In fact, many of the senior CERL staff were not sufficiently acquainted with the difficulties that had been revealed during the previous decade's attempts at innovative elementary school curriculum development, nor were they experienced in the intricacies of concurrent piloting and demonstration of new material on a still developing system. As it turned out, the elementary school components would, indeed, require CERL to explore much new terrain. Frequent changes in implementation plans and slippage in schedules soon occurred, and it became increasingly clear that the magnitude of the task had been seriously underestimated. The two elementary curriculum groups had markedly different responses to this situation. Certain of these differences will be noted in this report, with attention given especially to group organization, mix of expertise, and division of responsibilities. These observations, it is hoped, may offer useful cautions for future efforts in computer-based curriculum development.

2.2 The Elementary Projects

Although the elementary project was treated as a single component in the total PLATO effort, the reading and mathematics projects became in fact two independent efforts, with no overlap in personnel and, ultimately, considerable divergence in approach to building and implementing curriculum. For these reasons the projects will be treated separately, with occasional comparisons of their courses of development.

The Elementary Mathematics Project

The Staff

In 1972 Dr. Robert Davis was appointed to the faculty of the University of Illinois and made Associate Director of PLATO. Davis was to direct the entire Elementary component, heading both the math and reading groups, although his area of expertise was mathematics education. A year later, however, the Reading Project became an independent administrative entity, with John Risken its director, reporting directly to the director of CERL.

Davis had developed and directed the Madison Project in the 1960's, an extensive effort to rethink and reshape the traditional grade-school mathematics curriculum. Thus he had considerable prior experience in introducing curricular innovations into schools, as had the two teacher-trainers from the Madison Project who came along to Urbana.

The new staff was complemented by two half-time members, who were experienced in working with the local school systems. Two authors who had been working on math materials for PLATO III stayed on. Five half-time graduate assistants and a new Ph.D. in mathematics were recruited. Subsequently, several student programmers, to aid the authors, and a systems programmer were also attached to the group.

The staff, particularly those involved in lesson production, remained stable over the duration of the project. However, the two local liaison persons left before the pilot year got under way.

The senior staff brought experience in curriculum design and implementation to their task and a well-developed approach to teaching mathematics to students and teachers, because implementing the Madison Project had been construed partly as the task of stimulating teachers to undergird their teaching with broader mathematical understanding. These leading members had little programming facility at the beginning and had to become familiar with the PLATO system from the ground up.

The earliest goals called for a math curriculum spanning four grade levels (2-6) and comprising nine strands (a connected set of lessons and games dealing with a broad topic such as fractions), aimed at low-income, urban children. This plan was modified over time, ultimately converging on grades 4-6 with three strands. On the whole, the math group appraised the nature of the task realistically, seeing the materials produced under the NSF contract as "first drafts," with subsequent iterations implied. They were also disposed to welcome alternate modes of thinking about instruction.

The division of the task into curricular strands was reflected in the organization of the mathematics group. A pair of staff members was responsible for each of the three strands, and the work involved designing lessons, programming (with the help of part-time programmers), designing on-line feedback for teachers, preparing supplementary materials, and ensuring classroom implementation, including teacher training and liaison. Project functions were equally divided. The two senior members undertook the construction of the Graph strand, and two of the graduate assistants designed the Fraction strand. The Whole Number strand was developed by the two authors who made the transition to PLATO IV, joined by the mathematician.

The spirit of the enterprise and its conceptual base was significantly shaped by Davis. However, his hands-on participation diminished over the course of the project, although he remained in close touch with the staff. The three strands evolved almost independently, and pedagogical approaches diverged as the groups worked in parallel more than in interactive fashion. Different strands operated on different curriculum management or "router" systems, which were not designed to pass diagnostic information to each other, and which provided monitoring information to teachers in quite different formats. This lack of coordination, as well as the differences in level, pace, and content of the strands, made it likely that they would exhibit differential effectiveness with different groups of children.

The Curriculum

Given that there was a common base of certain shared views about the goals of mathematics instruction, although considerable tactical divergence, the immediate task facing the math project staff was to gain familiarity with the PLATO system. They needed to assess the constraints and opportunities PLATO presented for an approach that stressed understanding over computational ability and that viewed the learner largely as active constructor rather than passive receiver of knowledge. Beyond exploring the potential of the technology, the staff also had to gauge what it could accomplish within the time of the project and make decisions about what schools the curriculum would be given in and what kinds of children would be in the demonstration.

The evolution of the staff's thinking about their aims is recorded in several documents. The following summary of the conceptualization and goals of the project is taken from a 1974 document, the Implementation Plan for Elementary School Mathematics. The overall task was described as comprising five parts:

1. Finding acceptable (though perhaps not optimal) solutions to three integration problems:
   a. Integrating PLATO terminals physically into intermediate grade classrooms, at approximately the level of 4 terminals for a 25 student classroom
   b. Integrating the teaching role and demands of PLATO into the teacher's daily routine
   c. Integrating the PLATO curriculum into the other pieces of school curriculum in mathematics
2. Demonstrating the adequacy of the three integrations, via the "National Demonstration" and the ETS evaluation program
3. Creating first-approximation courseware adequate for 1 and 2 above
4. Demonstrating, via the "National Demonstration," and with ETS's help, the general adequacy of this courseware
5. Acquiring, from these trials, detailed information that could be used to revise and extend this courseware.

The courseware that was readied for the field trials was to consist of three strands: (1) Whole Numbers, (2) Fractions and Decimals, and (3) Graphs, Variables, Functions, and Equations. A parallel activity of equal significance was the design of the session selector, the routing mechanism for guiding the student through a prespecified curriculum composed of many lessons. The session selector was to enable a student to progress through the curriculum without the need for teacher intervention, although the option for teacher-guided sequencing would be available.

Although the primarily add-on usage of PLATO would have lent itself most naturally to drill-and-practice applications, the content of the strands was emphatically not oriented to drill and practice. With the exception of some games and a few lessons, the focus was on understanding, far more than on computational facility. The major goals of the strands were stated in the Implementation Plan for Elementary Mathematics (1974) as follows:

Whole numbers - General goals:

1. Move slowly enough to build meanings carefully, so that rote rules will not be necessary
2. Show that algorithms are efficient procedures for finding answers, but that definitions of operations are simpler than algorithms
3. Give students the feeling that every mathematical statement corresponds to some reality situation and the ability to translate between real situations and mathematical statements.
4. Develop such heuristic devices as renaming and finding a similar, but easier, problem.

More specific behavioral goals were:

1. The student should be able to illustrate meaning of arithmetic operations with at least one concrete model
2. The student should be able to write number sentences that correspond to word problems and also be able to generate word problems that correspond to number sentences
3. The student should understand the meanings of operations and properties of operations well enough to use them to manipulate numbers (e.g., 26 = 25 + 1, so 4 X 26 = 4 X 25 + 4 X 1 = 100 +4)

4. The student should comfortably and accurately carry out operations involving a 1-digit and a 2-digit number in his head and two 2-digit numbers on paper
5. The student should be able to do any of the four operations on two 2-digit numbers using some standard algorithm
6. The student should have some "feeling for numbers," including a sense of grossly wrong answers and an ability to estimate and check results of computations
7. The student should have sufficient problem-solving skills to be able to attack unfamiliar problems and should have a number of specific problem-solving strategies at his disposal.

In fractions, the goals appeared more traditional, although the lessons again put heavy emphasis on understanding meanings:

1. Identify and construct various fractional parts of various units, both continuous and discontinuous(e.g., regions, lengths, turns, sets)
2. Relate fractions to division problems
3. Construct equivalent fractions
4. Compare nonequivalent fractions
5. Find common denominators
6. Add, subtract, and multiply fractions
7. Add, subtract, and multiply mixed numbers.
8. Read and write decimals
9. Relate fractions with denominators = 10^n to decimals and vice versa
10. Use decimals with and in place of fractions in basic fractions activities.

Specific behaviors that would illustrate mastery of the fractions strand were given, but it was stated that the lessons were intended to add depth and dimension to the understanding of children who could carry these out:

1. Can illustrate fractions and equivalent fractions (both continuous and discrete cases)
2. Know that fractional parts depend on the unit chosen

3. Can reduce fractions to simplest terms and convert mixed numerals to fractions and vice versa
4. Can, without difficulty:
   i. Add and subtract fractions and mixed numerals using common denominators
   ii. Multiply fractions and mixed numerals
   iii. Divide fractions (tentative) and can illustrate i, ii, and iii with appropriate diagrams

For decimals, the student can:

1. Read and write decimal numerals to 100ths
2. Convert decimals to fractions
3. Convert fractions with denominators of 10 to decimals
4. Do simple addition and subtraction with decimals.

Graphs, variables, functions, and equations strand:

1. A student will be able to make numerical replacements of the variables in order to obtain true statements from such linear and quadratic sentences as:

   $a \times \square + b = \bigcirc$

   $a \times b = \square$

   $\square \times \square - a \times \square + b = 0$ (where there are natural numbers c and d such that $c \times d = b$, $c + d = a$)

   $\square \times \bigcirc + \square = a$

2. Given an ordered pair of integers, in the range -5, +5, a child can locate the corresponding point on Cartesian coordinates; and, conversely, given such a point the child can state its coordinates
3. Given a discrete graph a child can select the open sentence whose graph is shown
4. Given a table showing elements of the truth set, a child can identify a formula representing the underlying linear function
5. A child can write simple repeated multiplication using exponents and can evaluate simple expressions involving exponents
6. Relate fractions to division problems.

The Lessons

The elementary mathematics curriculum effort ultimately resulted in three content "strands"--whole numbers, fractions, and graphs. Although the graphs strand was essentially completed during the 1974-75 year, authoring of the other two strands continued through the demonstration. The three strands differ in design and emphasis.

The whole-numbers strand stresses the meaning of the operations of addition, subtraction, multiplication, and division, considerable emphasis being given to alternative ways of looking at operations and place value. Multiplication, for example, is presented as repeated addition, as arising from rectangular arrays by doubling and building up easier problems, the traditional algorithm delayed and not strongly emphasized. Word problems are presented quite thoroughly, but practice in computation emphasizes small numbers, again with more focus on meaning than facility.

Attractive games (e.g., "How the West was Won," "Speedway," "Pitcher Pouring Problems" and the "Claim Game") aim at giving practice in simple computation in the course of competing with the computer or the students' own previous performance. Many extrinsic graphics (not centrally related to the lesson but adding interest or reward) are employed. Numerous lessons are aimed more at experience than mastery, and hints are frequently given if the student should answer incorrectly.

The fractions strand, beginning with meanings of fractions, moves the student methodically through mixed numbers, equivalent fractions, addition and subtraction with like denominators, addition and subtraction with unlike denominators, and ends with units on multiplication and decimals. Students are not allowed to progress until they have shown mastery of prior concepts.

Reading of rather complex instructions is required to work through some touch panel simulations. A number of games (e.g., "Darts," "Fractions Basketball," "Splash," "Pick-a-tub") and simulations (e.g., "Painting," "Sky Writer," "Pizza," "Make a Monster") enliven the curriculum, but the general flavor is didactic and sequential.

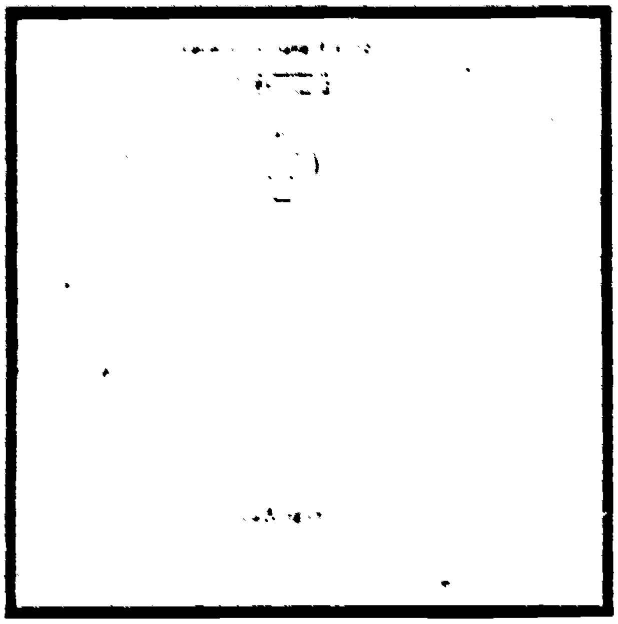
The graphs strand, the first of three to be completed, covers signed numbers, linear and quadratic equations, functions and variables, using techniques developed in the Madison project. Postman stories, games such as "Battleship," "Guess my rule," and the Tower Puzzle are familiar to many teachers who have used a mathematics laboratory approach. The general level of the material is high, and there are significant gaps and many instances of "try until you get it" rather than remedial information or hints. Considerable emphasis is placed on divergent approaches (e.g., coming up with a new name for a number or a novel way of writing an open sentence). Few lessons contain an internal criterion of success other than completion. This strand is almost antithetical in approach to the fractions lessons, and the whole numbers strand occupies an intermediate position in step size, in guidance to the student, and in open-endedness of goals.

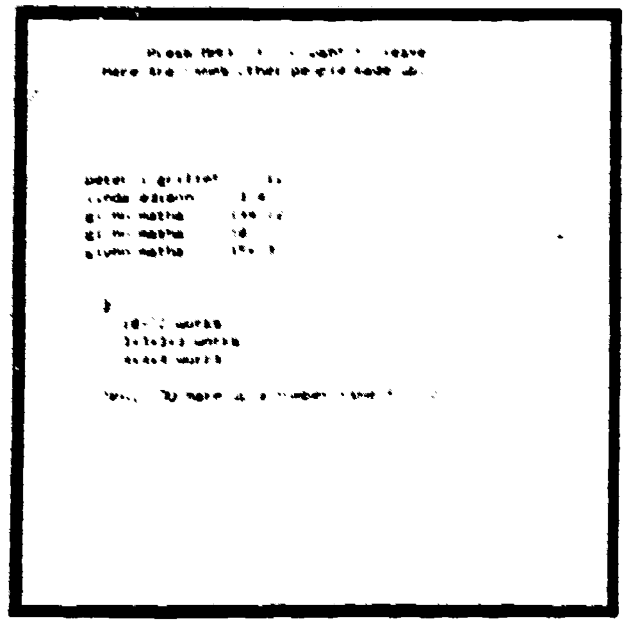
The three strands became available in partially completed form at varying times during the 1974-75 school year: graphs in September, whole numbers in November, and fractions in March. The complex router, or lesson-selecting program, was unusable during the first half of the pilot year because of memory restrictions. During the final year, the three strands ran independently in the router. Transfer from one strand to another was accomplished by teacher prescription (certain strands on certain days of the week for individual children).

It did not prove possible to link strands within the router. Thus, if a child's errors in fractions revealed problems in understanding whole number operations, no mechanism was available to route the child into an appropriate sequence in the whole number strand. Although the project director felt imposing unity and integration of approach would have been premature and would have inhibited variety and exploration, the lack of integration of the strands seems to the evaluator to have been a serious weakness, particularly because most teachers did not, in fact, regularly monitor and intervene in children's strand assignments.

Samples of selected lessons, reproduced from curriculum guides developed by the three mathematics groups, are shown on the following pages.

Names for Today's Date





Type: experience
Exposure: repeated

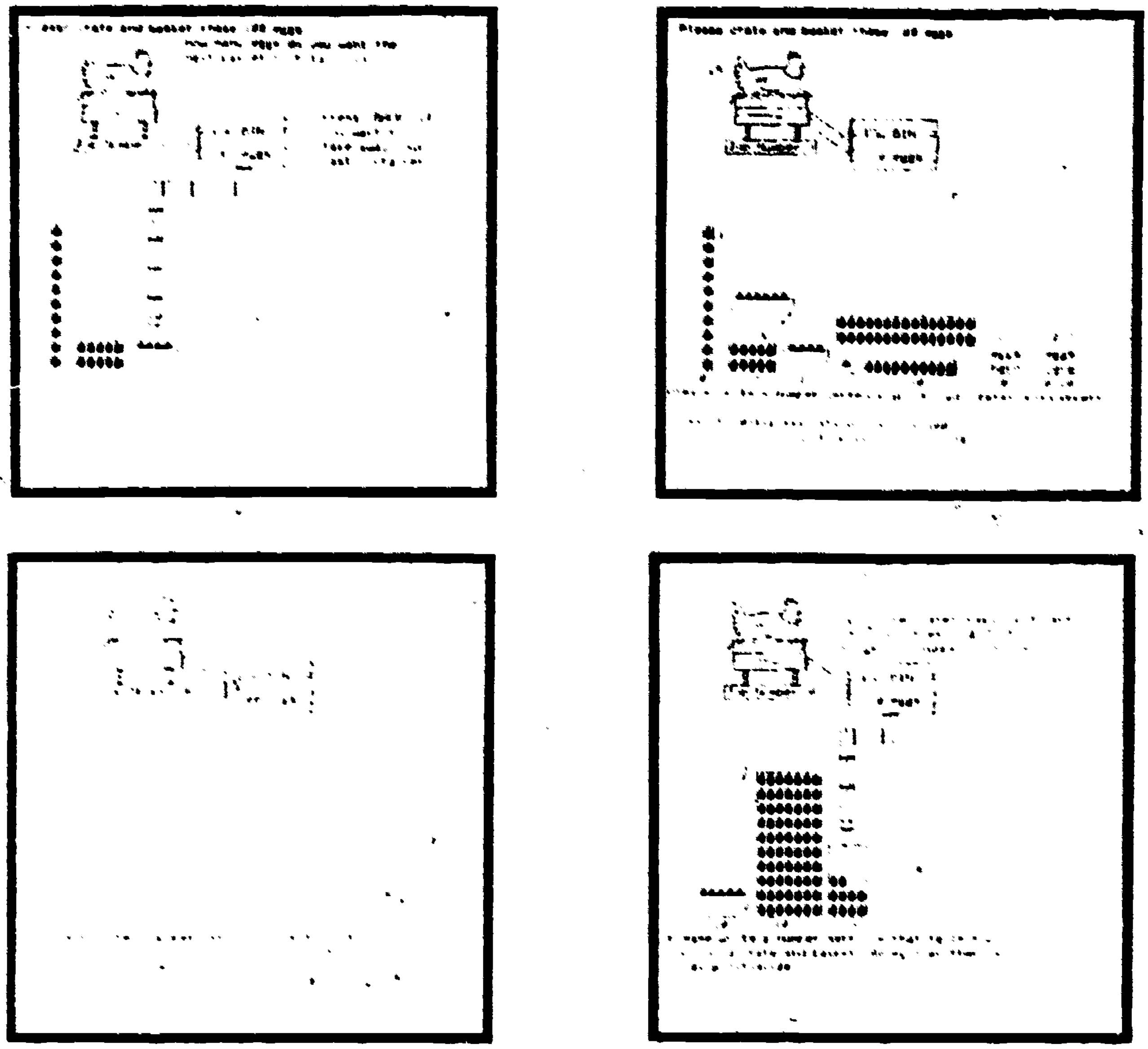
Objective: Student can write several expressions having the same numerical value.

Purpose: To provide experience in generating arithmetic expressions with a given answer, to increase flexibility in generating arithmetic expressions, to broaden experience with arithmetic expressions by exposure to expressions generated by other children.

Description: Student is told that day's date and is shown an example of how that number may be renamed. He then sees a list of names that other children have written and may add as many names as he likes to the list.

SPECIAL DAYS: The program can be set to accept only certain types of expressions, such as those containing no zeroes, or exactly one times sign, etc.

Egg Factory



Type: experience

Exposure: six segments, one repeats

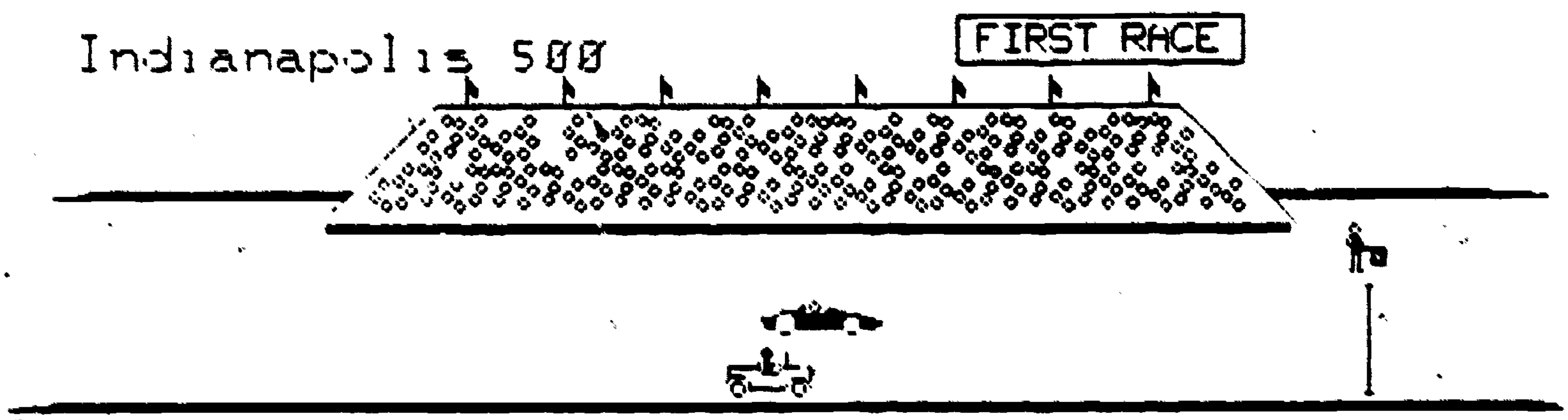
Objective: Student renames a number using addition and arrays.

Purpose: Provides a model for experiences with renaming a number using the operations of multiplication and addition. The situation provides a natural reason for multiplication's preceding addition.

Description: For the first "job" the student breaks up a given number of eggs into a series of crates (arrays) and baskets (addends), then writes a number sentence that describes the collection of containers. For the next job, the student breaks up the same number of eggs in a different way, or first writes his number sentence and then watches the factory crate eggs according to the number sentence.

SPEEDWAY

Lesson type: Drill and practice



8	8 ok	6	1	4
7	3)24	− 3	× 8	+ 6
56 ok		3 ok	8 ok	10 ok

Press -HELP- for a picture of the problem

11	
− 8	8)32
3 ok	

Lesson type: Guess a rule

Problem 20

input □	output ⬡
1	8
2	12
3	16
10	44

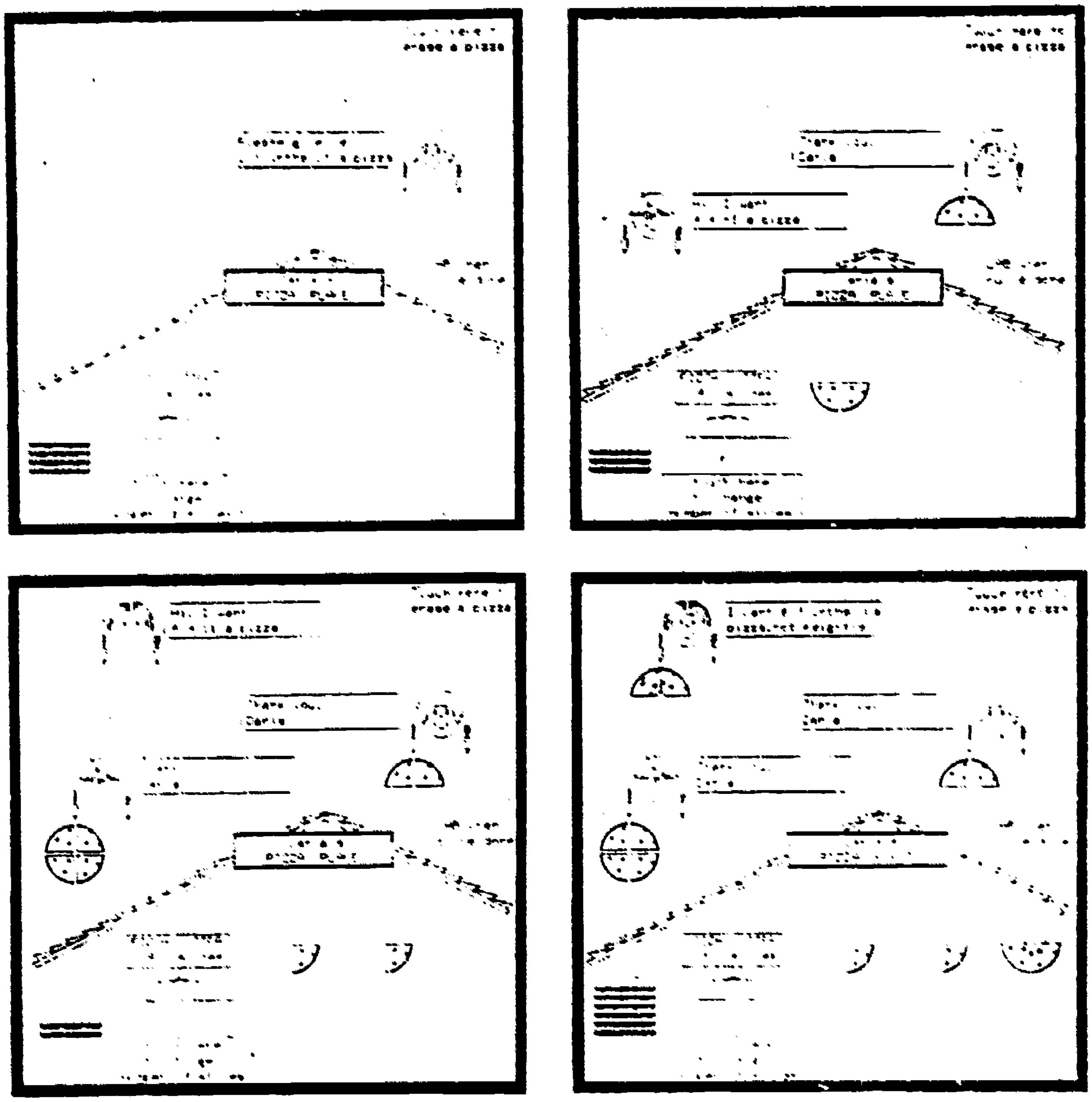
GUESS THE RULE

VOCABULARY

any number; (,),+,-,*; and

PRESS b for □; or h for ⬡

Pizza: Fractions (touch)

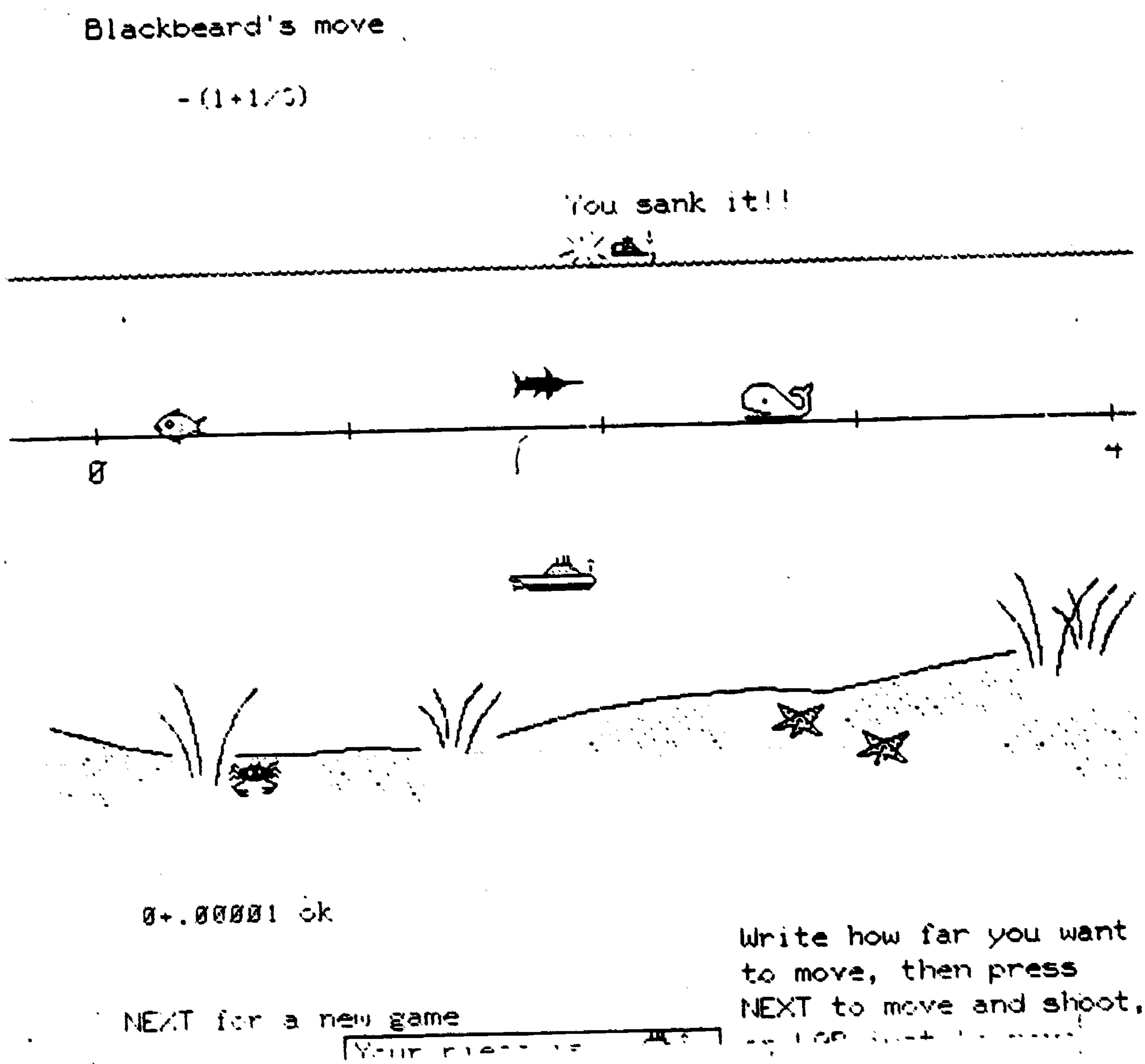


Purpose: 1) Re-emphasize with physical model that 3/4 is 3 of ~~a~~ fourth.
2) Extend this to fractions >1.

Description: The student operates a pizza place, serving kids who appear and ask for specific fractions of pizza. The problem sequence depends on the student's performance. It is designed to do fractions <1 until the student is familiar with the model, then lead into fractions equal to 1 and >1.

TORPEDO

Lesson type: Inter-terminal game



The Elementary Reading Project

The Staff

The PLATO Elementary Reading Curriculum (PERC) staff differed from the mathematics group in several ways: in the skills and experiences its members brought to the project, in its internal organization, and even its educational philosophy.

The Project Director, John Risken, was already on the CERL staff when a long period of negotiation with a prominent reading researcher for the directorship came to an unsuccessful end. Risken, who developed an interest in computer-assisted instruction while doing graduate work in English, had a teaching background in secondary-school English, with particular interest in remediation. Other members of the reading group had limited experience and training in reading instruction or curriculum development at the elementary level. The reading group as a whole had more initial facility in the use of a computer system and more inherent interest in the technological aspects of PLATO than did the math group.

In mid-1972 PERC included, in addition to the director, four full-time and two half-time staff. The staff remained relatively stable for the duration of the project. There was little change in lesson design personnel, only the classroom liaison function experiencing staffing problems.

PERC's internal organization was strongly hierarchical. The work of the individual staff members was relatively specialized, as the lesson design and authoring activities were fairly well separated from the implementation and classroom liaison functions. Although responsibility for initial lesson development was apportioned to individuals, all staff members working on curriculum development were involved in lesson review.

The director was also a hands-on working member of the group, who devoted a significant proportion of his time to developing a curriculum management system. He also dealt with the technical problems that arose with the audio device, was involved in the actual production of audio discs, and programmed the final year's phonics lessons.

The Curriculum

The PERC staff articulated its plans for the reading curriculum in a series of documents, which represent successive refinements and clarifications of the group's conception of the project. The following description of PERC's view of its task relies predominantly on two documents, one completed at the end of 1973, the Implementation Plan for Elementary Reading, (Risken et al.) and the Proposed Amendment to the Statement of Work (March 1974). These plans represent considerable modification of the effort outlined in the original 1972 contract but bear closer resemblance to the project as it was in fact conducted; they are thus a more appropriate referent - the evaluation.

PERC's statement of purpose is succinct enough to be quoted in full, giving a good flavor of the guiding conceptions of the project. The overall goal was subdivided into seven areas:

"First, PERC is responsible for the development of a large body of instructional materials for beginning readers at the elementary school level.

Second, PERC is responsible for the development of a reasonable model of the learning-to-read process.

Third, PERC is responsible for the development of a beginning reading curriculum that utilizes the instructional materials within the scope, sequence, and logical structure of the learning-to-read model. Note that these first three purposes are in no sense independent of one another. The exact nature of the materials to be produced is often dictated by the learning-to-read model; and the model itself is easily influenced by the knowledge of how children learn that we gain from experimental use of the instructional materials.

Fourth, because we are pioneering in the development of computer-based curricula, one of PERC's responsibilities is to develop principles of child-computer interaction that will be both valid and general. Specifically, our purpose is to develop rules of 'thumb' about display organization and response processing that will enable subsequent curriculum projects to reduce the amount of start-up overhead inherent in the development of any curricula.

Fifth, because we are pioneering the large-scale classroom implementation of computer-based curricula, one of our responsibilities is to determine what some of the viable alternative forms of implementation are. It makes no sense for us to assume that we can learn more about a teacher's students than the teacher does, and that therefore the teacher should subserviently accept both our conclusions and our curriculum. In fact the only curricula which are ever effective in a classroom are those that the teacher perceives as being effective. One of our purposes thus must be to find patterns of classroom use that satisfy the teachers' needs.

Sixth, growing cut of our need to find alternative modes of classroom implementation comes our responsibility for developing a curriculum management system that will interface between our instructional materials and the reading model on one hand, and the constraints and limitations of PLATO on the other. The system must be powerful, of course; but because we cannot predict exactly what form the materials or the model or classroom utilization might take in the future, it must also be very flexible in the sorts of structures it will accept.

Seventh, also growing out of our responsiblity to experiment with alternative modes of classroom implementation, comes our responsibility for developing a powerful teacher-administered instructional materials management system. It seems quite likely to us that some teachers will find the materials we develop quite unsuitable for their advertised purpose but admirably suited for some other use, and they will reject our curriculum out of hand and will propose a sequencing of materials quite unlike anything we had expected. For us to deny them the power to arrange materials as they see fit might well be to doom the curriculum for their classroom. Therefore a management tool at least as important will encourage the teacher to exercise as much or as little control over our materials as she desires."

The development of the instructional materials was guided by an outline of seventeen conceptual skill areas that were considered important for beginning reading. The PERC Staff arrived at these skills by way of an elaborate task analysis of prerequisite behaviors for proficient reading. The process of analysis, as recounted by the staff, can be characterized as a logical analysis of the identifiable skills of the competent reader rather than an analysis of the developmental steps in the learning-to-read process as it might be observed empirically. The concept areas themselves, as can be seen from their listing below, represent cognitive functions of varied complexity and teaching tasks posing different challanges:

1. Phoneme discrimination - distinguishing among the significant sounds of the oral language
2. Grapheme discrimination - distinguishing among the significant shapes of the written language
3. Grapheme-phoneme associations - pairing the sounds of the oral language with the shapes of the written language
4. Phonic analysis - decoding words and word segments by sounding them out
5. Visual memory - acquiring and retaining a maximum amount of raw visual print information with a fixation of minimum length
6. Left-to-right processing - habitually scanning print-dominated material from left to right, top to bottom
7. Temporal sequencing - recognizing the principles of chronological organization in narrative materials
8. Affixes - recognizing and employing the principle that the basic meaning of a word can be radically altered in function and meaning by the addition of prefixes and suffixes
9. Recognition of literal sentence meaning - being able visually to process a printed sentence and apply the information contained therein.
10. Vocabulary acquisition - habitually adding to the store of words one recognizes at sight
11. Word boundary recognition - recognizing and using the print convention of putting spaces between words
12. Pronoun usage - decoding sentences which make heavy use of pronouns to refer to earlier nouns
13. Similarities and differences - learning how to develop and use categories of comparison as a means of analyzing information

14. Contradiction, support, and irrelevance - recognizing the principles of argumentation and propaganda
15. Recognizing and applying the principles of synonymousness at the sentence level
16. Spatial ordering - recognizing and using positional concepts
17. Conceptual recall - remembering information over extended periods of time.

The PERC staff attempted to order these conceptual areas so as to guide the logic of a curriculum management system, postulating a cognitive hierarchy for acquiring the skills described in the conceptual areas. It is this hierarchy that was called the learning-to-read model. Figure 2.2.1 reproduces the model, or routing tree, as it was developed at the end of 1973.

In addition to lessons aimed at the skill areas, PERC also undertook to develop materials with less focussed objectives. Plans included the preparation of:

1. Interactive stories, which enable the child to choose from several alternate endings to a story with a single stem. Ten such stories were projected for the fall of 1974

2. Experience stories (e.g., programs which would allow stories dictated by children to be typed into PLATO and later made accessible for "reading" in the touch sensitive mode)

3. Commercially published stories which would be made available also in the touch sensitive mode and enhanced by the use of the microfiche capability of the PLATO terminal to make the book's pictures available as well. A large number of these, 50-100, were expected to be available for the fall of 1974.

Figure 2.2.1

PLATO ELEMENTARY READING CURRICULUM

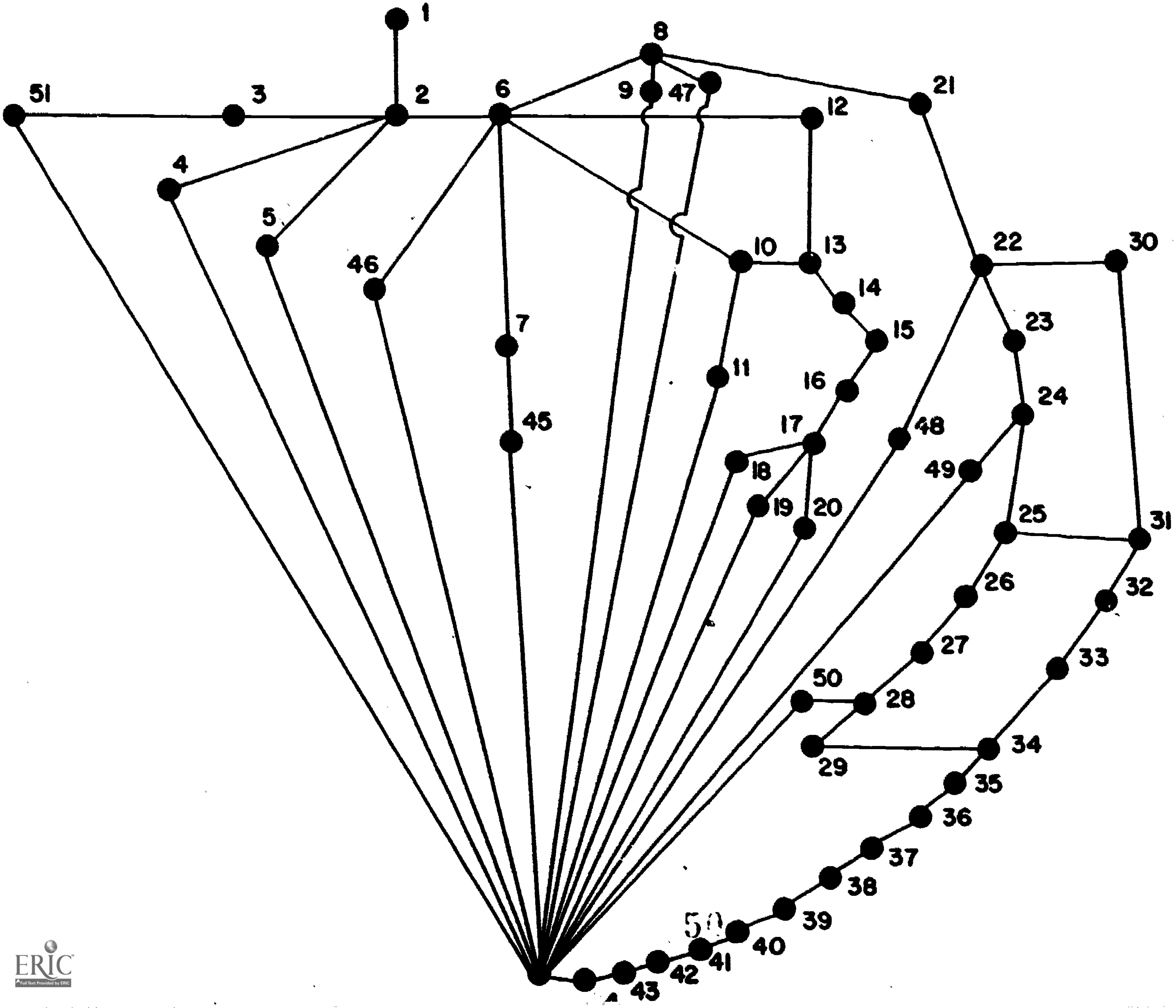


Figure 2.2.1 Key

PLATO ELEMENTARY READING CURRICULUM

Curriculum Chart, August, 1974

1. Initial sign-in procedures
2. Touch panel and keyboard orientation
3. Information about PLATO
4. Practice typing your name
5. Use of the replay key
6. Visual discrimination, letters, gross
7. Visual discrimination, letters, fine
8. Visual discrimination, words, gross
9. Visual discrimination, words, fine
10. Letter names
11. Upper/lower case correspondences
12. Identifying words by initial letters
13. G/P correspondences, letters i, p, n, t
14. G/P correspondences, letters a, s, b, l
15. G/P correspondences, letters e, r, m, d
16. G/P correspondences, letters u, k, h, f
17. G/P correspondences, letters o, c, w, v
18. G/P correspondences, letters y, g, j, z
19. G/P correspondence, -qu-
20. G/P correspondence, -x-
21. High frequency sight words, list 1
22. High frequency sight words, list 2
23. Hightfrequency sight words, list 3
24. High frequency sight words, list 4
25. High frequency sight words, list 5
26. High frequency sight words, list 6
27. High frequency sight words, list 7
28. High frequency sight words, list 8
29. High frequency sight words, list 9
30. Enrichment sight words, animals1
31. Enrichment sight words, face features
32. Enrichment sight words, shapes
33. Enrichment sight words, colors
34. Enrichment sight words, clothing
35. Enrichment sight words, animals2
36. Enrichment sight words, toys
37. Enrichment sight words, household1
38. Enrichment sight words, food
39. Enrichment sight words, vehicles
40. Enrichment sight words, people
41. Enrichment sight words, household2
42. Enrichment sight words, animals3
43. Enrichment sight words, household3
44. Enrichment sight words, misc. words
45. Visual memory
46. Left to right processing
47. Interpretation
48. Concept of up/down
49. Concept of under
50. Concept of left/right
51. Stories

PERC thus identified its primary task as curriculum development but viewed that effort as embedded in several related activities that were necessary or supportive of that goal, with particular concern for the order of the presentation of the materials.

The staff invested significant energies in the task analysis of reading and identified and articulated learning objectives. The quantity of materials expected to be available at different periods in time were clearly indicated, the nature and distribution of the materials among the learning objectives, however, were less clearly anticipated.

Aware of entering the uncharted waters of lesson design that would be responsive to the nature of child-computer interaction, PERC staff pledged to communicate their experiences, committing themselves to a process of reflection and documentation over and above what was immediately necessary for curriculum design. The area of child-computer interaction was a particularly salient concern, given PERC's decision to demonstrate the feasibility of having kindergarten-age children working on PLATO in an independent manner.

Viewing the teacher as an influential mediator of curricular materials, PERC accepted responsibility for the development of a teacher-administered management system along with the computer-managed one. The task of familiarizing teachers with the system and the available materials was implied in the goals but not perceived as an area requiring significant resources. The group's analytic approach of breaking the task into extremely specific and discrete subtasks, and of attempting to develop a comprehensive curriculum management system sufficient to make the computer capable of diagnosing and prescribing each component of the process, was not seen as precluding teacher involvement with the system.

It was argued, however, that while teacher involvement and intervention in the decisions of the system were to be encouraged, the system must be able to function at all stages without <u>requiring</u> teacher intervention.

In practice, then, the initial thrust of the reading curriculum was in some ways similar to the "teacher-proof" curriculum reform attempts of the previous decade, but it was also combined with provisions for the possibility of teacher intervention. This desire to make the system self-sufficient, if necessary, led to even further atomization of tasks: the programming of an extensive set of keyboard and touch-panel orientation tasks, followed by extremely detailed visual and auditory discrimination and visual memory tasks-- the latter extending even to showing fragments of letters through a "window," so as to sensitize the child to discriminating among the features of letters. A significant event in the early experience of the reading group was the piloting of a small set of early lessons with disadvantaged and remedial pupils in school XI in the 1972-73 school year. This experience drove home the myriad ways in which young children could misinterpret or confound the author's intention in presenting even the simplest lesson and led the reading group to even greater concern that lessons be presented in conceptually simple and slow-paced fashion.

The Lessons

After a series of lessons orienting children to the touch panel, keyboard, discs, and conventions of the terminal, including practice in typing their names, the lessons among which the system and ultimately the teacher could choose displayed a strong emphasis on perceptual and phonemegrapheme correspondence skills. Many lessons required children to match letters and words by touching portions of the screen, to discriminate among letters and words that differed by fewer and fewer or less salient features, and to sort auditorially and pictorially presented words as matching or not matching a given initial or final consonant or medial vowel. In most cases, correct selections were rewarded by an animated display in which the word moved to a list, picture of train, car, pot of soup, or other goal, and an audio message, such as "right." Incorrect selections were ignored or resulted in disappearance of the stimulus with no comment or a patient, if resigned, audio message of "No, that's wrong." This lack of emphasis on corrective feedback or of attempts to focus the child's attention on the source of errors or to suggest strategies resulted in part from the developers' concern that lesson procedures not be more complex than the content that a lesson attempted to teach.

The sequence of letter sounds presented and tested began with long vowels, following the Economy Company's Phonetic Keys to Reading series used in one district. Although PERC staff were not wedded to the idea that the names of letters of the alphabet, as opposed to their sounds, were intrinsically important to the reading process, each letter name was taught systematically to enable pupils to understand references to letters in other lessons.

Although sound blending was mentioned as a goal, no satisfactory method was developed of approaching this skill, central to most phonics-oriented reading approaches.

Sight words were defined for the curriculum as words not yet decodable by a child, rather than as necessarily irregular or ultimately not susceptible to word-attack rules. Surprising at first, this definition has merit for a system that is actually capable of keeping track for each individual student what letter-sound combinations have been mastered and, therefore, which words are in fact "sight-words" at a given time for a given child. The myriad connections necessary to carry this off were not made, however, and children were generally exposed to lists of words in sequence, not selected on the basis of the child's current word-attack status. One attractive series of lessons presented words in sentences: e.g., "The boy is happy," and went over each word in the order chosen by the student.

A number of games and animated popups illustrated concepts such as "up" and "down" and provided drill. One of these lessons, "Pacer," simulated tachistoscopic speed-reading training by controlled erasure speed of lines from the top of a paragraph.

Finally, a set of color-illustrated, touch-sensitive stories were prepared. Illustrations were reproduced on microfiche for computer-controlled rear-projection, while text appeared in the familiar orange dots of the plasma display at the bottom of the screen.

By touching a line, children could cause PLATO to read that line aloud to them. By touching a word, only that word would be pronounced, or if they preferred, children could simply page through the "book" by touching the corner of the screen. Most of these stories were reproduced from trade books, but several, including the excellent "The Glumph," by Cill Obertino, were written by CERL staff. This particular story was branching, in that the child could choose alternative directions for the tale as it proceeded. Vocabulary in the stories was not coordinated with other aspects of the curriculum.

Thus the curriculum covered portions of beginning reading, leaving gaps in several areas, while offering extensive coverage in others. In general the curriculum could be characterized as eclectic, offering heavy emphasis on readiness and beginning word-attack skills and a rather large jump to sight words and practice in reading connected discourse.

One rough characterization of the emphasis of the curriculum that emerged from the project may be obtained by simply counting the lessons in each final category of the curriculum.

The final classifications used by the developers were more global than were the initially proposed goals, reflecting the developers' movement away from the position that logical analysis into such minute skills as left-to-right processing and recognition of word boundaries could lead to hierarchies that would guide curriculum implementation.

Final categories included orientation, 14 lessons; visual skills, 35 lessons focussing on matching letters and words to a sample; "letter stuff," 30 lessons covering words beginning or ending with each letter of the alphabet and another 13 on matching and remembering lower-case and capital letters and on alphabetical order; auditory discrimination, the largest category, had 116 sorting and same/different judgment activities on words beginning with aurally presented letters; phonics, 30 lessons on word families such as "rag, bag, tag," and as many projected lessons on adding final consonants such as "but, bug, bun"; 65 lessons on basic vocabulary words, many presented as elements of four-word sentences, such as "Look what they do," while certain concept words were illustrated with brief animated "pop-ups"; 15 additional vocabulary word lessons, many in the form of a tic-tac-toe game in functional categories such as animals, clothing, and household objects; 32 stories, 11 with audio; 29 "pacer" stories; and 39 concentration games using letters, pictures, and words.

The Reading Curriculum Management System

As important as the lessons themselves in any curriculum is the means of deciding which lesson to present next to each child. This system can range in complexity from simply turning to the next page of a text to examining the child's entire previous response history, using this information to set a course for the child on a structured map of curriculum nodes and decision points.

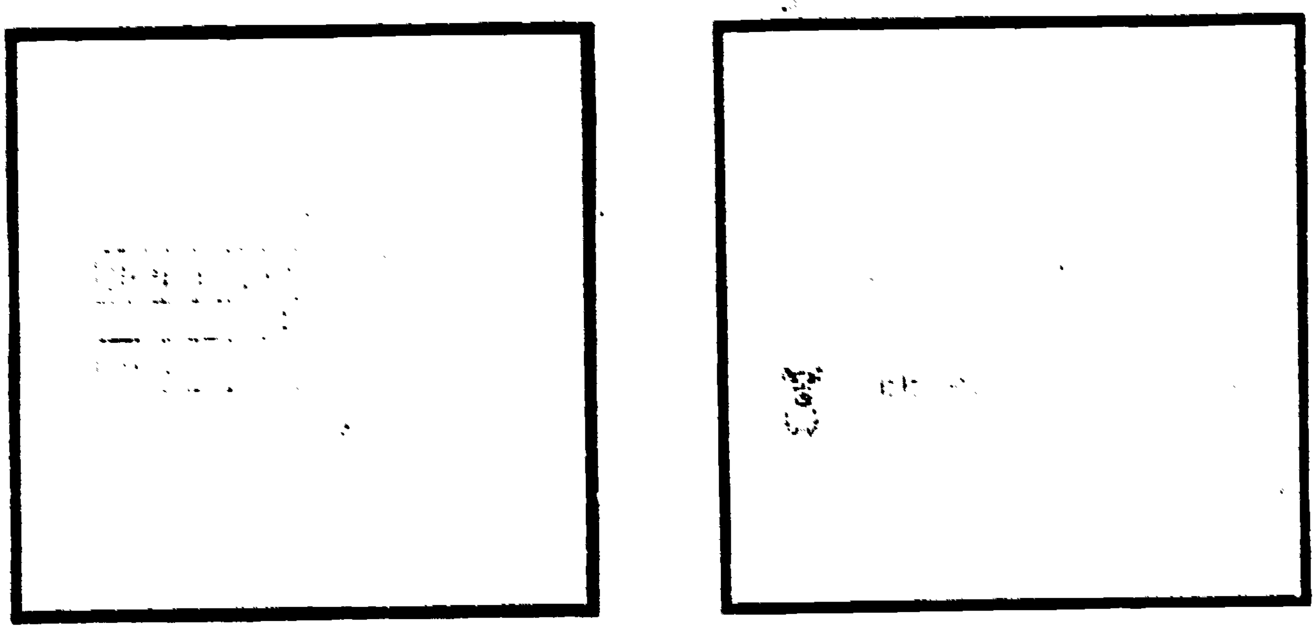
This latter automated approach presupposes the existence of a validated structure for the curriculum and a reliable means of diagnosing the child's status. A middle ground would offer the flexibility of many available paths through the curriculum, but it would rely on teacher decisions and diagnoses for routing, the system providing what information could be obtained as input for the prescribing teacher.

The PLATO elementary reading curriculum was initially based on an automated curriculum management system (CMS), which evolved through increasingly complex decision-making structures. This CMS was finally abandoned in favor of increased teacher involvement in lesson prescription. The extensive student record-keeping capabilities of the computer system, which had fed into the automated curriculum structure, continued to supply detailed student performance information to teachers to assist them in diagnosis and prescription. Although it was not the declared intention of the developers to make the curriculum "teacher-proof," it was originally held that, where possible, the decision of whether or not to intervene should be the teacher's and that the curriculum management system should thus not impose by requiring teacher intervention unless it had run out of available options.

Sample Reading Lessons

The following pages from PERC reports give a small sample of descriptions of reading lessons.

Objective: Practice typing your name



Name of lesson: Type Your Name

Type of lesson: Practice

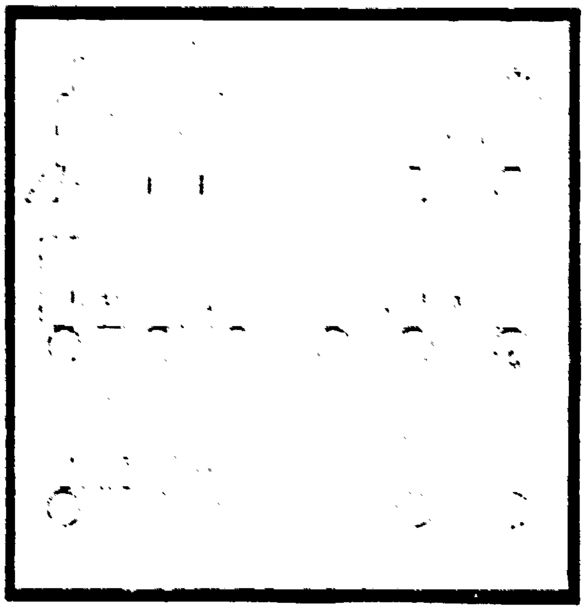
Task: PLATO displays the student's name in a row of boxes, one letter in each row. Below, there is a row of empty boxes. An arrow points from the appropriate letter to the empty box where it will appear when student types correctly. The student is to type his name.

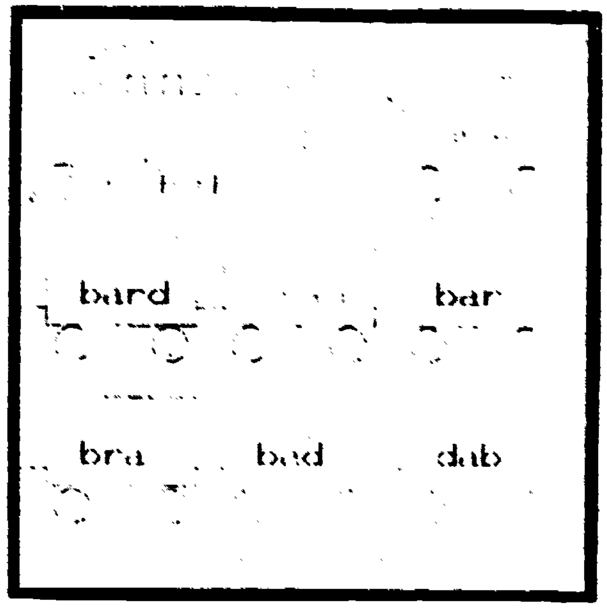
Type of feedback:

Correct response -- as student types, the letters of his name appear in the empty boxes

Incorrect response -- audio correction

Objective: Visual discrimination, words, fine discrimination





Name of lesson: Word Train

Type of lesson: Post-test

Task: PLATO displays target word at bottom of the screen. Child chooses matching word from field of seven words arranged one per car in a train of seven cars.

Type of feedback:

Correct answer -- target word erases and matched word gets several degrees brighter.

Incorrect answer -- target word erases; new target word appears

Items:

drab

bard

brad

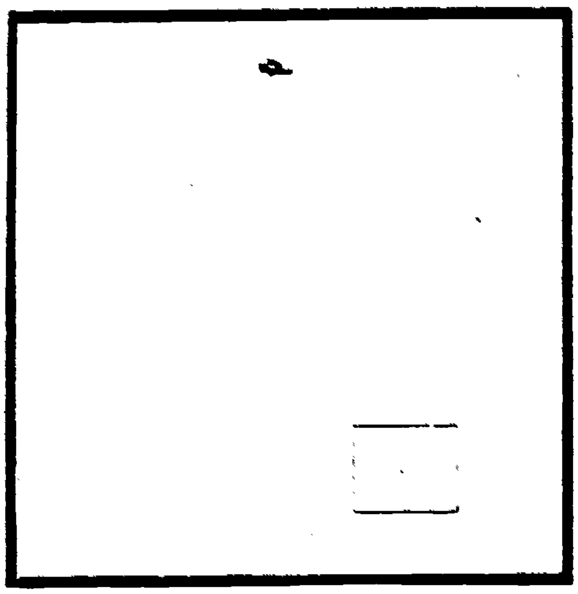
bar

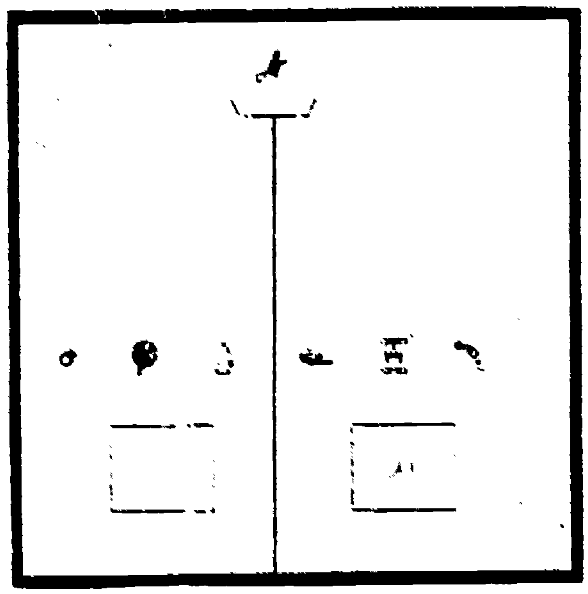
bra

bad

dab

Objective: G/P correspondences, letters o, c, w, v





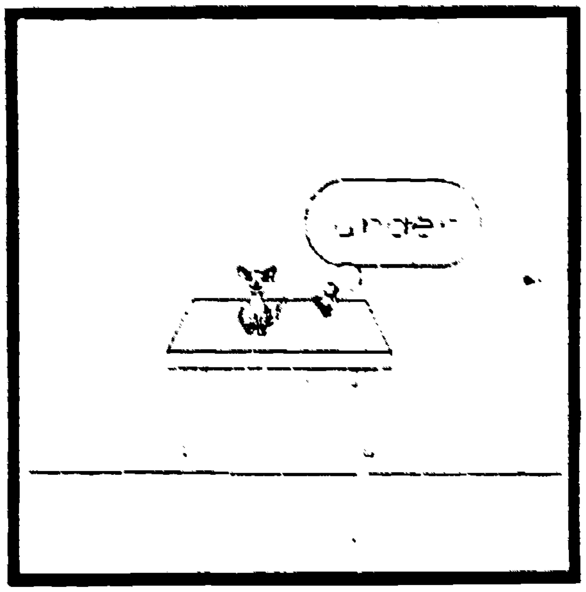
Name of lesson: -w- Pictures

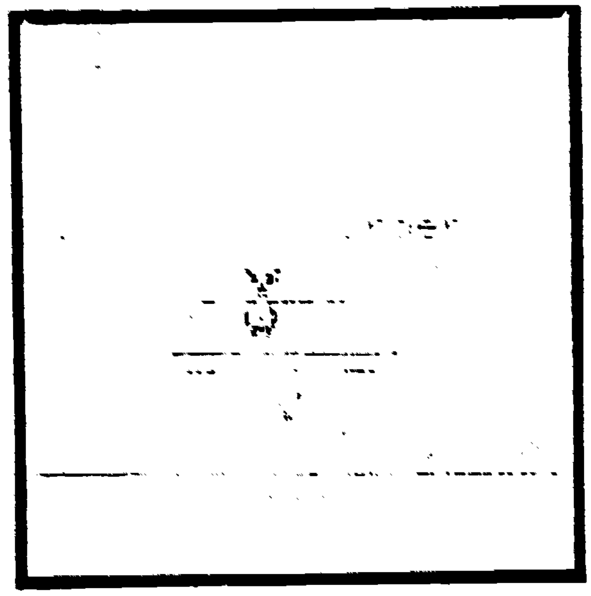
Type of lesson: Exercise

Task: The student is shown a picture and hears the name of the picture. If the word has the target sound in it, he touches the box with the letter in it; if not, he touches the empty box.

Type of feedback:
Correct response -- The picture is placed on the appropriate side.
Incorrect response -- The student is told to touch the other box. After several errors, the student simply goes on to the next word.

Objective: Concept of under





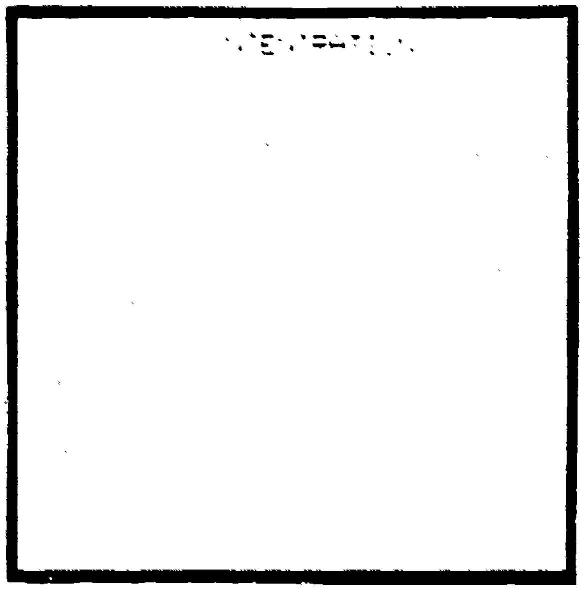
Name of lesson: Under

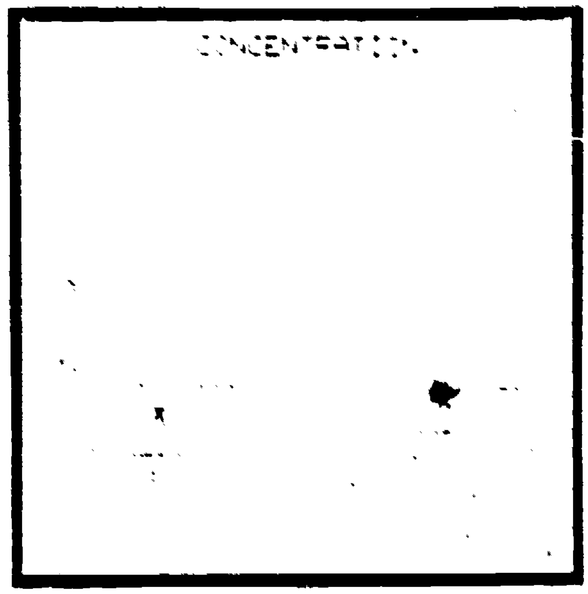
Type of lesson: Practice

Task: PLATO displays a cat and a bird sitting on a table. The bird explains that she would like to hide from the cat by going "under" the table. The child is asked to point under the table.

Type of feedback:
Correct response -- The bird flies under the table.
Incorrect response -- The audio corrects the student, telling him where he has touched: ie. "That is above the table. Please point under, etc."

Objective: Enrichment sight words, clothing





Name of lesson: Concentration (picture/word)

Type of lesson: Practice

Task: PLATO displays a set of boxes on the left of the screen and a symmetrical set on the right side. Pictures are hidden under the boxes on the left and corresponding words are hidden under the boxes on the right. The child can see what is hidden by touching the box; he must match a picture with a word.

Type of feedback:
Correct answer -- matching boxes erase
Incorrect answer -- non-matching boxes do not erase

2.3 The Evaluation

The Staff

A number of ETS personnel worked on various aspects of the evaluation. Roles changed as the nature of the task changed, from clarifying objectives and monitoring early lessons, to observing implementation, designing instruments and data collection, and analyzing and interpreting results. These individuals, and some of their major tasks, are listed in the Acknowledgements.

Goals of the evaluation

In its November 1971 proposal, ETS proposed testing 90 children at each of grades 1-4 in the four then-proposed experimental schools during the 1972-73 through 1974-75 school years. The then-projected grade span (grades 1-3 for reading and 2-4 for mathematics) allowed various combinations of reading and mathematics CAI as well as no-PLATO instruction to be contrasted in cross-sectional and longitudinal within-teacher comparisons.

The educational impact evaluation was intended to examine:

1. Student achievement outcomes
2. Student attitudinal outcomes
3. Impact on the classroom and curriculum
4. Teacher activities
5. Teacher acceptance
6. Reactions of other concerned parties

With the changes in sites, schedule, and targeted grade levels (K-2 for reading, 4-6 for mathematics), major modifications in the evaluation design became necessary, but the focus on an area of outcomes encompassing more than test results remained.

In early 1973, ETS was asked by NSF to consider the implications of a one-year delay in the formal demonstration. Accordingly, a redefinition of role in the 1973-74 year was suggested of monitoring lessons as they were developed. This would then make possible the construction of curriculum-referenced tests likely to be sensitive to effects of PLATO instruciton, the piloting and refining of instruments, and the analysis of the teacher recruitment and early implementation process leading to a September 1974 implementation.

During this interval, the outlines of the demonstration began to take shape. It was possible to delineate a more specific evaluation plan in April 1974 (Breland, Amarel, and Swinton, 1974). In the document (ETS PR-74-4), the evaluators pointed out that the still-evolving natu-- .f the course materials and the inability to achieve random assignment made the evaluation not a controlled experiment but a comparative field study. It was suggested that the generalizability of such a study could, however, be expanded by as faithful a description of its context as was possible. It was also pointed out that the impacts of the demonstrations would extend beyond those that could be measured by survey instruments, and these impacts were thus more likely to be accessible through observation and interview techniques.

A framework for questions on which the evaluation might obtain information was presented, and the importance of classroom process as well as of other outcomes was stressed. A list of fourteen issues were given:

<u>Integration</u>

Is PLATO reading instruction easily integrated in elementary schools in the K- through 2nd-grade range? Is PLATO mathematics instruction easily integrated in elementary schools in the 4th- through 6th-grade range?

Is the effectiveness of the PLATO curriculum related to the degree to which it is integrated into the ongoing reading or mathematics curriculum of the class?

Achievement

When integrated with reading instruction in elementary schools at the K- through 2nd-grade range, what are the achievement outcomes? When integrated with mathematics instruction at the 4th- through 6th-grade range, what are the achievement outcomes?

What amounts and types of adult intervention and assistance are required to enable children to work through the various lessons? Does more than the minimum of such assistance contribute to or detract from learning?

Attitudes

When integrated with reading instruction in elementary schools at the K through 2nd-grade range, what are the attitudinal outcomes for the pupils and adults associated with the program? When integrated with mathematics instruction in elementary schools at the 4th- through 6th-grade range, what are the attitudinal outcomes for the pupils and adults associated with the program?

What do pupils and teachers see as advantages and disadvantages of PLATO?

What is the effect of CAI on other concerned groups--nonparticipating teachers, principals, and parents?

The classroom

What classroom organizations, support systems, and teacher characteristics are consistent with successful implementation of the system?

What are the effects of the introduction of the PLATO system on aspects of classroom ecology: teacher's role and authority and such child behaviors as cooperation, competition, and isolation?

To what degree do teachers use the information available from the system to prescribe alternate sequences for different children? How does such intervention affect outcome?

The curriculum

What are the strengths and weaknesses of specific courseware in reading and mathematics?

Do the more effective lessons typically utilize certain features of the system's capability in a particular manner?

Interactions

How do pupil characteristics interact with amount of PLATO-related learning?

Which groups of children (boys or girls, high or low achievers, aggressive or shy) develop and maintain highest involvement with PLATO throughout the year?

Draft instruments were presented in the 1974 report. After piloting and revision, the instrumentation took the following form.

2.4 Data Sources for Reading and Mathematics

Interviews

The teachers' views and perceptions were obtained during two formal interview sessions. The preinterviews took place at the beginning of the school year before most teachers had the terminals installed in their classrooms. Most interviews were conducted in the fall of 1974, but a few occurred at the beginning of the 1975-76 school year with teachers who were new to PLATO as of that year. The postinterview was conducted at the end of the 1975-76 school year, when all teachers had had at least one year of experience with terminals in the room. The preinterview was designed to elicit teachers' perceptions, understandings, and convictions that were presumed to guide decision-making in the classroom. It was anticipated that these might interact in a significant way with the teachers' mode of PLATO integration. The postinterview was designed to get a detailed account of the way teachers, in fact, used PLATO, their experiences, and their judgments about PLATO's value and effects.

Classroom observation checklist

The classroom observation checklist was designed to record the frequency of prevalent activities and behaviors and to provide opportunity for more global judgments of general classroom atmosphere. It was developed in an iterative process in which theoretical hypotheses about important variables that might be affected by PLATO were modulated by the actual experiences of observers in the classroom. In all, six successive forms of the instrument were field tested. Theoretical constructs led to the incorporation of several sets of items covering Teacher Behavioral Control, Teacher Cognitive Control, Breadth vs. Narrowness of Focus, Degree of Pupil Cooperation, Teacher Involvement with PLATO, and PLATO Integration. In addition, there were primarily descriptive sets of items dealing with physical characteristics of the classroom, material resources, curricular approaches, and presence of PLATO-related materials and activities.

For the 1974-75 year and part of the 1975-76 year, the checklists were accompanied by a running narrative of what occurred during the observation period. This effort was suspended during 1975-76 as little new information was emerging and the preparation of the narratives was time-consuming. Instead, major activities of the observation period were noted briefly on the last page of the checklist.

Student interaction with terminal

In addition to observations of the classroom as a whole, the ETS field staff also observed children in interaction with the PLATO terminals. A checklist was developed for the purpose of focusing these observations and for providing data in a readily summarizable format. The major categories of concern were the following:

- the child's facility with mechanical aspects of the system, and the mechanical reliability of the system
- the child's apparent understanding of, and style of relating to, the system procedures and content
- overt indication, verbal and nonverbal, of the child's attitude toward the system
- the nature of the child's requests for assistance, and the type of assistance received
- the nature of any interactions in addition to requests for assistance

In addition, space was left on the checklist for a narrative descrption of any interesting occurrences.

Teacher log

In keeping with the evaluation strategy of gathering information from multiple sources, the participating teachers were asked to keep a log throughout the demonstration period. A $200 honorarium was offered as an inducement each year. To assist teachers in focusing log entries, a set of guidelines for the content and frequency of entries was provided along with the log notebooks. The content guidelines included specific questions, such as "Did the children learn some difficult things this week more easily because of PLATO?" and general questions, such as "In what ways has PLATO been a resource for your own teaching?"

Online data

Statistics for the students' records of time spent on the system in the various PLATO math and reading classes were regularly obtained from CERL staff. The printouts contained the starting and ending dates of use, numberal hours, CPU time (a measure of intensity of use), and a number of days and sessions completed by each student.

CERL also provided summary data of what "chapters" within strands were completed by each student; this information provided routinely for teachers throughout the year, indicated roughly the students' progress through the curriculum. ETS was supplied with the summary end-of-year data.

A final source of online data was the lesson "kidnotes." These were notes written by children online, addressed to CERL staff, and served as documentation of the kinds of questions and comments that came from the "Kids" and of the relationships with the CERL staff that they had.

2.5 Data Sources Specific to the Mathematics Demonstration

Standardized mathematics achievement tests

The Comprehensive Tests of Basic Skills (CTBS), published by McGraw-Hill, 1970, are designed to measure students' grasp of broad concepts and abstractions related to school subjects. The CTBS are published in four overlapping levels, with similar content at each level. Alternate forms Q and R were simultaneously developed. The mathematics battery at each level consists of three tests: arithmetic computation (48 items); concepts (30 items); and application (20 items) tests were used in this study. The tests have high reliabilities, ranging from .80 to .91 (K-R #20), and have been demonstrated to possess reasonable validity. For instance, in addition to possessing adequate content coverage, the CTBS correlate positively with other standardized tests such as the California Achievement Tests (r's from

.65 to .96) and the California Short-form Test of Mental Maturity (r's from .46 to .96).

Special mathematics tests

These math tests were developed in collaboration with the CERL math staff, to focus particularly on PLATO objectives for math instruction. Thus they provided a complement for the broader and more general standardized tests that may be relatively less sensitive to specific program effects. Three special tests were developed, one for each strand: Whole Numbers, Fractions, and Graphs. The tests went through a number of revisions: three revisions for the Whole Numbers test, four for Fractions, and two for Graphs. The final number of items in each were 23, 28, and 20, for Whole Numbers, Fractions, and Graphs, respectively. Each took about one-half hour to administer. All three tests used open-ended rather than multiple-choice items, as such items reflected PLATO's mode of interaction, and it was projected that the open-ended format might yield useful information as to children's mathematical misunderstandings.

Elementary mathematics attitude questionnaire

The purpose of the math attitude questionnaire was to obtain information about children's attitudes toward mathematics and toward PLATO and to detect changes in attitudes toward mathematics resulting from PLATO use. The questionnaire was drawn in part from existing attitude instruments and in part from an analysis of those attitudes that PLATO was most likely to affect. The questionnaire went through four revisions. The final version contained 73 items in the PLATO form and 46 items in the form for control classes, in the end-of-year administration. Sample items include "Math is fun," "I am slow at doing math," "I like working with math with PLATO," "I get mad when PLATO doesn't work." The response options for all the questions were "Yes," "?", and "No." The questionnaires were administered by ETS field representatives.

Mathematics coverage questionnaire

The exposure of children to PLATO as a treatment condition was, to an unknown extent, confounded by the fact that the PLATO teachers were a self-selected sample. Formal classroom observation was limited to PLATO classes. In order to obtain information about any major differences between PLATO and control classes in the extent and nature of math coverage, a questionnaire was developed and completed by both PLATO and control teachers.

The six-page questionnaire essentially dealt with three areas: organization of and approach to math instructional resources used in teaching, both material and human; and extent of coverage of specific math topics and areas.

2.6 Instruments Specific to the Reading Demonstration

Standardized reading achievement

The Metropolitan Achievement Tests (MAT), published by Harcourt Brace Jovanovich, 1971, provide a summary of each pupil's progress in the important skill and content areas related to school curriculum. The test batteries are organized in six levels, of which the Primer and Primary I have been used in this study, in addition to the publisher's Metropolitan Readiness Test.

The Metropolitan Readiness Test (MRT), published in 1969, was designed to measure the extent to which school beginners have developed in the several skills and abilities that contribute to readiness for first-grade instruction. The MRT has six subtests, of which the following four tests of Form A were used in this study:

Word Meaning: A 16-item picture vocabulary test in which the pupil selects from three pictures the one that illustrates the word the examiner pronounces.

Listening: A 16-item test of ability to comprehend phrases and sentences instead of individual words. The pupil selects the picture, out of three choices, that portrays the situation or event the examiner describes.

Matching: A 14-item test of visual perception involving the recognition of similarities.

Alphabet: A 16-item test of ability to recognize lower-case letters of the alphabet.

The reliability of the total scale (split-half or alternate forms) is in the low 90's and the subscale reliabilities range from .33 to .91. The total MRT scale correlates moderately high (.60) with other standardized tests such as the California Test of Mental Maturity and the Stanford Achievement Tests.

The Metropolitan Primer, designed for K.7 to 1.4, taps more specifically reading-related skills. The Listening and Reading tests of the Primer, Form F, have been used in the study:

Listening for Sounds (39 items)

a. Matching a sound spoken by the teacher with a picture that begins or ends with the same sound (22 items)
b. Matching a sound with a written letter (8 items)

c. Matching a spoken word with a written word (9 items).

Reading (33 items)

a. Identifying from four letters the one the teacher has named (11 items)

b. Selecting from four words the one that best tells about a picture (17 items)

c. Selecting one of three easy sentences that best describes a picture (5 items).

The publisher gives K-R #20 reliabilities of .90 for the Listening for Sounds test, and .93 for the first 28 items of the Reading Section. No predictive validity is reported, and the publisher justifies the adequacy of the test in terms of its content coverage.

The MAT Primary I is designed for grades 1.5 - 2.4 and includes three tests related to reading.

Word knowledge (35 items): Selecting from among four words the one that best describes a picture

Word Analysis (40 items): Identifying a dictated word from among four words that are similar in configuration and sound pattern.

Reading (42 items) consists of two parts.

a. Part A - Sentences: Selecting one of three easy sentences that best describes a picture

b. Part B - Stories: Reading simple paragraphs and answering questions about them.

The reliabilities (K-R #21) range from .88 to .96, and the Primary I tests are demonstrated to have satisfactory validity.

Special reading tests

As with the math, these tests were developed to focus on objectives that were emphasized in the PLATO Elementary Reading Curriculum (PERC). In the spring of 1974, the PERC staff identified five areas the program would teach that the standardized tests would not cover well: left-to-right processing; phoneme-grapheme correspondence; phonic analysis (dividing words at double consonants); recognizing contradiction, support, and irrelevance (not requiring reading); and comprehension of literal sentence meaning. Instruments were then developed by ETS for each of these areas. Initial pilot tests that spring, however, revealed that the target kindergarten sample was already competent in all these areas but the last. The ETS test specialist then developed a test that focused more directly on reading skills, overlapping somewhat with the standardized test but more closely related to PLATO's instructional approach. The final test, after two revisions, consisted of 20 phoneme-grapheme associations (picking one phoneme or grapheme out of three to match a spoken word); eight phonics items matching words to spoken words and pictures; five items requiring matching written sentences to sentences read aloud; and six items matching one of four pictures to written sentences describing the picture.

Elementary reading attitude questionnaire

The reading attitude questionnaire focused primarily on attitudes toward reading, some items toward math or other non-reading areas serving as a baseline for comparison and some items relating to attitudes toward PLATO. It was constructed somewhat differently from the math questionnaire, reflecting the fact that the target grades were K-2. The instructions were made as simple as possible, the pages were colored to help children locate their place more easily, and the response options were embedded in shapes so that children could identify them without having to be able to read. The items were all questions with the format "When . . . ., how do you feel?" For example, "When you read a story, how do you feel?" and "When it is time to work on PLATO, how do you feel?" The response options were "Happy," "OK," and "Sad." The questionnaire went through four revisions, and the final questionnaire contained 24 items. The instruments were administered by an ETS field representative to small groups of five or six children.

2.7 Special Testing Considerations

Because of ceiling effects in the 1974-75 CTBS posttesting, sixth-grade PLATO and control-grade classes in Schools V and VII received all three subtests of Level 3 Form Q of the CTBS rather than Level 2. All other classes received the concepts and applications sections of Level 2. For additional comparability, fifth- and sixth-grade classes at School I, and fifth-grade classes at Schools V and VII received the computation subtest of Level 3 Form Q.

These complex testing arrangements were facilitated by the cooperation of Dr. Donald Holste, of the Urbana School District, who agreed to use CTBS Level 3 in all sixth grades of the district, as part of the district's standard evaluation procedures, and to make data available to the evaluation, thus diminishing the heavy testing load on students.

References

Bitzer, D. L., & Skaperdas, D. PLATO IV: An economically viable large-scale computer-based education system. Presented at the National Electronics Conference, December 1968.

Breland, H. M.; Amarel, M.; & Swinton, S. The evaluation of PLATO: Educational analysis of the elementary school components (PR-74-4). Princeton, N.J.: Educational Testing Service, 1974.

Davis, R. B., et al. Implementation plan for elementary school mathematics. Unpublished document. Computer-based Education Research Laboratory (CERL), University of Illinois, 1974.

Murphy, R. T., & Appel, L. R. Evaluation of the PLATO IV computer-based education system in the community college (PR-77-10). Princeton, N.J.: Educational Testing Service, 1977.

Phonetic Keys to Reading. Oklahoma City: The Economy Company, 1973.

Risken, J., et al. Proposed amendment to the statement of work. Unpublished document. Computer-based Education Research Laboratory (CERL), University of Illinois, 1974.

Risken, J., et al. Implementation plan for elementary reading. Unpublished document. Computer-based Education Research Laboratory (CERL), University of Illinois, 1973.

Chapter 3

Implementation of the Demonstrations and the Evaluation

In this chapter we describe the major activities and experiences of the developers and the evaluators, from the early stages of the projects through the 1974-75 pilot year and the 1975-76 demonstration year. Table 3.1.1 is a time line, giving major events in the categories of the general project, hardware and software status, curriculum development, the participants, and the evaluation, in six-month periods. Since changes in one of these cells could affect all others, this table is designed as a reference to guide the reader through the narrative that follows. The narrative portion of the chapter is divided into sections on prepilot-year activities, including teacher recruitment and training and early evaluation activities; the design and implementation of the pilot-year demonstration and evaluation; a brief summary of those pilot-year results that affected the course of the projects, and a concluding section on the design which evolved for the demonstration year.

3.1 Site Selection and Teacher Recruitment

The selection process. The schedule outlined in the 1972 contract called for demonstration schools in the two school districts surrounding the University, Champaign and Urbana, and at an urban site, Chicago. These plans remained in effect for a brief period only. The June 1972 CERL report made no mention of Chicago, where negotiations came to an inconclusive end, and plans were scuttled. Instead, three schools in the Champaign-Urbana districts were identified as field sites. However, the memoranda of understanding,

Table 3.1.1

Project Developments

	January-June 1972	July-December 1972	January-June 1973
GENERAL PROJECT	Plato demonstration contract awarded Prof. Robert Davis directs elem. projects Reading and mathematics groups formed	hardware delays and complexity of curriculum development lead to schedule slippage	Explorations of involving the school district of a central-Illinois community at some distance from the University are initiated. No agreement is reached.
HARDWARE SOFTWARE	System consists of 40 terminals Audio unit designed Touch panel redesigned Hardware delays began to impact software development	System passes 200 terminals Tutor language exceeds 150 commands Audio device and touch panels in short supply	Authors begin to use more computer capacity than had been anticipated. Hardware delivery delays continue.
CURRICULUM DEVELOPMENT	Goals specified: Reading K-3, Math 2-4 First "edition" to be ready September, 1972 Math and reading groups diverge. Mathematics now targeted on grades 4-6 Preliminary plan for mathematics strands prepared	Small segments of reading material piloted in summer with low-achieving school XI childeren Reading project objectives and stratagies prepared	Mathematics Curriculum development focusses on Whole Numbers, Fractions, Graphs, and Measurement strands.
PARTICIPANTS	Site negotiations begin with local and urban school districts	Memoranda of understanding prepared with two local school districts, specifying terms of cooperation. Negotiations with large urban district fail to result in agreement	Agreement is reached among CERL, NSF, and ETS that two local schools will be the primary demonstration sites
EVALUATION ACTIVITIES	Evaluation contract awarded to Educational Testing Service Discussions begin with CERL, concerning specific curriculum goals, review of lessons, and site selection Review of achievement and attitude instruments	Site visits made to monitor development and to discuss requirements of the evaluation	The impact on the evaluation of a one year delay in starting date is considered Site visits continue, adding discussions with school administrators and teachers.

JULY-DECEMBER 1973	JANUARY-JUNE 1974
Start of demonstration is delayed one year. Additional funds are awarded to CERL for curriculum development.	Pilot operation of PLATO begins in 2 mathematics and two reading classrooms
Pilot lessons are delivered in terminal rooms in two schools. Computer and terminals experience frequent failures	6 terminals installed in grade 4-6 "triple classroom", four in a 4th grade and two each in a kindergarter and a mixed K-1 class. Difficulties are encountered with audio disc and microfiche production for reading.
Curriculum development goes forward. Graphs strand and router have priority in mathematics. Orientation and phonics lessons and CMS in reading.	Graphs strand nears completion, and is used with whole numbers games in mathematics piloting Reading piloting begins with one on one observation by CERL staff and extensive lesson and router debugging
Mathematics teachers from several schools and reading teachers from many schools express interest. 12 mathematics teachers from 4 schools and 9 reading teachers (+6 remedial teachers) from 7 schools eventually agree to use the system in 1974-75.	Teachers work through lessons at CERL or in pilot classrooms, attend meetings with developers Math project conducts two week training program over summer. PERC develops handbook describing reading lessons.
On-site observer joins the evaluation staff. ETS assists in PLATO lesson review for presentation to the National Science Board Test development of curriculum referenced and attitude tests begins. Interviewers of prospective PLATO teachers are conducted.	Pilot classrooms observed. Development of observation instrument begins Standardized and pilot curriculum referenced and attitude instruments administered in classes of participating PLATO teachers. Attempts to locate comparable non PLATO classes in mathematics encounter difficulty

JULY-DECEMBER 1974	JANUARY-JUNE 1975
PLATO lesson delivery begins in 12 math and 15 reading classes.	Target age of reading program lowered to kindergarten. Math attempts to recruit teachers with lower ability children.
Math classrooms have 4 terminals each (10 in triple classroom) Regular reading classes 2 terminals but initially only 1 audio device. 9 touch panels in place by end of September. Computer memory shortage degrades lesson choice, delivery, and authoring.	Additional memory (ecs) added. Initial disruption, then reliable service Audio devices and discs continue to plague reading project. All touch panels installed by end of March.
Graph strand runs in all math classes. Hardware limitations defer whole numbers strand until November.	Fractions strand begins in March. Fractions strand teacher feedback system instituted. Workbooks for graphs and fractions distributed.
CERL staff devote much time to delivery problems and classroom liaison. Lesson production schedules slip further.. Meetings are held through the year for math teachers.	One math teacher leaves program. Two re-recruited for 1975-76 10 additional reading teachers, 4 of them kindergarten teachers, recruited.
Spring data analysed, concerns raised about the high reading level of the targeted K-1 groups Instruments revised. Pretests administered to PLATO and control classes. Classroom observations carried out. Meetings with NSF and CERL lead to revision of evaluation plans in response to limited implementation.	Posttests administered Classroom Observations Continue Teacher interviews conducted Project review calls for revision of evaluation plan.

JULY-DECEMBER 1975	JANUARY-JUNE 1976
CERL assigns internal evaluator to NSF demonstrations projects. Lessons are delivered to 13 mathematics and 25 reading classrooms.	(March) Director of reading project leaves CERL. (June) Demonstration completed.
System functioning reliably New audio device goes into production Units replaced throughout the fall. Hardware problems continue to affect reading program.	Audio devices functioning reliably
Student data collection system for math, giving time in curricular modules. Teachers feedback system extended to whole numbers and graph strands Lesson development in fractions and whole numbers continues. Delays in beginning of Fall Math demonstration result. Phonics lessons completely revised over summer. New phonics router not consistant with CMS. Sight words in context developed Microfiche production slows interactive storing development.	Lesson development completed in math strands Reading project moves to increased teacher involvement and prescription. Abandons CMS, drops new phonics lessons
Teachers become more familiar with curriculum, do more prescribing and control of lessons. One PLATO mathematics teacher leaves teaching at mid-year. Replacement continues with PLATO	Most teachers indicate desire to continue with PLATO in following year.
Discussions with NSF as to direction of evaluation. Mathematics design strengthened. Reading evaluation scaled down to follow 4 kindergarten and 5 first grade classes with no external controls Pretests adminstered Classroom observations	Midyear testing takes place in 4 kindergarten classes (within-teacher study) Classroom observations concluded Teachers logs collected Post tests administered Teachers, principals, and CERL staff interviewed Data analysis begins.

which were to be completed with the participating schools by that time, had not been signed. Negotiations with these and other potential participants in the field trials continued through 1972 and well into 1973, when NSF granted a delay in the start of the field trials until September 1974. In the spring of 1973, contact was initiated with a suburban district, to explore a new configuration of field trials. These uncertainties were of concern to the evaluators, whose base-line data collection in anticipation of the start of the demonstration at the beginning of the 1973-74 school year was seriously impeded.

Yet another significant shift occurred in the summer of 1973, when one of the three schools (School XI) in Champaign-Urbana opted out of participation, leaving two schools (I and V) that had a history of experimental programs, including early involvement with PLATO, and were thus highly select environments for the demonstration of PLATO's classroom efficacy. Weighing these considerations, CERL ultimately decided to give up sole focus on these two schools and to call for volunteer teachers from the two districts at large.

The participating schools and classrooms were thus chosen indirectly, through the volunteer teachers. The choice of the districts, however, was CERL's. After negotiations with more distant school systems aborted, the directors of the elementary projects took the consequential step of confining the demonstration to the districts adjacent to the University, where the programs were being developed. Several advantages accrued to this decision, especially since the districts had a history of University connection, having often served as testing ground for experimental projects. Some of the schools were thus accustomed to, or at least familiar with, the disruptions and intrusions that accompany pilot projects. Ready access to the schools also made information flow between the user and project staff with greater frequency, richness, and shorter turn-around time.

The convenience of trying out methods and materials in one's own backyard may, however, be offset by other consequences of this strategy. The easy access to the implementer may foster dependence on the part of the user, who then does not invest the requisite effort to acquire facility with the resource and thus gives the evaluator a false impression of the cost involved in assimilating it into the classroom. The implementer, on the other hand, is not pressed to articulate, in publicly accessible and exportable forms, the skills and knowledge necessary for the effective use of the resource, making ultimate dissemination on a broad scale less probable. Another drawback of implementing close to home is the difficulty of generalizing to less hothouse-like conditions, when a program must stand alone without the facilitating presence of its own developers.

<u>Placement of terminals</u>. The decision to recruit teachers rather than schools also influenced how terminals were to be arranged at the demonstration sites. CERL staff considered various configurations, from a school terminal room that could accommodate whole classes, to one terminal to a classroom. The terminal room proved impracticable with only one or two teachers in a school, and one terminal per classroom was felt to encourage the terminal's use as only a marginal resource. Hence the final decision was to place four terminals in the rooms using the math program and two in the lower-grade reading classes. This configuration would make it possible for each student

to be on the system for half an hour each day in math and 15 to 20 minutes in reading. This arrangement also implied committed use of the terminals by the teacher, as a laissez-faire attitude was unlikely to result in full use of the resource.

School participants. The two school districts, albeit geographically adjacent, were detectably different in their administrative practices, attitudes towards innovation, and even fiscal policies. One district was comparatively more hierarchically organized, held a more conservative stance toward new programs, and was fiscally more stable. The other district was less centralized, a fair residue of policy decisions remaining with the individual building principals and staffs. This district also had closer association with the University, having maintained a hospitable stance toward innovative programs that originated with university faculty and a general openness to change. The district, for example, adopted a bussing policy to assure racial integration early on. This receptivity, however, had been recently accompanied by fiscal problems, as several of the programs instituted with external monies could not be maintained by the diminishing local funds alone. Further, the high degree of parental involvement was accompanied by considerable resistance to testing, random assignment, or other trappings of controlled studies.

These differences did not appear to affect the implementation pattern in the two districts. Each district had an "innovative" school, and these two schools were in fact chosen by CERL as PLATO sites. When the district-wide call went out for volunteer teachers in the fall of 1973, these schools produced a large proportion of the volunteers, the other interested teachers spreading more sparsely across several other schools.

Teacher recruitment. The teachers were invited to attend meetings with the Mathematics and Reading Project staffs in September to learn about the PLATO field trials and consider participating in them. The first meeting drew between 20 to 30 teachers, about 20 of them signing sheets indicating interest. A second meeting brought out fewer than 10 teachers, a difference that may have reflected the vagaries of the communication channels in the system more than teacher interest in the project. In some schools notices were placed in each teacher's box, in others the office bulletin board displayed the invitation, and in yet other cases it was carried in the school newsletter. The principals generally gave a free hand in the matter to the teachers.

The presentations were made by the directors of the two projects, who communicated the different shadings of their conceptions of the teachers' role vis-à-vis the implementation. The director of the Mathematics Project saw the teacher as "chief investigator," one who would work out the task of assimilating PLATO into the classroom, physically, managerially, and instructionally. An active and time-consuming contribution was implied. The presentation of the reading project director, on the other hand, anticipated less teacher involvement. He expected teachers to be able to attend a workshop to become familiar with PLATO and the reading materials, to show children how to sign on, a task which was estimated to require fifteen minutes per child, after which "most of what the child needs can be worked out between him and PLATO." The reading staff also expressed openness to review and criticism of the materials and invited "talented" teachers, "who can describe how they teach particular topics," to join in creating the remaining curriculum.

The classroom teachers. The group of teachers who initially expressed interest dwindled somewhat as they learned more about the project. The number of teachers who ultimately housed terminals in their room during the first year of the field trials, which were by this time put forward to September 1974, came to 27—12 middle-grade teachers for the math and 15 lower-grade teachers for the reading program.

The latter included six remedial-reading teachers. They had not been sought out by CERL, but several attended the initial meetings, and the staff became intrigued by this potential application of PLATO. The remedial teachers had no classes of their own but commonly instructed children drawn from classes across the school, working with them individually or in small groups for a defined period of time weekly.*

In addition to offering the incentives intrinsic to participation, the math project had a fund available for paying teachers directly for their involvement. The teachers were informed about the amount available and some options for distributing it. They opted for an equal apportioning among all teachers, amounting to $600 a year per participating teacher.

This group of self-selected teachers was in all likelihood unrepresentative of the larger teacher population. In an effort to capture any distinguishing qualities, seven of the teachers who attended the early PLATO

*As the inclusion of remedial teachers was an afterthought, the assessment of student progress would have required special techniques. Comparison groups were unobtainable; hence they were not part of the evaluation.

meetings, but did not pursue the matter further, were contacted by telephone to clarify their decisions. Most of the teachers cited time pressures and involvement with other projects as their reason for refusal. Two teachers said they might have participated had others in their school shown similar inclinations.

The 15 volunteer reading teachers were spread across seven schools, and the 12 math teachers came from four schools. The classes they taught were distributed across grades as follows:

Reading		Math	
Grade	# Teachers	Grade	# Teachers
K	1	4	1
K-1	2	4-5	1
1	4	5	3
1-2	1	4-6	3
2	1	5-6	1
Remedial	6	6	3
	15		12

Two of these schools (I and V) had been early experimental sites for the project. In one case, a PLATO III room with 12 terminals had been installed in 1969, where math materials designed on PLATO were tried out with individuals and groups of students released from their class. A few teachers cooperated to the extent of freeing their students, but there was little direct teacher involvement with PLATO. The other school had the first classrooms to have a terminal. Three terminals were installed in 1972-73, and one teacher made particular use of them with her sixth-grade class.

Designating the PLATO trials a "national demonstration" implied broad applicability of outcomes. A closer look at how the recruitment strategies affected the implementation is therefore warranted to gauge how well the assumption of generalizability will hold.

In the district-wide sweep for volunteers, no systematic effort was made to draw teachers with a particular affinity to the program's goals. The recruiting process did in fact succeed in bringing forth a group of teachers with a range of instructional beliefs and practices. The quality of information and the expectations held of the PLATO resource also showed considerable spread.*

Consequences. By relying on the self-selection, CERL expected to find a group of teachers hospitable to exploring a new instructional mode and willing to exert the effort that introducing a new program invariably requires. These assumptions often extend to the hope that the teacher will be on the program's side, invest it with positive expectations, or at least protect it by suspended judgment. This was indeed the case, even though our probing of teachers' reasons for participating in the project revealed a remarkably catholic set of motives, not all of which related to interest in trying computer-aided instruction. A sizeable number of the teachers could be classified as "high innovators," i.e., teachers who have a history of participating in new projects. In contrast, there were a few teachers who had no genuine liking for the subject matter that was to be computer-aided and hoped to be relieved by the computer of responsibility for teaching it. Others hoped that the computer would prove helpful to children with whom the teacher felt ineffective. The teachers with the more intrinsic reasons for

*The information about teachers' attitudes and expectations is based primarily on the pre-PLATO interviews conducted in the fall of 1973.

participating divided among those who felt in need of help with their teaching of reading or math and those who were interested in learning about new approaches, seeing the program as an opportunity for professional growth. There were also teachers who volunteered for idiosyncratic reasons; one joined the program because it ensured her stay in the same school till retirement; others wanted to enlarge their community of interest in computers with a friend or spouse.

Another consequence of relying on volunteers was the foreclosure of independent choice of the pilot schools. Most of the "high-innovator" teachers were from the two schools that traditionally had been hosts for programs emanating from the University. Although both schools had a cross-section of SES represented in the student body, the children of University faculty, and indeed of PLATO staff, were a conspicuous presence. These schools were also receptive to innovation, tolerant of the attendant disruptions, flexible regarding instructional styles, and not tied to a single mode of assessment, viewing achievement test results as but one, and not necessarily the most important, indicator of children's progress.

In summary, the strategy of soliciting volunteers affected generalizability in that it yielded a heterogeneous group of teachers, but not a representative one. These teachers were probably more energetic, and certainly more professionally adventurous, than a random sample of their colleagues would be. The schools where they taught tended to be distinguished by a receptive stance toward innovation, which made them sound choices as pilot sites but constrained the generalizability of outcomes.

3.2 Teacher Education and Support

The stipulation in the original contract for teacher-training workshops in the summers of 1972 and 1973 fell victim to the overall lapses in project schedules. As teacher selection got underway in the fall of 1973, plans for teacher education were also reexamined.

The mathematics staff outlined the components of the planning phase of its teacher education and liaison program in the spring of 1974:

i. Planning bi-weekly teacher-participant meetings

ii. Planning the Summer Workshop

iii. Informing teachers

   (a) PLATO programs

   (b) Mathematics in general

   (c) The future of the project

   (d) Considerations related to the use of terminals by children

   (e) Location of terminals in the classroom

   (f) Parent involvement

iv. Planning meetings with teachers to review programs after school, during school hours, and Saturdays, Sundays, or evenings at CERL

v. Planning parent meetings

vi. Coordinating new terminals arriving at the schools and monitoring the operating conditions of same

vii. Informing principals of progress of the program

viii. Observing children at teacher request

The expected structure of the school liaison and summer workshop program was further elaborated:

> Biweekly meetings of approximately two hours each are scheduled for the school year 1974-75 and 1975-76. These meetings will attempt to involve teachers in an assessment of the project. Teachers will meet to share experiences, successes, and failures with each other and members of the math group.
>
> One workshop of four weeks duration is planned for each of the summers of 1974 and 1975. The first summer will provide time for teachers to become thoroughly familiar with PLATO lessons by going through the lessons as students. Lesson designers from each strand will explain their goals and strategies in each lesson, develop the necessary background ideas in mathematics and respond to teachers' reactions and suggestions. Questions of curriculum, organization of classrooms, student, parent, and administators' reactions will be considered. It is anticipated that teachers would select two or three students who will be in their PLATO classroom for the fall to attend some time during the summer. This would enable teachers to observe and study student reactions and become more aware of their role in training student assistants.

These inclusive plans gave way under the pressures of curriculum development priorities. The summer workshop plans were also made contingent on additional funding for teacher training, as allocations from the general project budget for this purpose were inadequate. The four-week meeting was ultimately scaled down to two workshops, each consisting of three three-hour sessions. These were offered to teachers as an option, with University of Illinois academic credit for those who desired it.

The biweekly meetings were also reduced to periodic meetings with the teachers, and these tended to dwell on organizational, rather than instructional issues.

As the more formal aspects of teacher preparation were losing ground, what was to become the primary and pervasive mode of teacher support was evolving. After a few teachers dropped out of the math program, CERL became concerned with providing sufficient contact and support to keep teachers committed to the program. The two staff members who had extensive experience with teacher education became the most active in this area. They visited classes, talked to teachers, and engaged them in discussions of mathematics and the philosophy of the PLATO program. They also worked with individual children at the terminal in the pilot classes and occasionally taught a math lesson to the whole class. PLATO staff thus became familiar figures in some classrooms, and in most cases they were positively received. While this gained acceptance for themselves and PLATO, the original goal of having teachers become "chief investigators" who would forge a community of interest for PLATO-related issues did not fully materialize.

The reading staff, holding a more limited view of the teachers' role in the implementation process, confined training plans to familiarizing teachers with all of the instructional materials available and with the means for accessing them. An on-line training program, equivalent to a forty-hour workshop, was to be accessible on PLATO, rather than presented in a traditional workshop. The staff expected the materials to be ready by March of 1974, teachers being thus free to engage in it at their convenience before the start of the 1974-75 school year. Additionally, hard-copy descriptions of the instructional modules were to be made available to teachers.

The staff did prepare on-line training materials, but they found them not well used by the teachers and eventually abandoned further development. Most teachers did spend some time on the system becoming familiar with its operation and going through the lesson materials. The preparation of the teachers, however, was highly uneven.

In the reading program, staff also spent considerable time in the classrooms testing materials out with children, observing at the terminal, trying to keep the much more troublesome apparatus needed for the reading lessons functioning. One staff member was assigned to classroom liaison full time. CERL ultimately took responsibility for initiating children into the use of the terminal, an activity the teachers could not handle in the course of regular instruction. The original estimate of 15 minutes start-up time per child proved to be over-optimistic.

Teacher involvement in curriculum review and development, contrary to initial declarations, was minimal. One teacher who was a particularly active user offered several lesson ideas, one of which a staff member eventually programmed, but more as a reward for her efforts than as a contribution to the curriculum.

The most effective, in fact indispensable, mode of teacher support proved to be the presence of CERL staff in the classroom, at least in this early stage of program implementation. This was the case for both projects, although the nature of the support differed. The implementation of the reading program required more attention to the children's facility with the terminal, while the math classes needed more subject matter-related support.

3.3 Spring 1974 Prepiloting

Early in 1974, four classrooms had terminals installed on a pilot basis. Two of the classrooms were in the reading program, two in the math, all in the two schools that had been experimental sites the previous year. By this time there was a sizeable number of lower-level materials (e.g., letter recognition) ready in the reading program, and the math project had one of its five projected strands, the graph strand, largely completed. There were also several whole-numbers math games available. At first the terminals were restricted to teacher use, CERL staff helping teachers, during and after school hours, to become familiar with the system and the available lessons. The math group was reluctant to let students on the terminals before a sufficiency of academic materials became available, lest expectations should develop toward the terminal as a plaything. The reading programs, since they required the touch panel and the audio device to function, were especially handicapped by dasign and production problems of ancillary equipment. By March, however, students were working on the terminals. All told, there were 13 terminals assigned to math (three each in the open-plan, three-teacher classroom in School I—combining 4th, 5th, and 6th grade students; and four terminals in a self-contained 5th grade in School V). The reading program had two terminals in a kindergarten and two in a K-1 combinati… in School V.

The experiences of hese classrooms typified problems associated with the early stages of most experimental programs. Yet some impressions specific to PLATO eme·ged from the end-of-the-year interviews with the six teachers involved.

<u>The Reading Classrooms</u>. The two teachers trying out the reading program did not have unduly high expectations of the terminal. Each saw it as an auxiliary resource and postponed judgment till more advanced lessons would be available.

The children were shown how to use the terminal by the CERL staff, who worked in the classrooms almost daily. Both teachers felt that they could not have done this themselves. The frequent system malfunctions were taken in stride by the teachers, who were not dependent on the PLATO lessons, but frustration among the children was reported. Difficulties with the audio device were apparent from the start, from relatively solvable problems of disc changing and sound fidelity to more difficult ones of aligning audio with visual presentations.

A flavor of how the children interacted with the terminal is captured by a classroom observation in May 1974 that characterized that early period:

> No one was working at the terminal, but the teacher suggested I wait a minute and then someone would be on. She signed in and the terminal called up the first child, Tom, who had no problems signing in or putting on the desired record. However, when the lesson came on, it said: "would you like to see left-right again?" Tom said no, and that was the end of that lesson. He had to change records again, this time #20...it was one on the sight words full and empty. Unfortunately, the record was not saying anything. The audio device was working, but the record was not saying anything. So as we went through that one, I told Tom what to do for each step. The next lesson called for record #8 again. Tom put it on, again with no trouble, and he had the lesson where the child is given a word-ending and asked to make words by filling in an initial consonant. Thus Tom got _an_ and through random typing finally made the words _ran_, _man_, _dan_, _wan_, _tan_, _pan_. When he typed a non-word, nothing happened. When he typed a word, the audio would say it and put the word on the screen. Next Tom was to go to a lesson requiring record #4...Unfortunately, record #4 was not there, so I shift-stopped out and Tom's turn was over. He did not make comments during the session, but was reluctant to leave the terminal.

The math classrooms. The four teachers working with the math program experienced the introduction of terminals differently. Learning to use the terminals was not a problem for the older students, particularly for those in the triple room, which had housed terminals the previous year and which had some skilled users, indeed, some TUTOR authors, among the students. All four teachers, however, found PLATO requiring more time and attention at the beginning than they thought was instructionally justified. The teachers made considerable efforts to fit PLATO into their daily schedule in a way that would not shortchange other subjects and activities, but they did not always succeed. Discipline around the terminal was a problem in the triple room; the noise of four terminals proved particularly troublesome for the other. CERL staff was welcome in the rooms to work with children at the terminals and occasionally give general mathematics instruction. Yet teachers also noted that CERL staff did not always show sufficient regard for the teachers' other responsibilities, making it difficult to keep PLATO within the bounds teachers wanted to set for it.

Another observation excerpt from a math classroom, dating from May 1974, is revealing of PLATO from the student's perspective:

> ...two of the four terminals were in use and the teacher was shouting at several other kids to get on. I watched while Sue (the machine called her Pam, the kids can ask the terminal to call them anything they want to be called) signed in. She was given a lesson where she was required to put in a number in one column. After several numbers were put in the Input and Output columns, the student was to supply a rule telling why PLATO was putting the numbers it was in the Output column. It looked something like this:
>
> | □ Input | ○ Output |
> |---|---|
> | 0 | 1 |
> | 1 | 4 |
> | 5 | 16 |
> | 4 | 13 |
>
> Sue guessed the rule 3□+□=○. She tried that rule. It fit on one pair but not the others. She tried several other ideas, none of which were correct. Finally PLATO gave her some answers which other kids have given. She was asked which she liked best, and to

try it on the numbers. She tried the one which was similar to her first try, $3\square + 1 = \bigcirc$. This worked on all choices. Sue did not talk to the machine during this time. She did not show enthusiasm, but was rather neutral.

Sue was asked whether or not she wanted to try again. She said no. She was passed on to *Dates* and was asked to give names for 28. She said 28+28-28x1 and was given a *good*. Then she put in some wrong answers and answers which others had already given. Finally she came up with 7+7+7+7 and was given a *good*. She was then shown the answers others had given and asked to pick out one she liked. She was asked to enter one more answer, which she did, 28+1-1. Sue was then given a check-up involving filling in a number in a number-sentence related to a line on a graph. She did a couple, and then on one kept getting the wrong answer. Finally she turned to me and said: "I know the answer is 6, but I like to put in the wrong answer and see the design it makes." On the *How I Feel* page Sue wrote: "its ok but it could do better." I asked Sue what she meant; she said she was tired of doing the same things over and felt there could be some new and more interesting things on PLATO. Sue was then given a game choice and she picked *West*. She played against PLATO and lost. Then she picked *Pitcher Pouring*, which she had many troubles with. This brought her turn to an end.

During this time the teacher did not approach the terminal, called out once in a while for kids to sit down and get busy if they were gathering around the terminal. She was giving a group some help with *Guess My Rule* type of material. The kids working on the other terminals were quiet. The boy working next to Sue played several games. He made no comments. When he was finished a girl signed in and got *Guess My Rule*. She simply sat there, apparently with no idea what the rule was. She looked around for help, but no one appeared.

Early evaluation activities. The classrooms were affected during this period not only by the efforts of CERL but also by the evaluators, who began to document the implementation process. The spring of 1974 was used mainly for gathering baseline information about the participants and the setting, for attempting to locate non-PLATO classes comparable in ability to prospective PLATO classes, and for piloting instruments to be used during the field trials. Continuing attempts to clarify objectives and identify participants took place, culminating in the collection of base-line data which served four purposes: (1) determining the appropriateness of the standardized instruments to be used, (2) providing pilot information for ETS-developed instruments, (3) assessing the level and comparability of potential PLATO and comparison classes, and (4) piloting test administration and feedback procedures.

The special math, reading, and attitude tests constructed by ETS were given in 16 classrooms on a pilot basis. The CTBS standardized test was administered in 20 potential PLATO and comparison classrooms. Most of the teachers who volunteered were interviewed and designated PLATO classrooms were observed, although potential comparison classrooms had not yet been obtained, for the twin purposes of learning about the setting for the field trials and of helping in the development of appropriate observation procedures. PLATO teachers were also requested to keep a log during the following year, and discussions were held with those who agreed to undertake this additional task.

The test results, together with the interviews and observations, yielded information about the instructional environments that were to serve as field trial sites for PLATO.

Through the interviews, it became evident that the teachers' expectations for PLATO in the coming year were nonspecific but generally optimistic. The variety of motivations and styles in the two groups suggested what the evaluation plan had anticipated, that the impact of PLATO interacted with the environment in which it was being used. Thus, there would be as many PLATO treatments as there were classrooms using the system. Both the

CERL and the evaluation staff viewed the variety of classrooms not only as inevitable but as an opportunity to learn about the differential effects of PLATO in several instructional contexts.

The analysis of test results led to revisions of the instruments and to a decision to raise the difficulty level of the standard test of reading. It also led to a concern, communicated by ETS to the developers and NSF, that many of the children targeted for the reading curriculum, even kindergarteners in Schools I and V, reached year's end reading well beyond the projected upper limit of the reading curriculum. An additional concern emerged with regard to the overall high level of achievement of the PLATO mathematics students, the unavailability of control classes in their schools, and the scarcity in the district of comparable children.

Repeated reminders by the evaluators that placing terminals without regard for the availability of comparable control classes threatened the quality of information that could be obtained led to the decision that at this stage the evaluation was not expected to be summative as much as descriptive. Given the evolving nature of the projects, the need to place terminals where they were genuinely wanted was seen as outweighing the need to avoid confounding school and treatment effects.

PLATO was described by a consultant at one meeting as a "growing plant," and the evaluator's job was seen as following it where it happened to extend itself. Thus, when both teachers of a given grade level in a school wanted PLATO or the principal or non-PLATO teachers of a particular grade did not wish to participate in comparison testing, they were accommodated and, hence, no within-school comparison data were available in these cases. Although it was expected that school differences would be great, attempts were made to locate comparable classes in other schools. Negotiations continued through the opening of school on the pilot year, and the designs of Tables 3.3.1 and 3.3.2 were implemented. Although the reading design was reasonably adequate for drawing inferences concerning PLATO effects in the targeted grade 1 classes, the pilot-year mathematics design almost completely confounded PLATO and school effects.

Table 3.3.1

Reading Design 1974-75

Numbers of Students by Grade and School

	School	I	II	III	V	VII	IX	X	Total
Grade	K	15	(31)		34				49(31)
	1	6		22(24)	43(18)	23(23)	18(19)	18(23)	131(106)
	2		23		13				36

(Numbers in parentheses refer to numbers of comparison children.)

Table 3.3.2

Mathematics Design 1974-75

Grade, School, and Number of Students

PLATO	School				Total
Grade	I	III	V	VI	
4	13		34		47
5	41	26	12	38	117
6	45		46	36	127

Comparison

Grade	II	III	IV	VIII	IX	Total
4				68		68
5	21	24	21		18	84
6		18			74	92

The design for the pilot year evaluation thus left much to be desired. In mathematics, the two schools with greatest PLATO involvement were unable to provide control classes because all classes at a grade were to receive PLATO, or in other cases unwilling to provide control classes. One within-school control was available in 5th grade, and other comparison classes were from schools that had no PLATO involvement, participating in the evaluation only through a combination of pressure from their district and principals' hope that such cooperation would increase their chances of receiving PLATO terminals in the future.

In reading, only one kindergarten teacher was located who was willing to participate in control testing. However, the announced focus of the reading curriculum was first grade, and it was possible to secure a same-school comparison class in five first grades. This success seems largely due to the fact that PLATO reading teachers were more widely dispersed among schools, not saturating any grade level, and most were in the more traditional of the two districts, where testing was more hospitably received.

3.4 The Pilot Year

As of autumn 1974, the size of the elementary school program was about half of its originally intended goal. Twelve classrooms, with approximately four terminals in each room, were participating in the math program, each child receiving a half hour of PLATO instruction per day. Nine primary-grade teachers and six special education teachers were using PLATO in the teaching of reading, and each child was to receive 15 minutes of instruction per day via PLATO.

The fall implementation was hampered by a number of factors. In mathematics, only the graphs strand, the most difficult of the four proposed lesson sequences, was ready at the beginning of the school year. Touch panels were not yet in sufficient supply (initially 17 of 78) to implement certain whole numbers lessons and many fractions lessons, had the lessons been ready. In reading, sufficient audio devices did not exist, and the quality of sound was inadequate. Nevertheless, the school year began. Immediately the large influx of new users overloaded the system's extended core storage (ECS) capacity, severely degrading service through the first semester. Not only was response slow and the terminals essentially unavailable to authors for needed continuing lesson development and revision during normal working hours, but memory constraints were so severe that lessons called for by the overly ambitious routing programs, which themselves required large amounts of cove space, could not be condensed into memory and delivered. In the case of the graphs strand, children spent an inordinate amount of time in a restricted list of games. When the whole numbers strand replaced the graphs lessons in the middle of November, the developers were forced to abandon the router and offer a restricted weekly "menu" of lessons, thus greatly constraining the individualization capabilities of the system within the strand. Only in the middle of the second semester, when expanded system memory had been installed and touch panels were in place, were the fractions strand materials introduced, and few children had finished these by year's end. In reading, continued difficulties in production of audio discs and microfiche, coupled with a router error which withheld phonics lessons for most of the first semester, confounded the memory problem. Frequent system crashes and terminal malfunctions also plagued the first semester of the pilot year, yielding an initial implementation that could be aptly described as "early chaos."

The reading program also encountered a different sort of problem, in that ETS spring 1974 tests showed that a substantial number of the children who were to participate in the reading program already knew how to read. This, of course, provided a serious threat to the possibility of answering some of the planned evaluative questions.

Pilot year evaluation activities. ETS obtained the cooperation of teachers in administering a complete set of pretests in the fall: standardized tests, PLATO-specific tests, and attitude questionnaires. Approximately 450 children at the K-1-2 level and 600 children at the 4-5-6 level were included. In addition, three rounds of classroom observations were conducted that used an observation checklist which was modified several times on the basis of the observers' experiences. Individual statistics maintained by the PLATO system, on the time spent by each child on the system, were handcopied each month, while negotiations continued for hardcopy printouts of appropriate on-line data summaries.

ETS staff visited Champaign-Urbana to observe classes, conduct discussions with the CERL staff regarding project developments and future cooperation, and to discuss the observation instrument with the ETS field representatives. The evaluation team attended an NSF site visit in Champaign-Urbana to represent the evaluation concerns in discussions among the project participants. Given the constrained nature of the fall implementation, ETS was again invited to submit a revised evaluation plan to NSF, listing several alternative plans that reflected various time frames. Meetings were held internally with ETS officials, with various external consultants, and with the field representatives, to discuss the possible options.

Analysis of fall 1974 pretest scores revealed that in only one case had a 5th-grade comparison class been obtained that was not significantly below its PLATO "counterpart." The situation was no better in 4th grade, but more comparable in 6th grade, where the comparison students in school VII exceeded PLATO students at pretest. As Tables 3.4.1 and 3.4.2 reveal, these entering differences were sufficiently large to threaten covariance adjustments of initial differences, particularly in grade 4, where it appeared that PLATO and control children represented different populations and would almost certainly have different regression slopes.

Although the design had been better achieved in reading, neither the curriculum nor its automated delivery had been implemented in a manner consistent with the developer's intentions.

Pilot year results. The data collected during the pilot year from five instruments, each administered pre and post to over 500 children in mathematics, and from three instruments, administered twice in small groups to more than 300 children in reading, thus proved not appropriate for summative conclusions about the effect of PLATO in either the elementary reading or mathematics implementations. However, process data from observations, interviews, teacher logs, and the system itself, as well as continuing interaction with the developers, helped to clarify possible variables of importance and to highlight questions for the evaluation year. For the sake of completeness, outcomes of pilot-year test data analysis are presented in detail in Volume II of this report. Here, instead, we list only those pilot

Table 3.4.1

Pilot Year CTBS Computation Pretest Scores

Grades 4-6*

	School	I			II			III			IV			V			VI			VIII**			IX		
Grade 4		N	Mean	s.d.	N	Mean	s.d.	N	Mean	s.d.	N	Mean	s.d.	N	Mean	s.d.	N	Mean	s.d.	N	Mean	s.d.	N	Mean	s.d.
	PLATO	28	34.4	9.5										22	24.2	8.7									
														10	27.2	5.9									
	Comparison																			23	19.9	7.1			
																				22	21.2	8.1			
																				23	23.0	8.3			
Grade 5	PLATO	12	31.5	11.4				27	31.2	10.6				10	29.0	11.2	38	31.4	8.7						
		10	31.7	13.0																					
		12	38.1	7.5																					
		3	37.0	4.9																					
	Comparison				22	34.7	6.5	24	28.4	9.1	24	24.3	10.8										20	27.4	7.4
Grade 6	PLATO	7	36.6	7.6										22	34.3	7.9	36	39.6	5.4						
		7	39.9	11.4										23	37.0	7.2									
		6	41.0	5.4																					
		3	34.3	6.6																					
	Comparison							18	33.4	8.4													25	38.8	7.6
																							24	39.1	5.9
																							25	38.1	7.3

* These represent fall CTBS scores only, and may be slightly different from corresponding figures on Table 3.3.2, for students with complete pre- and posttest scores on the CTBS or on special tests. In grades 5 and 6 of School I, only students who had not been given the CTBS in spring were readministered the test in the fall, so these totals are considerably less than those of Table 3.3.2.

** Schools VII and X did not join the mathematics demonstration until the following (demonstration) year. School XI withdrew from participation before the pilot year.

Table 3.4.2

Pilot Year Metropolitan Primer Pretest Scores

Grade 1

School	I			III			V			VII			IX			X		
	N	Mean	s.d.	N	Mean	s.d.	N	Mean	s.d.	N	Mean	s.d.	N	Mean	s.d.	N	Mean	s.d.
PLATO	10*	19.7	4.9	26	25.0	5.8	15	28.7	5.0	23	24.3	5.4	23	19.9	8.0	23	23.9	8.6
							10	28.3	7.0									
Comparison				24	23.3	6.0	23	27.3	5.2	23	23.3	6.8	19	18.5	5.4	26	20.4	5.7

*These numbers represent total numbers pretested, and exceed those in Table 3.3.1, which are for students with both pre- and posttests.

year findings that influenced modifications in the implementation and evaluation procedures for the final evaluation year:

1. In spite of the less-than-optimal conditions of use during the pilot year, pupils in PLATO mathematics classes showed significant gains in attitudes toward mathematics, while control children's attitudes toward mathematics tended to decline during the same period.

2. On the CTBS standardized test of mathematics achievement, a significant grade-by-treatment interaction appeared; 4th-grade PLATO pupils showed a covariance-adjusted, four-point gain over non-PLATO children, and 5th- and 6th-grade PLATO children showed 1.5 and 2.3 points less adjusted gain than control children did. This, however, was coupled with evidence of a ceiling effect for 6th-grade and some 5th-grade classes on the level-two CTBS instrument.

3. On the special mathematics tests, results were mixed, the whole numbers tests showing a negative PLATO effect in grade 4 and positive in grade 5; the fractions tests showing a four-point adjusted differential gain in grade 4, a two-point gain in grade 5, and less than one point in grade 6, all in favor of PLATO; and the graphs tests yielding results favorable to PLATO in grades 4 and 5, but unfavorable in grade 6.

4. Classroom observation, teacher interviews, and logs suggested that few teachers seriously integrated PLATO into their mathematics curriculum, and none devoted less time to their usual teaching of mathematics because of PLATO. It was only with the introduction of accessible pupil performance reporting systems by the fractions strand in the last few months of the pilot year that most teachers began to monitor and intervene in children's progress on the system.

5. In spite of early systems problems and the peculiar graphs-whole numbers-fractions sequence, teachers generally reported continuing enthusiasm for PLATO among most of their children. Most teachers felt that children had learned more mathematics than in previous years. The two exceptions were in classes with extremely high-achieving children. In one of these, the teacher withdrew from the project at the end of the pilot year, stating that the curriculum offered review but not a challenge for her selected 6th graders. In the other, a mixed 4-6 open classroom, usage was severely restricted by teachers for part of the year because of a feeling that students were "playing" instead of working on more challenging tasks both on and off PLATO.

6. In reading, the apparent effect of PLATO on the Metropolitan Primary I Reading Test and on attitudes in grade 1 was negative. A number of factors, beyond the greater number of disruptions and demands on teachers' time arising from young children's problems with the audio device and child-changed discs, touch panel, and microfiche, seem to have contributed to these negative results. The major problem was the curriculum itself; heavily oriented toward atomistic beginning readiness activities such as letter-sound correspondences, controlled by a router that moved children through the curriculum slowly regardless of ability, and tending to yield false negative diagnoses because of inadvertent touch panel responses, the curriculum held children who were already reading in such activities as sorting words by initial consonants and paging through stories as the machine pronounced the words, for most of the year.

7. According to observations and interviews, most reading teachers did very little to integrate PLATO into their teaching of reading, and indeed, most expressed a lack of familiarity with the curriculum, beyond that gained by incidental observation of lessons while helping children with problems. Although most teachers felt that their kindergarten and 1st-grade children enjoyed PLATO and liked the experience of individual interaction with and control over a complex machine, few felt that PLATO had had a significant impact on reading skills beyond providing reinforcement or practice.

Given these preliminary results and the accompanying threats to the validity of conclusions, several modifications in both the implementation and the evaluation design were clearly necessary. The National Science Foundation became concerned about the unfinished nature of the projects and the inferential weakness of the design in mathematics. The developers responded by relocating terminals from the highest-achieving 6th-grade classes to two schools in which comparison classes were available. In one of these schools, the same teacher (PG6) taught mathematics to PLATO and control classes, and the CERL mathematics group supported ETS's efforts to ensure that the School IV control children did not have access to PLATO during the evaluation year. The developers were not prepared, however, to remove terminals from one of the two 6th grades in School V or 5th grades in School VI, because of prior commitments to the teachers. School district records suggested that School VII might be a better match for Schools V and VI than School VIII had been in the previous year. After considerable negotiation and the offer to reimburse control teachers and classes with a $50 honorarium and $80 in classroom equipment, it was possible to secure within-school comparison classes in all other cases. Since PLATO mathematics teachers were receiving a $600 payment from CERL, the payments to control teachers probably did not equalize the differential incentive to cooperate.

In reading, negative pilot-year results for grade 1 and the developers' projections that the reading curriculum would not cover appreciably more advanced material by the end of the demonstration year led to a considerable change in focus. Selected grade 1 classes were tested and observed in a frankly formative attempt to describe the process of child-terminal interaction and curriculum integration and to relate these to relative progress in reading, but control classes were not tested. In kindergarten, however, four teachers agreed to use the system in only one of their two classes (morning or afternoon), providing a small but controlled study, unconfounded by teacher effects, at a level at which the PLATO reading curriculum's readiness activities might be more appropriate.

3.5 Design for the Demonstration Year

The negotiations among the PLATO developers, cooperating school districts, evaluators, and NSF continued through the summer of 1975. In spite of the admittedly unfinished state of the curriculum, it was agreed that the achievement outcome evaluation would focus on the mathematics demonstration. Primarily to allow a description of implementation and to assess pupil and teacher reactions to the still-developing reading curriculum and the PLATO system, a subset of the reading classes in the cooperating schools was also monitored.

As indicated in Table 3.5.1, the mathematics demonstration involved a total of 25 teachers, seven schools, and 27 fourth-, fifth-, and sixth-grade classes. Twelve teachers in six schools used the PLATO curriculum, 12 teachers in six schools taught control groups, and one teacher (School IV) taught both PLATO and two control mathematics classes. In school I, fifth and sixth graders in one multigrade class used PLATO, while fifth and sixth graders in two other multigrade classes served as controls. Both available sixth-grade classes in School V and both fifth-grade classes in school VI used PLATO. Appropriate control classes were drawn from Schools IV and VII. To be included in any of the analyses, it was decided that pre- and posttest results on the Comprehensive Tests of Basic Skills must be available. Thus the total possible PLATO populations in grades 4, 5, and 6 were 51, 109, and 87, respectively. The total numbers of control pupils were: Grade 4, 57; grade 5, 124; and grade 6, 100. With apologies to R2D2, teachers are coded as P(PLATO) or C(control), an identifying letter, and in the text, numbers indicating grades taught. Thus in School II, teacher PE taught a mixed PLATO class consisting of 4th, 5th, and 6th graders and appears in all three grades of the PLATO column of the Table 3.5.1.

The planned comparisons are obtained by reading across Table 3.5.1. Because multigrade classes were involved at each of the three grade levels,

Table 3.5.1

Design for 1975-76 Mathematics Demonstration

	PLATO School		Control School	
Grade 4	I	PA, PB, PC	I	CA, CB
	II	PE	II	CE
	V	PH	V	CJ
Grade 5	I	PD	I	CC, CD
	II	PE	II	CE
	III	PF	III	CF, CG
	V	PI	V	CK
	VI	PL	VII	CL
	VI	PM	VII	CM
Grade 6	I	PD	I	CC, CD
	II	PE	II	CE
	IV	PG	IV	CH, CI(PG)*
	V	PJ	VII	CN
	V	PK		

*CH and CI were regular classroom teachers for these two classes, but PLATO teacher PG taught their mathematics classes.

a total of 14 within-grade comparisons were available. Except in School IV, where PLATO and control mathematics classes were taught by the same teacher, treatment effects are confounded with differences in effectiveness among PLATO and control teachers. Moreover, in the instances in which within-grade/within-school comparisons were not available (two sixth-grade PLATO classes in school V and two fifth-grade PLATO classes in School VI), treatment effects are confounded with any systematic school differences.

This design is thus sensitive to overall PLATO effects only if they are large compared to teacher differences. Further, it should be kept in mind that the curriculum, initially targeted at grade 5, articulates differently with the curriculum of the three grades. For example, while whole numbers lessons are supplementary to the teacher's activities in grade 4, they are more likely to represent remediation in grades 5 and 6. The fractions component of the PLATO curriculum represents enrichment in grade 4, but is supplementary in grade 5, and may or may not be remedial in grade 6. The graphs material should be classified as enrichment at all grade levels, but appears to be at a very high level for fourth graders. In addition, in all strands, reading demands are not trivial, and students from higher socioeconomic status backgrounds, concentrated at schools I, V, and VII might be expected to perform differently from those at school II, the lowest-income and most racially segregated school in the sample.

The design limitations thus suggest that there be a careful examination of the possibility of differing effects at differing grade levels and in different schools, in addition to an examination seeking to characterize the overall impact of the treatment on the multiple achievement and attitude performances of the students.

As indicated earlier, for the demonstration year it was decided that attention in the reading area should focus on the collection of descriptive data. The only controlled reading achievement comparisons involved four kindergarten teachers who used PLATO curriculum materials in only one of their two half-day classes during the first semester. All four teachers used PLATO with both of their classes for the second semester.

The design for this portion of the evaluation of the reading demonstration is presented in the following table:

Table 3.5.2

Design for 1975-76

First-Semester Kindergarten Reading Study

School	II		IX		IX		X	
Teacher	PAK		PEK		PFK		PIK	
	AM	PM	AM	PM	AM	PM	AM	PM
PLATO	18*		15			17		18
CONTROL		19		17	21		10	

*Numbers refer to numbers of children tested.

3.6 Demonstration Year Implementation

The demonstration year got off to an inauspicious start with a teacher strike in one of the districts, but this was quickly settled, and pretesting went smoothly. The reading curriculum was initiated on a classroom-by-classroom basis, with CERL staff introducing children to sign-on procedures. Within a few weeks, all 25 PLATO reading classrooms were using the system.

In mathematics, last-minute changes to the fraction strand and router held up the beginning of PLATO lessons for six weeks into the school year, but when the lesson delivery began, few problems were encountered. In an effort to improve curriculum integration, mathematics teachers were asked to prescribe whole numbers, fractions, and graphing strands in different combinations for different groups of children in their classes. These prescriptions were not changed often during the year, but they did give teachers the potential for considerable control of their students' PLATO experiences. In reading, four first-grade teachers initially attempted prescribing lessons, and CERL staff tested children before and after particular lessons with ETS-developed formative lesson-specific tests. Newly-developed phonics lessons in reading appeared to be confusing to a number of children and unpopular with several teachers. With the departure of the director of the reading program in March, these lessons were dropped, and the automated curriculum management system was abandoned, thus involving all reading teachers in lesson prescription. In effect, two distinct reading programs were delivered during the demonstration year. The within-teacher first-semester kindergarten study was implemented as planned, but it thus gave information about the achievement effects of only the first of the two reading programs.

In mathematics, lesson delivery, testing, observations, and interviews proceeded as planned, resulting in quite complete, reliable, and initially comparable data. The only deviation from the plan occurred in the administration of the fractions pretest. The two School V PLATO 6th grades and their School VII comparison were administered a version of this test containing 4 fewer items than that administered to other students. This had the effect of inflating the apparent School V and VII fractions effect and also of slightly decreasing the reliability of the covariate in estimating the PLATO effect in the School V-VII 6th-grade fractions contrast. Time on system and in mathematics strand and module was collected by CERL staff and provided to the evaluator. Table 3.6.1 shows the average number of sessions and time on the system for each PLATO class in the demonstration year evaluation, and it indicates that, in mathematics, the level of "dosage" was adequate to warrant evaluation of PLATO effects.

In summary, in spite of the delays, the midstream course corrections, and the lack of a finished curriculum--events which were bound to attend simultaneous system and curriculum development and tryouts--the PLATO elementary mathematics curriculum was sufficiently well implemented to yield useful outcome data, and the evaluation design instrumentation and implementation were suited to the capture of these data.

In Chapters 6 and 7, we will present both the analytic model and the results of analyses of the demonstration year mathematics and reading outcome data.

Table 3.6.1

Average Usage In Target Classrooms

Total for 1975-76

Reading

	Hours Per Student	Sessions Per Student
PAK	7.2	44
PEK	12.7	74
PFK	10.3	51
P1K	7.4	44
PB1	30.3	180
PC1	19.0	116
PD1	18.4	124
PG1	17.6	103
PH1	20.6	116
	$\overline{X}$ = 13.26	$\overline{S}$ = 79

Mathematics

	Hours Per Student	Sessions Per Student
PA	25.0	200
PB	10.2	66
PC	29.0	194
PD	42.2	251
PE	39.8	259
PF	59.6	449
PG	63.7	639
PH	65.6	319
PI	55.0	381
PJ	68.3	737
PK	56.6	589
PL	61.4	397
PM	65.2	409
	$\overline{X}$ = 49.4	$\overline{S}$ = 376

Chapter 4

The Case Studies

4.1 The View from the Classroom

The varied resources invested in the PLATO project had as their ultimate destination the classroom. The moment of truth was the coming together, in the school setting, of the PLATO-delivered curriculum and the student. The account of the introduction of the terminals and the subsequent effects of their presence is thus a pivotal part of the evaluation.

In other sections of this report the context of the PLATO project is considered, aspects of the implementation process are chronicled, and the results of achievement and attitude tests are presented. In the next two chapters the focus is, specifically, the classrooms. PLATO was certainly a salient addition to the classrooms, for it represented a potentially strong influence on many aspects of the setting and the people in it.

The information that follows about events in the classrooms is presented from multiple role perspectives: those of the teachers, students, and classroom observers. The implementation of PLATO is also depicted from different time perspectives, a chronological sequence being used in some segments and a cross-sectional one in others.

We begin with several classroom case studies, accounts which attempt to integrate information from the several sources and across time, about individual classrooms. Aggregate instrument-specific information, whether it be from composite observations, achievement scores, or interview responses, is likely to impart little of the richness of actual classroom experience or of the sense of vicarious participation that can be an effective way to learn about complex events and their consequences.

The complicated PLATO field trials could not be easily encompassed in multiple foci taken one at a time. Thus the case study was found to be a more hospitable frame for conveying the sequence of tangled events.

In constructing the case studies, all available sources of data were used, but the heaviest reliance was placed on classroom observations, teacher interviews, and the logs that several teachers volunteered to keep. These logs emerged as an especially important and unique source of information. They provided an ongoing account of the teachers' responses to PLATO, one that was anchored in the present; they were not the anticipated or recollected responses so characteristic of conventional interview and questionnaire data. The teachers' perspective predominates more in these accounts than in other chapters. Teachers here speak and write for themselves. Even when the points they make could have been more parsimoniously summarized, they provide an authenticity that might otherwise have been lost.

Portraits of five classrooms are presented: three primary grades that used the PLATO reading program and two middle grades that tried out the mathematics materials. A third case study of a fourth-grade room was also prepared by one of the field staff. It is an in-depth, meticulously detailed portrait. Because of its length, it is presented as a supplement to this report. The selection of classrooms for portrayal was diff-cult. All the rooms had a story to tell, each informing the introduction of an innovation in a unique combination of particular and common elements. The classrooms chosen reflect this fact. That is, they are offered not as typical of the group as a whole but as representing the diversity found among the participating classrooms, which were a heterogeneous group providing a variety of instructional settings for the field demonstration. The mode of PLATO utilization was expected to differ among classrooms, and it did. The amount of PLATO use (the actual time students spent on terminal) was a major, if crude, indicator of these differences, which were undoubtedly affected by a host of situational factors. One of these, the teachers' interest in the resource, was found to be related not only to the way PLATO was deployed but also to the amount and quality of information that became available for evaluative purposes. Teachers with only a moderate interest in PLATO, for example, were less likely to keep a log of their experiences. Yet it was the log that turned out to be one of the most richly informative sources of day-to-day life with PLATO in the classroom. The interview responses of teachers were also sensitive indicators of degree of involvement, the more reflective responses tending to come from teachers with high interest in the innovative resource and the less elaborated responses characterizing their less committed colleagues. Such teachers are critical informants, as they are probably representative of teachers at large in their attitudes toward innovations. Thus, in selecting classrooms for case study, we attempted to include teachers from all of the range of teacher interest in PLATO, even if that resulted in self-reports that varied in length and depth of description. The differences are presented here as witnesses to our own interactive approach to the evaluation, for we regarded the participants assessed as active shapers of the significant data available to the evaluator.

The classrooms ultimately chosen do not, in fact, fully represent the range of PLATO use, but they are weighted toward rooms that were high users of the resource. Of the three reading classes described, two were high users and one a low, irregular user of PLATO. The teachers in the two rooms making regular use of PLATO had contrasting approaches to the use of classroom resources, and their deployment of PLATO points up alternative patterns of utilization.

The three case studies of the implementation of the mathematics program describe rooms at the three levels that were field sites for PLATO--fourth, fifth, and sixth grades. The sixth-grade room was a high PLATO user during the first year of the demonstration, but at the end of the year the teacher chose to terminate her participation. The antecedents to her decision provide useful insights into the problems of merging two curricular streams in one classroom. The fourth-grade room, also that of a high PLATO user--in fact the most intense utilizer of the resource--was possibly the most successful implementation site. The fifth-grade room was also a hospitable site for PLATO, but, again, it exemplified different conditions for the implementation.

The first year of the demonstration tends to get more emphasis in the case studies than the second, for the initial impact of PLATO and the accommodations made to it were more fully felt and visible during the first year. The events of the first year thus are not generalizable to a mature stage of implementation, when the disruptive effects of the innovation would have diminished but so might the enthusiasm and energy that accompanied the introduction of the resource. One sign of this reversion to "normalcy" could be found in the quality of the logs, which tended to be greatly attenuated during the second year and thus deprived the evaluation of that crucial fount of information.

4.2 Reading Case Study I

The school day of the 24 children in L.T.'s* first-grade room is well ordered and closely planned. Their teacher is experienced in working with young children, having directed a nursery school for five years before coming to the present school six years ago. Teaching is a dominant aspect of her life, her classroom-related work and other professional activities overflowing into evenings, weekends, and summertime.

The teacher's manner is friendly, and she has a quiet, controlled voice. She regulates the classroom by various means, both direct and oblique. The playing of a music box signals heads on desks, the flicking of lights calls everyone to attention, as does "I need good listening ears," or "Will you be all right there?", which translates to "Will you stop talking and moving around?" Children can move about the room at designated periods or with permission.

The behavior codes governing the room are clearly stated. Some of them are posted on the bulletin board:

1. cooperate
2. listen
3. walk at all times
4. do what told
5. no fighting
6. work quietly
7. be polite

There is a fair amount of discussion about rules, especially at the beginning of the year. The teacher works hard to have the children internalize the rules. An excerpt from a classroom observation is illustrative:

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*Because of the large number of students in her demonstration year class who participated in a summer PLATO program, this teacher was not included in test score evaluations in 1975-76. Thus she is spared the designation PF1 (School X) in this narrative.

> ...the lights were out and the children appeared to be settling into a quiet, anticipatory state. The teacher turned on the lights, and complimented the children on their behavior the previous day. She asked why the children thought they had had such a nice day. What was different? The final agreement was the fact that they were learning the rules, and learning how to cooperate.

The children appear well socialized into the pupil role. They seem on the whole respectful and task oriented, if occasionally listless. Spontaneous bursts of activity, sudden shifts in plans are rarely observed in the room.

A somewhat formal egalitarianism is enforced in the room and is based on a rather literal interpretation of equal treatment. When making applesauce, for example, each child gets three stirs with the spoon, rather than having fewer children explore the process to completion. In social studies, which often takes the form of circle meetings, every child responds in turn to a question such as "what makes you happy, sad?" Open-ended discussions, with elected participation, occur less frequently.

Everyone does not do the same work, but everyone knows what is to be done. Individual work is regulated by contract, the teacher preparing individual packets for children daily. The assignments are based on the students' "academic ability, attention span, and social-emotional ability" and often consist of a phonics paper, a math paper, and a fun paper.

The room is provisioned for a fair variety of activities, eight centers situated around the desks-in-groups arrangement of the room. The centers (reading, math, science, art, etc.) are used in a rotating fashion, each child being assigned to one after finishing contract work.

In March 1975, a classroom observer took a snapshot:

> L.T. was having a reading group. The Jr. participant was helping children with their contracts, The older children were working independently. B. was making an egg out of an egg carton. A boy watching her said: "I'm gonna make a boat." Three boys were looking at a book and telling about insects. Some children were working on contracts. One child was reading in Raggedy Ann corner on floor. Two girls were looking for book to read. One boy was making a styrofoam boat. Some children were working on an activity book for Green Feet (a primer activity book).

The teacher praises a lot, ceremoniously congratulates and shakes hands with children who have done well. Work papers are sprinkled with "superb," "fantastic," "unbelievable" if judged satisfactory; less desirable work brings the invitation to "come and see me."

Reading instruction is organized around 4 or 5 groups, which are ability based. A basal series is used, Phonetic Keys to Reading (Economy), along with Macmillan and Scott Foresman materials. The teacher supplements the predominantly phonics approach with sight recognition, starting the day with board work for the whole class, using a common word of greeting, days of the week, etc. Children who, in the teacher's judgment, "are not going to master the sounds" are given additional sight instruction. The teacher reads to the class, usually after recess, when such reading is seen as instrumental to quieting the children down for reading group. There are other reading-related activities in the room, but the reading group is at the heart of reading instruction, a highly valued i... ructional mode. It was the one activity that always superseded time on PLATO, as children could be interrupted in most other engagements for their turn on the terminal.

The work of the reading groups usually focussed on identifiable instructional objectives. The teacher liked to use game-like formats for practicing skills, and as the year progressed introduced a greater variety of activities to the reading groups. Two brief observational excerpts, one from the beginning, the other from the middle of the school year, catch a glimpse of reading groups in action:

> The teacher is having the children figure out the rule for goat. It is a short word with two vowels, she tells them. They go on to other rules, vowels at the end of the word, etc. They also talk about words that you can't sound out, calling them sight words. The group works out a page in Keys to Reading Activity books.

The observation from later in the year records some interactions in two reading groups, one at a middle ability level, the other the top group in the class:

> Middle Group: The children sit in a circle and read a book together. The teacher asks comprehension questions such as: What is going to happen? Who took off the wheels? etc. They read a poem together, too, listening for rhyming words.
>
> The children read another story, and then the teacher reads a poem to them. She reminds the children to be quiet while the reading group is on. She tells Greg who is reading: "I think if you sat with your feet on the floor you'd be able to do this better." After all the kids read, she shakes each one's hand.
>
> Top group: Before this group started, the teacher said: "Now I'll show you a group that can really read." The kids play a game of being doctors, and are cutting words into syllables. They hold hands over mouths to check how many syllables they pronounce as they speak. They also clap to the syllables. Teacher asks to come pick a pencil: "never throw things". While the group was working, the teacher remembered recess, and in about two minutes they were all outside.

The teacher views reading as a complex, not well understood process and is aware of individual differences in learning how to read. In one of the interviews she talked about this:

> I've been trying to figure out why some children learn to read just like that...they are in the room a couple of weeks, they've cracked the code and are really going...and other children just can't grasp this at all, no matter which way you put it. Has a lot to do with motivation, yet, some children are really motivated, really want to learn those sounds, those letters, and it just doesn't register...I ask mothers and children who already read how they learned, and most say they didn't have anything to do with it, the children just picked it up...a very perplexing question.

These understandings however seem to be held apart from the assumptions on which the teaching of reading rest. For this teacher, as for most others, there is no viable alternative mode of instruction to the one guided by custom and basal readers: the postulate of a set of subskills that are prerequisite to reading along with the assumption that a process of direct instruction, in ordered sequence, will benefit most children. L.T. was, however, set apart from other teachers by the amount of time she spent analyzing and planning the children's work in basic skill areas. For two to three hours every night, she corrected, commented on the work sheets, and assembled the assignments for the next day. She kept elaborate cumulative records and had a highly differentiated view of the children in terms of these academic activities.

The teacher's mode of instruction, along with her curricular assumptions, thus were compatible with those of PERC. L.T.'s room was in fact one of the most hospitable to PERC, and she was probably the most actively participating teacher in the project.

Early Participation

L.T. became intrigued with PLATO's potential on first acquaintance, indicating her interest at the first meeting in the fall of 1973. She was the only teacher in her school to do so. When a letter came subsequently inviting the teachers to try out the system at CERL on a Saturday, she spent two hours on it, and continued to do so every Saturday throughout the spring and summer, when she incorporated her interest into the graduate course she was taking at the University of Illinois. She worked through the then available programs, and proceeded to make good on her offer to sketch out designs for lessons that would go beyond the stress on letter-sound correspondence, to include sight words, comprehension, and even such broad goals as the facilitation of divergent thinking.

This active posture made the classroom a natural site for the experimental implementation in the spring of 1974. This period gave the teacher time to experience the presence of terminals in the room, to work out some scheduling arrangements, and observe children interacting with the terminal.

The Pilot Year

L. T. began the 1974-75 school year, retroactively designated the pilot year, with a fair familiarity with the resource. As soon as the children received their individual training sessions with the PERC staff, a schedule based on reading group membership was posted, the child who finished responsible for alerting the child who was next scheduled on the terminal.

The general rule stipulated that unless in a structured group, or exceptionally engrossed in work, the children would stop what they were doing, including contract work, for their time on PLATO. The teacher was reporting her observations soon after the children began to use the terminal:

9/10 PLATO has found some weakness. C. definitely has problems with left and right...also found he didn't know the letters of his name, areas that were not observed by me. He could print his name on paper and he could raise his left hand when playing Simon Says.

9/18 PLATO has found the same difficulties as I observed with some children. D. and E. are very reluctant to do anything on their own--want to be told--also very slow--takes them a long time to put on the records. F. and G. want to be reassured that they are doing the right thing. The poll of acceptance of PLATO is high...the free typing is one of the favorite activities.

The unreliability of the system was frequently noted by this teacher, as it was by all the others. L.T.'s notes record not only the gross malfunctions but also the harder to detect problems that affect the instructional content of the programs

10/6 I have listened to a number of the lessons. I find the audio somewhat distorted with power and some overlay - the children didn't mention it but when I asked some said they had experienced the same - they came out to check the audio device - found it O.K.--think a lot of it is in the recording. There are background noises, etc., but know it would be hard to perfect.

10/22 There were a number of hardware problems this week. Then some of the children had the trouble of getting the wrong words with what was on the screen or the story was about one and they were told to type <u>but</u>. This could be quite a serious problem - especially if it happens to a child who doesn't know the word.

The teacher copes with PLATO-related disruptions as best she can, involving children in dealing with the problems:

9/18 I have assigned a child for each group to sort of be responsible to take care of little questions regarding the reading of "just a moment" and checking if record is on right or other problems. They are not to help, just be flunky for those who are not capable as yet of working without some reassurance. Feel PLATO will be good to teach responsibility.

11/7 Things go smoothly as long as PLATO gives them their fifteen minutes, but this week most of the children only got one lesson less than 5 minutes - then they complain and interrupt the groups to tell me. I took D's (PERC staff member) suggestion and told them on Thursday that they would probably only get one lesson and if they didn't want just one lesson don't go on - and if you do go on don't complain to me - only tell me if you get over 5 lessons - That worked!!

When difficulties with PLATO interfere seriously with reading group instruction, she draws the line:

11/22 When problems like this come up with the children it causes a lot of frustration because I have to leave the group I am helping and see what can be done. Usually ends up by taking the child off.

The teacher continues to report close observations of the children's work at the terminal, the student's attitudes toward the programs:

10/1-6 This week I tried to observe the children indirectly when they are on PLATO. Also tried to see what kinds of programs they liked best. Find most of them like lessons that have their name involved. The least liked thing seems to be the matching of the part of a letter by moving the box with the arrow keys. Very few use the keys....

M. wanted to stay in from outdoor play to do PLATO. So watched her - indirectly. She kept doing the same lesson over and over - the Grape letter one - finally I asked her if she was tired of that - she said "sort of" - then asked her why she kept doing it - she said that if she said no she would have to quit. So it is strange how some children interpret directions.

B. is excited about PLATO. She begs to get on. She figures many things out by herself and helps other children who have problems.

12/15 The children in my top reading groups do not like the letter recognition activities as they know all these - they enjoy the pop-up and sight words. The slower kids are still getting the games (Spinner, Concentration, which are too complicated) - though some good improvements have been made. My good readers would enjoy these games but never get them.

The teacher monitors PLATO's routing decisions and expresses some of her own preferences:

11/30 Would like to be able to prescribe for some children - especially the low ones - to see if PLATO can teach and get the child to retain sight words. The children who are getting the sight words have no problem but would like to see what carry over is for children who I am having difficulty with retaining.

She also attempts to check the effectiveness of PLATO lessons and plans to link the PLATO and classroom curriculum:

9/18 I have used some of the words from the Make-A-Face lesson on the board to see if the children knew them--a few did--will be working in this area more-carry through of PLATO words--a reinforcer.

At the start of the new year, PLATO brings an unexpected benefit:

1/10/75 The children that got the 1974 changing to 1975 enjoyed it and this is the first year I have had children consistently tell and write 1975 without constantly being told. I asked how they knew - reply 'PLATO told us'...All the children seem to be enjoying PLATO and no one ever refuses to get on.

The teacher continues to wish for a more direct match between lessons and learning needs as she perceives them:

1/10 Would still like to see the slower children who are having trouble getting lessons where their trouble lies - feel some advance to lessons that are too advanced - For instance, A. has trouble printing his name--would like to have more lessons for him to perfect this as well as more concept lessons especially on left - right - row type direction.

L.T. studies the performance data provided by PERC in great detail, and reports more general observations as well:

1/24 Haven't been able to interpret the data on performance. Can't figure why the children who are proficient in reading and knew many of the sight words didn't pass the test - said were not sure of those words - then there are kids who aren't still able to read these sight words passed!

2/9 Played with PLATO today. Went through the performance data. Found some interesting things. Some of the same letters and sounds I find the children do not know PLATO also says much practice needed. Found that B. has only done two objectives and keeps doing them - also C. keeps complaining he is getting the same lessons, but on checking his performance data he is not proficient in areas - does he get a repeat of things he doesn't pass. C. is a good reader and confused on why PLATO registers him not sure of sight words such as I - you - am - she - he.

4/18 The same kids that have trouble doing things for themself in the classroom - also are still having trouble doing PLATO. G.'s behavior on PLATO - wants everyone to know what he is getting - turns around and tells kids - "Hey look what I get" - is the same type of thing he does when he is at his desk - always wanting attention.

Most children kept working on PLATO willingly, a few signalled lagging interests:

2/18 H. surprised me and didn't want to get on today. This is a child who has been possessed by PLATO...last week he was messing around and using my records so I reprimanded him, then two days last week he was kicked off. Don't know if there is any relation to this.

2/21 D., a good student, has decided two days she doesn't want to get on. When asked why, she gives no answer. E. also has lost some of his enthusiasm...His mother says since he couldn't get on PLATO he has changed to a dog. He is interested now in the neighbor's dog.

When new materials become available, or the teacher can select for children, interest perks up again:

4/18 Children have shown an increased interest in PLATO again. Think when someone gets some new game that they like they tell another child - then that child wants it - before I used to tell them that I couldn't get it for them but now if a child asks for a specific activity I try to prescribe or get it for him. This keeps their interest up. Some children get tired of the Magic Hats and Balloon Bear activities.

The year ends with a more flexible attitude toward PLATO use on the part of the teacher and more autonomy by the children:

5/14 Children are more or less getting on as they want to -- no scheduling. Some get on twice--or beg to - especially those doing stories and play options. Found many of the kids now know how to get what they want by experimenting with keys or by picking up by watching me get them a particular activity.

Summary

True to her hardworking ways, L.T. reflected on her experience with PLATO in a paper written in August 1975. This summary reiterated most of the concerns and judgments she recorded more informally in the log and communicated in interviews.

For all her close observations and detailed analysis of student performance data, she did not feel able to judge the effectiveness of the programs to her satisfaction:

> Although I had an overall view of what was taught on PLATO, I was not always cognizant of what activities each child got, the purpose of the activities and how the children performed on the activities. Therefore, there was little integration on what the children were learning in the classroom and vice versa. In a lot of instances what the children were learning on PLATO they already had in the classroom. Thus an evaluation of what was learned solely from PLATO was difficult.

Evaluating the effects of PLATO proved to be difficult for other reasons as well:

> Because of the time element, it was not possible to check each child's PLATO performance each day. I did get print-outs of the performance data of each child periodically. Many inaccuracies were found in the data print-outs. For instance, the print-out would say a child failed a certain sight word and letters,... when I asked the child what the word or letter was, he many times got it correct. This happened consistently. ...so there must have been some problem, either with the audio, the touch panel, or the child was deliberately making mistakes.

The performance data were not satisfactory, and the teacher tried to learn about the effects of PLATO her own way:

> On May 4, I made up an evaluation of all the concepts contained in the "red book." I put it on ditto and each child was given it in a test situation. It was given in three different sittings...My purpose...was to see if there would be any carry over from the PLATO screen and audio to a flat sheet of paper and my direction. Also wanted to see if there would be any pattern of error.

These data were also thoroughly analyzed, only to yield more equivocal information about PLATO's effect on learning specific, reading-related skills. The influence of PLATO on more global areas was reported less hesitantly:

> I feel my children have done better creative writing because of PLATO's influence. It was a great motivational factor in getting them to try to write and in giving them ideas. They drew pictures and made many stories like many of the PLATO lessons...
>
> PLATO helped the children to realize that they had to take turns. They also learned that if they said they had not been on, I could check it out and show them on the PLATO screen that they had been. They were really awed at this. It got to the point, where if one child doubted another they would say, "You better not lie. PLATO is smart.
>
> The children were also always very willing to help a child who either was having trouble putting on the disc or understanding what to do or how to get off or on. At times, I felt some children learned too much about the operation of PLATO. They would watch me and if I would shift stop them out and reenter them because of a hardware problem, they would do it themselves especially if they did not like the lesson they got. This, of course, could have affected their lessons. Also some children learned by watching and experimentation that they could get other children's activities and I know at times some children did this.

Her final evaluation was summarized as:

> I feel that PLATO needs to give better results than what I had experienced in the year of 1974-75 to warrant the time and expense of this program.

The cumulative on-line usage records indicated at the end of the year that this classroom was the second highest user of PLATO among the ten reading classes, with a mean of 18.7 hours per child, where the range was from 8.6 to 19.2 hours.

The standardized test results for this class however did not deviate greatly from the general negative trend. Of the three subtests of the Metropolitan Primary I Achievement Test, the results were positive only for the Word Knowledge subtest. On this 35-item test of matching words to pictures the class had an estimated 1.9 point advantage over the control classes, a significant result, after the pretest scores were taken into account. This class also did better, i.e., less negatively than the -1.6 point PLATO effect, on the 40-item Word Analysis subtest, but not significantly so. On the 42-item Reading subtest, involving matching a sentence to each of 13 paragraphs, this class scored 3.3 points below comparison classes.

This teacher's interest however did not diminish during the course of an uneven, often frustrating year. The children seemed to like working on PLATO as much as, if not more than on the other reading-related activities available in the room. Throughout the year, the terminal remained a scarce resource, which may have enhanced its value.

The teacher would have preferred more control over the children's lesson assignments and certainly a more elaborated rationale of the assignments, so that she could shape the class curriculum to fit closer to PLATO lessons. Although L.T. spent more time than did any other teacher in analyzing performance data, she received dubious returns for her efforts. This was the case not only because of the inaccuracies due to software problems but also, in the evaluator's view, because the information provided was fragmentary and not easily integrated into instructionally useful terms. The teacher came to PLATO with a predilection for such microanalysis of the childrens' work, and the PLATO data reinforced this tendency.

As she was still dissatisfied with her ability to judge the efficacy of the program, L.T. undertook to organize a summer program for about twenty children who had no previous formal reading instruction and would be exposed to PLATO alone for a half-hour each day during a four-week period.

The teacher's expectations of a definitive judgment were again disappointed; nevertheless, her commitment to continue using PLATO remained unshaken.

The Demonstration Year

The final year of the PLATO field trials started in L.T.'s room with a new group of children, 13 of whom had had a good measure of exposure to PLATO, having participated in the summer program L.T. supervised. The teacher by now had prodigious experience with PLATO.

The school year itself started inauspiciously. All during October, malfunctions were reported almost daily. The noise of the terminals was particularly disruptive. Log entries reflect these and other curriculum-related problems:

10/10/75 PLATO not turned on - too noisy...

10/10 PLATO is so far behind what children are getting in class. The long vowel lessons are confusing children - it says ae says e, ie says i. This is the opposite of the way I teach it...at present trying to reteach PLATO's misconception on the long vowels...using PLATO's ideas to show children how it is the same as mine.

10/14 Didn't turn it on until noon...it is too noisy. When I did turn it on, it didn't work. CERL people came out to move compressor. Don't plan to use PLATO until noise is lessened.

Problems continue, yet PLATO has not lost its attraction to children or parents. Asking the children if they liked PLATO:

10/15 All but one said yes. The negative one didn't like it because he had to wait too long! All the children said they would like more time. All but three said they had told their parents about it.

10/16 PLATO has not worked all week. The compressor has been moved to the furnace room, but fuses keep being blown...no air pressure to make audio work.

Had open house...many parents interested and fascinated by PLATO's capabilities. Had many questions, and I demonstrated some lessons. Parents thought the games most appealing... also intrigued by the availability of performance data.

At the end of October L. T. reports that PLATO has not yet been a resource for her teaching, even as the presence of the terminals in the room are wasteful of her time. When asked if this keeps her from some customary activities, she writes

> I just spend more home time doing the things I didn't get done at school.

The teacher's involvement also brings rewards:

10/22 The story I wrote last year is now on as a special entry. Plan to make a ditto of the text and let the children illustrate it. Will use it as a reasoning and logic exercise. The kids all were shown the story. They liked it. It is simple enough, they can read it without audio. The animation is very good.

The teacher reports on children's reactions, continues to monitor learning in relatively narrow terms, and registers dissatisfaction with some offerings:

11/6 Children love the Bingo games, sentence maker, and the see story. Some children get mad because they don't get it and others do.

11/7 Got printouts of the performance data. Still can't figure out why so much time is wasted giving children activities on letter recognition - when they know them - all but 2 of the children scored 100% on two different letter tests. Also 16 of the children know their letter sounds perfectly.

I like the sight word activities and find them beneficial. Plan to see if there is carry over to board work. Also am going to make some dittos and see if the child knows the sight words PLATO indicates he knows.

11/17 It seems like PLATO's curriculum is sort of haphazard. Some good ideas but there seems to be no continuity, jumps around from one idea to another.

The system is performing more reliably now:

11/21 Everything went fine on hardware this week. When the machinery works children get turns and the class is much easier to teach.

Individual children's interaction with PLATO is also monitored:

12/6 E. exhibits the same behavior pattern with PLATO as he does in the reading group. I sat with him on his lesson. He never waits for the complete message but starts pounding the keyboard. Then he gets mad. He can take about 10 minutes.

The teacher's main concern now is with instructional content, and she is increasingly impatient:

12/4 Still have children complaining about getting lessons they have had, lessons to see if they can use the touch panel. It seems to me that the cost of PLATO is not that cheap -- if they cannot get lessons the children need, forget it...the frequency of record changing still continues to annoy many children. They spend more time changing records than doing the lesson.

12/10 The touch sensitive stories are well liked by the children, but I feel many of them are too subtle. Also the way they are to be read does not foster reading fluency--stop at each line. Still feel the teacher needs to know more what the kids are getting each day or at least weekly.

The limited selection of PLATO materials is taking its toll:

1/17/76 First day PLATO back since Dec. 19. Even though it was the first day the children had a chance to see PLATO they were not all eager to get on. Some thought they would get new materials. Were disappointed because they didn't.

L.T.'s concern intensified sufficiently for her to ask to see the director of CERL:

2/4 Had a conference with B. today. He agreed with me that PLATO was not meeting the needs of the children. We plan another meeting next week.

But new materials are not forthcoming, the system is malfunctioning as well, and her dissatisfaction mounts:

2/23 PLATO off and on all week, audio problem, slide problem. Kids not interested.

2/26 Kids are still getting old stuff...Someone to straighten out the mess!! Develop more appropriate material - I get a lot of ideas but everyone seems too busy. Having another meeting with B. Tuesday.

The outcome of the meeting is not logged, but a new option is opened up:

> E. [CERL Staff] came out to show me how to prescribe. I hope it works...If they really get it, then I can reinforce PLATO with my teachings.

3/5 Things have been working better...more time is spent prescribing specific activities but I don't mind because I know what the kids are getting and can reinforce-supplement activities for them. PLATO is helping children make better sentences. When I started teaching them sentence making, used the PLATO lesson to introduce it. Kids even illustrate their sentences like PLATO does.

But prescribing does not solve all problems:

3/7 Prescribing myself has provided more interest for the children but still there are not enough activities available to the needs of 3/4 of any class. PLATO is still interesting to the children not for the curriculum but for the typing and the suspense of what might be got.

3/9 The records for the activities my children haven't had are not available so kids are not getting anything new. Prescriber does not store or allow to add on to activities. Also no performance data available.

Then, an improvement, and other problems.

3/12 Performance data is now available. It helps a lot in prescribing. Now if no success indicated can represcribe that activity. The data I still do not feel is reliable. The more intelligent children deliberately make errors.

Another option, well received:

We can now prescribe story writing for the children. They love it. It is a good motivator for getting them to write. They also do not object to correcting a written story before putting it on PLATO. This activity is good for the self-image of the child. Also helps him to learn to type. It is also possible for them to read other children's stories which they like. One of the more advanced students got into math--he learned to do fractions through PLATO and a little explanation and a ruler in two lessons.

The year ends on the upbeat:

5/11 Kids that I allow to get math love it. The math seems to be more challenging to the children now than reading - they like the games learning things they don't know.

Interpretive Summary

From the teacher's perspective, the demonstration year of the project was no less problem-free than the previous pilot year. There was a distinct shift in concern, however. During the first year, mechanical and system problems dominated, but during the second year concern focussed on the instructional content and relevance of the PLATO materials for the students. L.T. continued to wish for a close connection between PLATO-delivered materials and her own curriculum, wanting to know in detail what lessons the children were getting daily, so that PLATO and classroom instruction could be dovetailed. This was in keeping with her overall teaching style, which was quite centralized, and which exercised considerable control over the children's instructional experiences. The nature of the PLATO materials supported this conception of the teaching role. Thus the use of PLATO did not serve to motivate the teacher to reflect on or to reexamine, and so to broaden, her own teaching constructs.

The teacher never lost faith in the potential of PLATO as a useful curricular resource, although her store of good will was severely depleted as the materials became increasingly inappropriate for many of her students as the year wore on. It is noteworthy that long after she concluded that many children were not benefiting from PLATO, she continued to let them spend time at the terminal. It is inconceivable that she would have done the same with her own instruction or with activities of her own devising.

The cost of participating in the early implementation of an innovation was high for both teachers and children. Ongoing activities and routines were often disrupted. The teacher spent considerable time during school hours dealing with malfunctions and helping children work the terminals, observing and working with children at the terminal. She also spent an average of an hour or more daily, after school, working through lessons and analyzing performance data.

The children paid in the coin of frustration, needing to cope with an insufficiently stabilized technology, features of which were quite cumbersome for first graders to use. More important perhaps, they were exposed to materials that were repetitive and unproductive, if not counter-productive of learning to read for many of them.

What of the benefits? For the teacher, the exploration of a new instructional resource was of intrinsic interest. Participating in a special program and the attendant opportunities of having contact with curriculum developers were also a source of satisfaction. For the students, interacting with a "smart" machine proved durably fascinating, but reached a limit with the continued repetitiveness of the content presented. Interest became quickly rekindled however when new materials became available. and toward the end of the year the math programs were in brisk demand. There were a few children who became students of the machine itself. These children, the brightest, according to the teacher.

> ...liked the whole idea of being in charge of that machine. They know how to get in and out of the lessons, into my lessons too. They experimented around and discovered many things I didn't even know. They loved the control that they had.

This intrinsic interest in the machine among the students proved to be a mixed benefit. It facilitated the children's involvement with instructional materials, but it also kept them involved after the instructional value had attenuated. Learning to work with the terminal was recognized by both teacher and PERC staff as valuable in itself but was not acted on by PERC. No systematic provisions were made to enable the students who expressed interest in the workings of the machine to get a deeper understanding of its nature or to acquire skills for a broader use of the computer beyond the restrictions of the reading program.

4.3 Reading Case Study II

This first-grade room is a telling illustration that the essential qualities of classrooms are rarely captured by such bipolar dimensions as open-traditional, child-teacher centered, or structured-unstructured. The teacher's salient quality, which pervades the room, is warmth, an evident liking and caring for children. Other commonly used descriptors make for less comfortable fit, as this classroom is both child and teacher centered, each making important contributions to the quality of the learning environment. Structures regulating the use of time and materials in the room, instructional goals set for the students, are well in evidence, but so are many opportunities for self-selected activities and aims that the children can pursue.

With 27 years of teaching to her credit, N.F's* manner in the classroom has the ease of experience about it. She creates a comfortable environment, where expectations are set, but not insisted upon. The teacher maintains effective control of the 23 children in the room with mixed strategies. There is praise for desirable behavior, some good humored, if stilted teasing (slow kids are "grandmother"), the use of such time-honored techniques as the "magic spot," which, when approached, signals her demand for everyone's attention. Students are free to chat and appear to know just how loud they can get. They move about the room, but again within broad constraints. A month or so into the school year, the children are rarely admonished, but casual reminders are frequent.

The teacher tolerates, even welcomes, a certain degree of complexity

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*In the tables, this teacher is coded as PB1, School III.

and uncertainty in the environment. Schedules are not adhered to inflexibly; unanticipated events or changes in routine are treated as opportunities.

N.F. construes her curricular priorities mostly in terms of grade-level skills, yet at the same time she provides a considerable variety of activities and experiences. Children have required work to do, as well as optional activities that call for some selective decision making. On a typical day, there is a list of "Things We Can Do Today" on the board that reads:

finish seat work
do buddy reading
write a story
listen to a record
play a reading or math game
paint a picture

The connection between academic learning and these activities is not well articulated by the teacher but seems to rest on her belief that children will benefit from a broader array of experiences than those provided by text and work books and on her desire to make learning interesting and involving to the children. There are classroom discussions on a variety of topics that are open-ended, as is the case with some of the optional activities, but in the required work a "right answer" approach tends to prevail.

The working rhythm of the room alternates between large-group, small-group and individual activities. The arrangement of the room is well suited to this pattern, with its double horseshoe of desks and several well-used activity centers.

For all its diversity, N.F. monitors the classroom closely. She scans the classroom effectively, and she seems to know where each child is and to keep track of who has done what. She is quick to note signs of disturbance, and directs children to activities away from trouble spots. She is always accessible and is not averse to interruptions; in fact, when working with a small group, she often calls out to children in other parts of the room with reminders, suggestions, correctives. The children take these in stride, seem at ease with the teacher and each other.

The reading curriculum reflects the general character of the learning environment. The children meet with the teacher daily in reading groups that are ability-based but can change in membership during the year. A basal series using a phonics approach (Economy) serves as the backbone of reading instruction, but other reading materials are available. The texts are followed sequentially, starting with long vowels going on to short ones, and consonants last. Children who, according to the teacher, "do not hear sounds" spend additional time working with sight words. The school system mandates that first-grade teachers work on reading twice a day. For most students the second time is spent in optional activities related to reading. Observations made of some reading groups in session impart the flavor of reading instruction, as well as the teacher's working style:

The teacher calls the Orange Dots; they are the top reading group. The children read from Keys to Reading silently. The teacher reminds them to read silently, without fingers or mouth movement, please. She gets up to tell a little boy to wipe the water he had spilled, telling him if someone falls, it will be his fault. She comes back to the group. The children read the story and tell her about it. She asks how many kinds of pets there are and which pets they couldn't pet. Kids talk about petting fish. The room gets a little noisy. The teacher says: "I think someone is goofing off now." Tells children painting not to forget to put titles on their painted pictures. She reminds the reading group not to use fingers as they read faster that way. She tells three children standing at the door to find an activity. One little girl teases the teacher--she responds with laughter. She asks the reading group if they know what to do in the workbook after they finish reading. The children who do, leave. The teacher reminds the painters to cover the whole paper with paint.

Another observation with another group of children:

The teacher is working with four children in a reading group. This is the lowest reading group and she is using flash cards to check the children's skill. Dug is the first word. The children sound it out. They have trouble with both the initial consonant d and the vowel. If they are able to sound the word, the card is given to them. The teacher says: "Are you thinking about the sounds?" "We've got to get the b's and d's in our minds. Then she has a child write the b and the d on the board. She goes to the board and shows them how a small b could be made into a capital B. She wants them to associate the direction of the circle on the stick b with a capital so they could remember to distinguish the b from the d. She continues with the flash card, then has the children pretend that each card was a $5.00 bill, and they count their money. One child has $5.00, one $15.00, one $25.00 and the other $35.00. The teacher has the children write the numbers on the board.

The teacher, on the whole, accepts the prescribed aspects of the curriculum. She recognizes differences in children's learning patterns, motivational factors, general ability, and accommodates to these within the resources and customs of the room.

She conceives of the process of learning to read primarily as learning to translate graphics into sounds. The ability to put sounds together and blend words is, in her view, the most difficult task facing children. She does not however focus exclusively on the mechanics of decoding. In the beginning of the year, she or other adults read to the children; later the children read to each other. She recognizes that some of the best readers can read out text without comprehending it. Comprehension is judged by asking the questions provided by the basal readers or similar ones constructed by the teacher.

N.F. elected to participate in the PLATO project on the general grounds that she likes to try new things. She had some acquaintance with PLATO four years ago when she was teaching at School X, the first experimental site. She volunteered under the assumption that math materials would also be available for her students. This first year, she was the only teacher in her school to volunteer. As most of the other volunteers, she did not have a good idea of what the PLATO-delivered curriculum would be like or what impact the terminals would have on the room. She indicated that she would like the PLATO materials to be keyed to her teaching preferably to the basal readers used, serving in a supplemental, reinforcing mode. She wasn't sure who would benefit by PLATO, hoped the majority of children would get something out of it. She expressed some apprehension about its disruptive potential.

The Pilot Year

The actual story of the PLATO experience during this first year, seen from the teacher's perspective, is best told by the teacher herself, through selections from the log she kept. One month into the school year she reports:*

8/30/74	One terminal came to the classroom. I will wait to see what child will discover the terminal first and ask questions.
9/6	Questions from children: "What is that thing? " "Who is he? "What is he doing?" "Can you write my name on that?"
9/18	Second terminal came. Some people from PLATO office came. Terminals not ready yet.
9/19	Window was made ready for the air conditioner. Evening--open house. Most parents wanted to see how terminal worked. Sorry they were not in operation.
9/25	No action at the terminals. Children not as enthusiastic. Have not been asking questions.
10/7	Since the terminals were not in working condition, I thought of moving the tables around to give me a little more working room for other activities. I moved the heavy table, terminal and all, alone. Hope my back is in good shape!
	Before I finished rearranging my classroom, R.B. [PERC staff member] came to teach the children how to sign in. The terminals were off and on. She finished more than half the children. The children weren't too excited about getting their turn. A few of the children stood around to look on. I must get them enthusiastic about PLATO again. Hope the machines do not continue to break down this is not good when working with little children.

*The selections represent between one-third to one-half of the complete log. Care was taken that recurring comments were selected in proportion to their occurrence in the log.

10/10	R.B. spent most of the day working with the children. She says they are doing well. I spent part of my lunch hour working with her. I need many more hours with her.
10/17	Worked with the children without R.B.'s help.
10/30	Terminals off most of the day. It is hard for me to find time to call in [to report a malfunction].
11/4	A good day at the terminals. Most of the children had a chance to work. I need to find more time to watch the lessons the children are doing now. They were very excited about a lesson today, I must check it out.
11/5	One terminal out all day. Second reading group did not recognize words taken from terminal reading lesson.
12/5	So far I have not been able to evaluate or put my finger on exactly how PLATO has helped my children. It is hard to compare groups of children. In checking with my last year's class, by this time of the year they were moving much faster. One thing that should be taken into consideration is the class last year was smaller. I had children with higher and lower I.Q. last year. My class this year has no very high or low I.Q.s.
12/9	Terminals not working in a.m. I have two girls and one boy that would probably spend most of the day on the terminals. Some children will not go to the terminal until they are told. More than half of the children ask for their turn. Only one child has said only once that she did not want to go to the terminal.
12/15	Although I believe that many of the lessons are too easy, the children seem to enjoy all lessons. They have never said to me the lessons are too easy; they go along with whatever lessons that come up even if they have had the lessons many times.
1/14	I checked some of the words used on PLATO with the children. Word recognition test. The children did much better than on a test given earlier. The terminals have not been working well.
1/20	All children continue to enjoy the terminals but are disgusted when it will not work. One child made the comment that the terminal cheated.

2/7 The children are ready for more difficult lessons on the terminal. I would like to see more two-syllable words. Would like to spend more time at the terminals working with individuals and trying to find out lessons that they have done well on.

3/3 Few children have had a chance to work with the Pacer [Display of lines of stories at timed rates that could be controlled]. I hope I am able to help the children use this more. They need the experience in comprehension and fluency.

3/17 Because of the terminal breakdowns, the children have not been too happy, and have used terminals only when told to do so.

3/21 I have been using some of the games...The children especially like tic-tac-toe (animals). This game can be played using vegetables, birds and other noun words.

3/25 This morning I set up a new schedule for the children to follow in using PLATO. All of the children have not been getting on PLATO because of breakdowns and other reasons. The children are to check off name on chart when they have completed their lessons. I spend little or no time with the children on PLATO now.

4/16 Children are using Pacer.

4/23 Pacer is not working correctly. I cannot set the speed. The children enjoy always beating PLATO.

I must prescribe lessons for the children which will take more time. The questions after the story are fine - the children enjoy them and will many times ask if they can do a lesson over. The children are very helpful to each other in using the terminals.

5/13 PLATO, in some ways, changed my teaching:

1. More interruptions because of breakdowns
2. The children learned early to listen to directions, follow directions, and improved listening skills.
3. My morning planning period had to be lengthened, getting children started with PLATO.
4. I have tried to locate lessons on PLATO that coincided with some lessons taught in reading. Most lessons were easy and it was more a fun thing.

5. Visitors asking for information. After the first few months the children could do a very good job of explaining how PLATO operates.
6. Those children who did not know their alphabets were reinforced by using PLATO. Those children who knew the alphabets enjoyed playing the alphabet games.

5/15 Observation of children using PLATO: It seemed that my top group and my lowest group wanted to work with PLATO more than the middle group...The top group has little or no trouble completing assigned work and the bottom group is required to do less, which gave them more free time perhaps. The middle group continue to work trying to complete required work which gave them less extra time on PLATO.

5/19 I have been spending more time with children and the things they are doing on PLATO. Checking out things that I would like to keep, and things that need to be omitted next year. The workshop we attended this spring will be helpful because it is important that we as teachers help in planning the program. I hope we will be able to use PLATO to introduce certain skills and reinforce others.

5/21 I am making comments on each child's report card concerning his use of PLATO. Most children enjoyed it and learned many things. I wish I was able to evaluate the program by listing the things learned. There is no way to be specific or list the many hidden things learned.

Summary

The PLATO terminals were a notable presence in this first-grade room. Some classroom routines were changed to enable students to spend time at the terminal, the noise level of the room increased when the terminals were on, and the teacher expended considerable effort to accommodate this new resource. Several scheduling arrangements were tried out, yet another pattern was instituted as late as March. Both teacher and children were affected by PLATO-related disruptions, which persisted throughout the year.

The teacher's attitude toward PLATO remained positive, although she was concerned about the effects of malfunctioning equipment on children this young. She was unable to assess the influence of the PLATO programs on the children's reading, but she felt that most students benefited in some way. She was puzzled to find some children persevere in going through programs repeatedly, but she assumed that, as they seemed to enjoy it, it was a reasonable use of their time. She was similarly accepting of children's exposure to materials via PLATO that they were already proficient in. N.F. did not monitor the students' work on the terminals closely but was sensitive to their attitude toward the resource, which she read as being positive on the whole. In keeping with her overall approach to curricular materials and activities, she did not attempt to critically analyze the instructional significance of the children's interactions with PLATO.

The teacher's efforts to encourage the use of PLATO were successful. The online accumulated user data revealed at the end of the year that this classroom was the highest user of PLATO among the ten early-grade classrooms working with the reading programs. The average number of hours children spent on PLATO in this room was 19.2 for the year, where the low end of the usage range was 8.6 hours per child. N.F.'s attempt to distribute the use of PLATO among the students evenly was more difficult to implement; the range of time on PLATO for individuals in the class was from 6.6 to 38.7 hours, which was characteristic of the wide range across all rooms.

The results of the standardized achievement tests for this class were uniformly below those of comparison classes not using PLATO. Taking pretest scores into account, the PLATO effect in this school was -2.1 on the 35-item Word Knowledge portion of the Metropolitan Primary I Test. On the 40-item Word Analysis subtest this class also scored 1.6 below the expected level, while on the 42-item Reading portion, the deficit was 3.4 points. These negative results were unexpected, in view of the commonly noted difficulty of detecting difference between educational programs by means of standardized tests.

The Demonstration Year

The teacher began her second year of the PLATO field trials with a higher than usual number of children, ?8 in all. She needed time to organize the class and would have preferred to delay the arrival of the terminals:

> ...it did take up more of my time than I wanted it to--I really asked for it [PLATO] later in the school year, but got it earlier than I expected. There are many things we needed to do to get organized, to get ready for work, to get used to each other, before we could get into something like the terminal, where the children needed lots of help in learning.

The CERL staff was supportive, helping out in the room almost daily for the first two weeks. In the teacher's estimate, it took four to six weeks before most children were well versed in working the terminals. Still, help was needed on a continuing basis. The teacher tried to set limits on her own involvement:

> I told the children: "If it doesn't work, check everything out. If it still doesn't work, go to your seat." But they still continue to come to me.

The scheduling arrangement found most workable the previous year was put into effect. A schedule was posted in the room, based on the five reading groups in the room. The children were responsible for alerting the person following them on PLATO when their time was up. The teacher aimed toward getting each child on every day, and she succeeded when there were no breakdowns.

The mode of PLATO utilization remained essentially the same for the greater part of the second year as it was during the Pilot year. The teacher saw to it that the children got their time on terminal, encouraged them when interest lagged, and dealt with malfunctions temperately. She did not follow the students' progress on the terminal in great detail. About once a month she overviewed the lessons completed. Once, she checked to see if the students recognized words presented on PLATO in another context, i.e., the blackboard. She found that some did not make the transfer. Although the teacher did not have specific plans for incorporating the children's performance data into instructional decisions, she expressed unease about not keeping sufficiently abreast of the feedback information.

Late in the school year, around April, she was offered, as were the other teachers, the option to prescribe lessons of her own choosing for the students. She did periodically prescribe materials for groups of students, but she did not explore this alternative with great vigor. While monitoring the children's course through the prescribed lessons, she discovered that some of them did not do the lessons, even though they logged time on the terminal.

At the end of the second year with PLATO, N.F. expressed her uncertainty regarding the impact of the program and her wish for external information about its efficacy:

> I would like to know just what has it done--I don't really know. What has PLATO done to make a change--I don't know if there is that much difference.

This classroom, confirming N.F.'s account, was again found to be a high, in fact the highest user of PLATO during the year. The students averaged 30.3 hours on terminal, where the low end of the range was 7.4, with a mean of 13.3 of the nine classrooms monitored.

Interpretive summary

PLATO received a fair trial in this room, benefitting from a supportive teacher and responsive children. The teacher reacted with much tolerance to the mechanical and other problems that colored the experience for all participants, although she expressed concern about the effects that unreliable equipment might have on "little children." The students' reactions varied from good-natured understanding to anger, frustration, and occasional withdrawal.

The extensive support provided by PERC was indispensable in this room. Even with well functioning equipment, the teacher could not have handled on her own the process of introducing children to the ways of the terminal. She did, however, accommodate to the demands that the presence of the terminals continued to make on her throughout the year.

The teacher retained a positive stance toward PLATO, even though she was not clear what benefits the children derived from it. The PLATO materials were congenial to her view of reading instruction, as they emphasized the sequenced acquisition of discrete skills. Neither the teacher nor PERC held a highly integrated view of the learning-to-read process, beyond postulating a preferred order for teaching the requisite skills. Both laid primary emphasis on decoding skills over the extraction of meaning from text at the early stages of reading instruction. At the end of the year, the teacher departed somewhat from her uncritical posture to voice concern about the difficulty students have with comprehension and to question her own and PLATO's instructional strategies in this regara:

> ...it bothers me that the kids are not understanding, that they are not just reading. I wonder about the phonics--getting the child to look at the word, to put the sounds together. They are so concerned about getting the sounds they lose the context of the story They learn how to read. They're watching those different sounds, putting them together, but they are not thinking what the story is about. That's what we are trying to get at, that's what the whole ball game is about...

Given the teacher's view of reading instruction, what form could the integration of the classroom and the PLATO reading curriculum take? The teacher expressed preference for parallel tracks, PLATO materials being keyed to classroom instruction, mostly for practice and reinforcement. As the teacher had no control over either the content or the order of presentation of the PLATO lessons, and she monitored the children's work on terminal irregularly, integration even so minimally conceived was low for most of the year. When the option of taking charge of lesson delivery became available in the spring, N.F. tried her hand at it, but she never became an enthusiastic prescriber. By that time, the children had worked through the lessons, many of them repeatedly, which may have lessened the teacher's interest in undertaking this additional task. More fundamental perhaps was her approach to the use of her own time--placing greater value on direct contact with the children than on formal curriculum planning.

The use of PLATO in this room thus reflected the teacher's receptiveness to a range of instructional resources. The classroom was well provisioned with materials that the teacher judged on the whole to be valuable, even if their contribution to learning was not always clearly articulated. The teacher encouraged the use of these resources, as she did PLATO, was aware of the children's preferences, knew how they spent their time, but did not closely observe, analyze, or feed back to the children the specifics of their work.

4.4 Reading Case Study III

The 25 children in the Kindergarten-Grade 1 combination in School V had a new teacher in the fall of 1974. The previous teacher, who had volunteered for the PLATO trials, went on to another assignment in the school system. C.U.*, the new teacher, was however no stranger to PLATO. She had done some programming and authoring in the past and willingly accepted her predecessor's commitment to the project.

Continuity was also maintained in the overall approach to teaching. Under C.U.'s guidance, the children were accorded considerable latitude, with attendant responsibility, for choosing and following through on their classroom work. The room was richly provisioned, and the students appeared to make use of the variety of materials and activities. During an observation well into the school year, when a classroom can be assumed to have hit its stride, the children were found by the observer to be engaged in the following activities:

two children working on a puzzle
two playing Rook
three working in SRA math workbooks
two working with tools in wood
one playing dominoes
two working on PLATO
four painting papier-mâché bracelets (with a student teacher)
one reading flashcards (with an aide)
one writing and drawing a story about a cowboy
one reading a book in the rocker
one reading with the teacher
one working with blocks
two walking around doing nothing

On first impression, the room had the somewhat disorganized appearance of classrooms that accommodate diverse activities. The surface indicators of joint decision making by teacher and students were well in evidence: a mixture of activity centers and tables that are shared by the children, a

*Because of low PLATO usage, this teacher, coded PCK, was not included in the demonstration year testing design.

fair amount of student movement, a steady hum of conversation, which occasionally becomes noise. On closer look, some of the rules and structures governing the room were revealed: access to the various activities, for example, was controlled by a pegboard that was divided into sections, each representing an available activity such as math, reading, PLATO, blocks, etc. The pegboard was supplied with a set of student name tags. The children, on choosing an area of work, would place their name tag in the designated section of the board, which held a limited number of tags. The students had their choice of activity in the first part of the morning, the activity customarily followed by a class meeting and discussion and the later part of the day taken up more exclusively with reading, writing, and math activities.

C.U. appeared to be in good contact with the students, offered frequent feedback, and was available for consultation to those who needed help. She praised freely, also pointed out errors and wrong answers. Her preference was to lead students to the desired answer or solution, rather than offer or impose it directly.

There was little whole-group instruction in the class; rather, the teacher worked with children individually or in small groups. Children frequently worked together or side by side, in groups of four or five. Assignments were also given on an individual rather than class basis. The teacher gave highest priority to her own one-to-one interactions with the children, which occurred regularly, and these interactions focussed on the students' individualized reading, writing, and math programs.

The teacher thus created a relatively complex environment for herself and the children. It may be assumed that if the options offered in the room were to be used productively, the teacher would need a differentiated view of her students, along with differentiated goals for them. The teacher did work toward the acquisition of a common core of skills, while assuming that children take different paths to learning. Beyond these competencies, however, she did not expect all children to learn or experience the same things. The specific substance of the goals held for all students, or the boundaries of the general aims, were not, however, clearly revealed by either interviews or observations.

The approach to reading instruction differed somewhat in this room from that of the other classes participating in the trials. Learning sight vocabulary, reading, and being-read-to were activities emphasized more than instruction in phonetic skills or moving students through a basal reading series and the attendant workbooks. The teacher did occasionally assemble an ad hoc group for drill in a specific skill and used work sheets as well, but these were not the dominant features of instruction. There were several basal series available in the room, along with a variety of trade books. Records were kept of each child's reading. Concern with comprehending as well as decoding was evident: stories were discussed, acted out, represented in painting and drawing. Writing, by the children or by dictation to the teacher, was considered integral to reading instruction.

C.U.'s approach to teaching reading was not wholly consonant with the approach that guided the PLATO curriculum, in that she regarded reading as a process requiring the integration of many subskills, and her curriculum emphasized the integration of decoding and comprehension over the acquisition of discrete subskills. The teacher's approach may have reflected the fact that many children in the class, including the kindergartners, were already reading. Nevertheless, C.U expected most children to benefit from PLATO and had a generally positive attitude toward the resource. She particularly liked the independence she felt children would gain from working on the terminals.

The terminals were treated as an activity center, although they had somewhat more regulated use. The teacher had tried to set up a schedule at the beginning of the year, only to find that she could not get all the children on because of the many malfunctions. No schedule was enforced during most of the year, but the attempt was made to give access to the terminals fairly. The children often worked together at the terminals, as they did in the other activity centers. The children were encouraged to solve the problems that arose during the course of their joint work without external help; the teacher did step in, however, when disruption threatened. An excerpt from a classroom observation highlights characteristic use of PLATO in the room and the teacher's role in guiding use of the terminals:

> D. says, "My turn on PLATO." Three children are around to help D. She types her name. E.F. put the record on for her. D. presses many keys, she can't get anything on PLATO. The teacher helps her get started. D. repeats and spells PLATO. G. tells D. that she typed her name and the cat ate it up. G. changes the record for D. D. pushes her head against the screen; she doesn't want other children to watch what she is doing. PLATO is not working right, lets D. stay for such a long time. The teacher checks to see why she is on for such a long time and tells G. to go away, D. is supposed to be alone. D. never did get a lesson, but PLATO told her "that's all." H. came up, her name was on the list after D. She gets the <u>Train</u> words. She does it five times. H. talks out loud as she works; also reads words out loud that she touches. H. asks I. "Do you want to see this again?" "yeah," says I. H. does the <u>Train</u> words again... then she said, "This time I get the B words," and leaves. When she left, a boy took over. It was not his turn, he had a turn earlier. The teacher tries by persuasion to talk him into giving another girl her turn. She finally lifts him gently from the chair so that J. could have a turn.

Although C.U. was firm in containing the demands PLATO made on her time and attention, she did continue to help out students who wanted to work on PLATO.

Summary

The pattern of PLATO use in this classroom was consonant with the teacher's overall approach to curricular resources. No single instructional activity was viewed as necessary to student progress; rather, multiple routes to learning were assumed. The students were expected to participate in shaping and managing their own learning, which included selecting among the learning opportunities provided in the room. This approach was not well matched with the centralized curriculum management of the PLATO reading materials. In working through lessons on PLATO, the students' choices were largely limited to the option of repeating a segment or going on to the next one designated by the lesson selector. The PERC staff was also uneasy with the informal, self-service way of regulating PLATO use. The investment represented by the terminals in the class was too great for the staff to feel comfortable with student demand as the basis for access, expecting it to result in underuse or uneven use by students. Working with limited resources themselves, the staff reduced their contact with the classroom, judging the teacher to have insufficient interest in PLATO.

The prediction of underuse did not come true. The cumulative use records put this classroom in the middle of the range, a mean of 12.6 hours at the terminal per child for the year, the low end of the spread being 8.6 and the high end 19.2 hours. Notable, too, was the range of use among the individual children in the room, where the least active student spent 4.7 hours on the terminal, ranking him/her seventh among the lowest users in the ten classrooms monitored. The highest user, spending 33.0 hours on the terminal, was also well up in the range of high users. Thus distribution of the resource within the classroom was not found to be any more skewed than in rooms where more systematic efforts were made to achieve across-the-board use of the terminals.

The thinness of contact between teacher and PERC staff, in reflecting the staff's discomfort with laissez-faire use, also precluded a closer look at this alternate mode. Little was learned about the kind of support that might benefit this mode of use, what formats of curriculum presentation would be suitable, etc.

The impact of PLATO on the students' reading skills is difficult to interpret for this class. The pilot-year standardized test results are similar to those of most other PLATO first grades. In the 35-item Word Knowledge subtest of the Metropolitan Primary I Achievement Test, a 2.0 point deficit was scored. The Word Analysis subtest showed scores 1.6 points below expectations based on children with similar pretest scores in non-PLATO classes. However, in the Reading portion, a 42-item test of matching sentences to pictures and selecting answers to questions about paragraphs, this class performed 3.4 points better than non-PLATO classes. Since little of the pilot-year PLATO curriculum dealt with comprehension of connected prose, except for a small number of stories, it seems likely that this effect is attributable to the teacher's emphasis on reading as an integrated skill, rather than to PLATO.

The Demonstration Year

The teacher continued her participation into the second year of the project, but with diminished enthusiasm. The classroom had only one terminal equipped with an audio device, as PERC, in allocating scarce hardware, gave priority to more committed users. The children were new to PLATO, and needed to be oriented to the system. In the teacher's words:

> It takes quite a bit of time to get kids familiar with PLATO, longer than the PLATO people are willing to devote to it, longer than I am willing to devote to it.

Nevertheless, many of the children learned how to use the terminal, and the teacher did attempt to set up a schedule. She found it demanding:

> ...at the beginning of the year, when trying to use it in a consistent pattern it would break down frequently, I would have to go back and check it, would have to see when they started the lesson, you would have to call in, type the message, and so on--yes, it was pretty time consuming.

The teacher felt PERC minimized the support needed:

> I feel that PLATO, for the little ones, is not as self-explanatory, is not as self-correcting as they [PERC] would like it to be. There needs to be more supervision, more monitoring kids,--I can't be there and do that, I have to do other things in the classroom.

The mode of use was adapted to the classroom:

> Instead of building the routine around PLATO, I did not want it to interfere, or change the way the room operated. As the year progressed, I did not have the children go on at a set time each day. The PLATO people were upset by that. I thought of it as another station in my room, which children could go to if they were interested. Some of them did go, and utilized it quite a bit. Some did not, some did not feel at ease with it.

The teacher thus did not actively promote the use of PLATO, although it was an available activity. She also felt many of the students were beyond the materials on PLATO.

The teacher's stance toward PLATO changed dramatically during the last two months of the school year. This change was brought about by a shift in PERC strategies in the direction of greater teacher control over program delivery. In this case, a staff member contacted the teacher, offering to familiarize her with the more recently developed materials and to show her how to prescribe for students. At the same time new audio devices were installed, correcting some of the mechanical problems that made using the reading lessons difficult for the younger children. The newer materials were also of greater interest to C.U. She particularly liked the Word Families and stories, which were more compatible with her own approach to teaching reading. The teacher chose a relatively broad guideline for prescription. She divided the class into two groups, selected stories for the more advanced group, and Word Families along with stories for the less advanced readers.

The year ended with an upsurge of enthusiasm for PLATO. According to the teacher, the children were vying for time on the terminal, were assessing the reading lessons and also working on the math lessons, which some preferred to the reading materials. The teacher, too, was more involved, now actively assessing the costs and benefits of giving her time to the improved use of the resource.

The teacher's report of PLATO use was confirmed by the cumulative use records for the year Even the end-of-the-year surge did not compensate for the low use earlier in the year. The average use per child was 9.0 hours, the range in the 9 target classrooms having been monitored as a low of 7.2 to a high of 30.3, with a mean of 13.3 hours.

Interpretive Summary

The introduction and use of PLATO in this classroom exemplifies common dilemmas confronting teachers and developers alike during the assimilation of a new resource.

The teacher started out with a lively interest and positive expectations toward PLATO. Since she viewed herself as productively occupied in the classroom, the demands that PLATO made on her time and attention confronted her with the need to set priorities vis à vis PLATO, to estimate its present or potential benefits before she has had sufficient experience or evidence to make that judgment. Given the frequency of breakdowns, and her assessment of the materials as not particularly relevant to many students, she opted for a minimum personal investment that would still retain the terminals in her room. This weak commitment was in effect for most of the year. It became revitalized by a change in PERC's approach to teacher involvement in curricular decision making. In March, with two months left of the school year and the NSF-funded life of the project, a change in PERC directorship brought with it increased options for teacher control over lesson materials. For the teacher, the issue of allocating her own time reasserted itself. With increased student use, she needed to weigh the utility of PLATO as an add-on independent activity of the children versus the benefit her own involvement might bring. She articulated her ambivalence:

> I would like to schedule prescribing about once a month. Now I probably should do it more frequently--it's something I would have to work out. Probably should be once a week, looking over what the kids have done.....but I still feel that I don't have enough time to devote to it because of all the other preparations I do for the classroom.

Unlike some of her colleagues, this teacher was able to protect herself and her students against the disruptions of a prematurely implemented innovation. For her, the allocation of time became an issue only after she began to see PLATO as a useful addition to the class. As PLATO's contributions were not clearly assessable, she continued to experience the conflicts inherent in accepting a new, potentially useful, but also demanding resource.

4.5 Mathematics Case Study IV

The PLATO demonstration came to an anomalous conclusion in this sixth-grade room, when M.E., the teacher in charge, voluntarily gave up the terminals after one year of working with the mathematics materials. The major reason underlying her decision was the fact that her incoming students had been exposed to PLATO, and she judged it "educationally unsound to expect students to redo in sixth grade the exact lessons on PLATO that they had had in fifth grade". Unrepresentative as this decision was of the group of participating teachers, hers is an instructive case of a teacher who valued the PLATO resource, invested considerable effort in familiarizing herself with the lessons, monitoring student work on the terminals, and trying to integrate PLATO into her classroom. Her conscientiously kept log reveals the course of implementation and the evolution of her views, which were further elaborated in interviews at the beginning and end of the year.

The two sixth-grade teachers in the school worked in a team arrangement. Students were based in a homeroom with one of the teachers, where they began and ended the day. During the rest of the school day they moved between the two rooms according to their assigned schedule, which grouped them into different configurations for different subjects and activities.

For mathematics instruction, the students were placed in ability-based groups that cut across the two classes. M.E. was responsible for teaching mathematics to the top group, while the other teacher instructed the middle and lower groups. The PLATO terminals were housed in M.E.'s room, as she had volunteered to participate in the field trials. The other teacher was not a participant, which meant that the only students out of this double classroom to work on PLATO were the high-ability students. The situation was further complicated by M.E.'s feeling that the rest of her homeroom students, who were not in this group, could not in all fairness be prevented from using the terminals in their own room.

M.E. is a teacher with long and varied experience who taught all but eight of her 26-year career in the present school. She also had previous experience working with experimental programs, having participated in a mathematics curriculum development effort for television in the past, which in fact led her to expect to play a more active role in the development of the PLATO curriculum than was to be the case.

In her own room, M.E. was the central figure, planning and directing curricular life in full detail. She was firm and clear about instructional goals and the steps to be taken to achieve them. Students did not take an active role in determining what they were to learn, and the teacher monitored the course of each individual student's progress closely, in a well differentiated fashion. Her expectations were high, her manner businesslike, her investment intense. Little went on in the classroom that she was not aware of or the value of which she was uncertain.

Although academic subjects predominate, M.E. does not set narrow boundaries around the classroom curriculum. The room has a good display of the students' art work. The analysis of writing includes stylistic, aesthetic judgments. The teacher is aware of the social and emotional concerns of her students, although she does not dwell on them in class. She treats students with intrinsic respect; conferences, for example, are conducted in privacy.

In keeping with her view of herself as the instructional pivot of the classroom, M.E. does not encourage informal interaction among the students. There are planned, reciprocal interchanges, as the meetings between first and sixth graders to read their poetry to each other, but casual conversation or "visiting" at the terminal is discouraged, unless specific help is asked for by a student, and another is directed to give it. The students seem to respond to M.E.'s somewhat formal regime positively, the room is quiet and the students task-oriented much of the time.

The mathematics curriculum in the room follows the general district requirements. Although the teacher refers to aspects of it as "lock-step," she does not seem critical of the content or the sequencing. By the time they reach her in sixth grade, the students have moved through the four primary processes, (addition, subtraction, multiplication, and division), and were introduced to fractions and graphing in the fifth grade. M.E. gets acquainted with the student's problem-solving skills by starting the year with application problems, which she finds are difficult for nearly all the students, many of whom in her judgment don't read critically enough and have difficulty seeing relationships. The teacher's goals for the 6th grade are to cover all four primary processes for decimals, fractions, and percents. In addition, she wants to enrich in areas of geometry, sets, graphing, and have students work in the metric system. The basic text used in the room is that of Addison-Wesley, along with Harcourt Brace. Other texts are available, along with 7th- and 8th-grade texts of algebra and introductory probability, which a few students use in independent study.

M.E.'s math curriculum was not fully characterized by the content areas she covered. It was distinguished by her expectation of the mastery of processes and the ability to apply them to problems formulated in a variety of ways. Above all, she wanted students to monitor their own learning, to be clear about what they did and did not know, and see the relationship between specific instructional activities and a domain of knowledge.

After the terminals were installed in the room, the teacher tried to work out the logistics of getting 38 students (her math group and her remaining homeroom students) on the four terminals every day:

> Classroom management for PLATO in my case was to make a schedule for 38 students for thirty minutes a day, and put them on their honor to go on at the proper time.

Initially, M.E. viewed PLATO as a supplementary activity. From the first week's entry:

> My students are taking PLATO in addition to our math program. PLATO is not correlated with our math program.

This was a provisional situation, however, as she felt that

> it could be a marvelous teacher and reinforcer for the regular program. I feel teacher and PLATO should "tool up" and get programs correlated.

From the very beginning, structures were set up for keeping the teacher informed about students' activities on PLATO. Each student was required to:

> ...keep a log which reflected what they did, any problems they had, and any help they felt they would need.
>
> These are written each day by the students and read each night by me, comments written, and returned to student.

At the end of the second week, the teacher summarized the students' initial reactions to PLATO. She records an assortment of comments culled from student logs.

Relaxes mind
A review of negative and positive numbers
Machine made mistakes
It is fun
Felt students cooperated
Learned how to place numbers on a grid
Too easy
Learned how to use the machine
Learned how to put #'s on graphs
Power down during noon hour.

> Learned how to use different keys
> Learned positive and negative numbers
> Learned about # sentences.
> Game of deductive reasoning.

In addition to reading and responding to student logs, the teacher also observed students working at the terminals. She was able to comment at the end of the first week:

> Students with short attention spans who just want to sample and not work a lesson through become frustrated and want to quit. They have not developed the study habits to carry things to a finish.

The initially worked out schedule was buffeted about a good deal by the unreliability of the system.

> This week has been frustrating for all of us, but we feel we are getting our difficulties "ironed out" and we can move forward into some real learning situations.
>
> We are working out our schedules for every other day.
>
> Went back to old schedule. This again required some shifts.

As the schedules were drawn and redrawn, rules were established.

> I have made a rule that people may not do PLATO if we are having a movie or a filmstrip.

The failure of the system to keep time allotments was noted with annoyance:

> The students were to be kicked off PLATO at 30 minutes. This is not happening...I do not have time to check each student's time. The machine itself must close them out. The students miss other items in other classes as it is and certainly need to be a part of the class they are missing a portion of the time.

The unreliability of the system and its component parts continued to take its toll in this classroom as in all others throughout the year. The teacher's customary impatience with wasteful disruptions was tempered by her view of the project as experimental and herself and the class as participating in research.

As the year goes on, priorities are more apparent:

> Some people had to be off because they needed to work in other subject areas.
>
> Some people did not take the session today because they needed to work through some math or reading that they were having problems understanding.
>
> Some students are refusing to go on PLATO because they do not want to miss the class discussion in another area.

Her own and PLATO's demands on the students' time were in conflict at times, and she articulates her preferences and outlines an alternative mode of PLATO use:

> I do not believe it is educationally sound to have a student miss participation in another subject area to do PLATO. However, that is the only possible way I can get my people on.
>
> Perhaps there snould be a terminal room with enough machines for a total class and the teacher and students move to that room for math. In this case, the teacher and PLATO people should work out a year's math program and a team approach could be used. If math were scheduled for an hour and the teacher had 25 students and 13 terminals, she could do correlated work with 1/2 students for 1/2 hour while other students worked, then switch. The two types of work would reinforce each other.

The picture that emerges is that of a teacher who plans classroom activities carefully, who values the experiences she provides sufficiently to feel uncomfortable when some students miss out on them. The intent to direct student learning closely is also revealed by the teacher's efforts to monitor student work on PLATO and the uses she makes of the information gained:

> I have talked with students about trying the most difficult problems and have asked them to copy their summary. This way I can check during the day for amounts of time, shift stops, and completions.
>
> The records kept on PLATO were good, but I did not have time to "tune them in." Therefore, I found the "print out" as designed b" the fraction strand most helpful as it served (along with the student logs) as a basis for conferences.

The fact that the data on PLATO has been sent to me as a "print out" has helped me to see where the students were working and given me the point for a conference which has helped me assist more students. Also, it has given me something concrete to show parents and to discuss with them.

The teacher's observations of the students' progress are well detailed, including subject matter as well as attitudinal aspects:

Students working with mixed numbers. Many playing hockey as much as 12 times. (I wonder if this is a profitable use of their time.)

There has been some difficulty with student attitude. Some of the students punch other people's lessons and cause problems. (This is done as a fun thing, but is very difficult for all.) I wonder if machines would be better in individually partitioned sections.

Things have been operating smoothly. Students enjoyed the new material on fractions. Most of them seemed to do fairly well with Cut and Paint and the Meaning of Fractions. Some few needed assistance.

Students moved into Pizza. Here many people failed to make a connection between the number of pieces in the whole and the number for the denominator; therefore, they cut Pizza without regard for solution - became weary and skipped next one. (Here I feel student should be made to finish a lesson before he can move on.) Because my people shifted over they were a long time finishing Pizza and became very weary and tired of it. Finally, we set up a "house rule" that each person would attempt to finish Pizza by "staying in." Several conferences were held with students having problems.

This part of the week went smoothly; however, I have the feeling students are choosing the easiest problems in order to move to a part of the session they especially like: or they have a tendency to give up and seek help just so they can move on. Many do not seem to be challenged to conquer the idea--just to move on. They think of the "screen" as a viewing screen.

The students are failing to read entire screen. They seem to want to punch without thinking.

The teacher continues to record observations of students' progress, problems, and reactions toward PLATO:

J. had to have help with equivalent sentence and - + integers.

A. needed help today. We worked with her regarding the meaning of the denominator in fractions.

> S. has captured the true spirit of PLATO: she is working against herself.
>
> L. did not like the zero game. She felt the explanation was poor. In Mental Arithmetic she felt the machine was too slow.

Other comments differentiate the needs of students:

> I am finding that the slower math students are frustrated with sentences and negative and positive numbers. At the same time some of my more capable students need new games, they are saying they are tired of Tic-Tac-Toe--Battleship, etc.
>
> I feel we need to work out some reinforcement ditto sheets which students and teachers could use in the classroom.

Students are also observed for more generalized PLATO influence:

> I do not feel PLATO has had any direct bearing on the study habits of my students. In some instances I have felt it might have fostered carelessness because it was easier to punch until correct rather than think out.

The lack of diversity in the available materials is noted periodically:

> Some of the students are becoming weary of the same games.
>
> Students feel Pizza stays on an unusually long time.
>
> Students began working again on PLATO. Several students were disappointed to find the same format and the same type of programs on.

Occasionally, the diversity got out of hand:

> Obscene language on R.'s machine. D. and S. also received some, as did L.

An important source of information for the teacher were the students' logs, where she expected students to record their work on PLATO daily, just as she commented on the entries nightly. A few excerpts from these logs are illustrative not only of the students' way of accounting for their work but of the didactic style of the teacher. She expects a record of the lessons engaged in by the students, an account of difficulties. In addition, she urges the students toward an actively monitoring stance toward their own learning and the instructional intents of the materials. The following interchange is from early in the school year:

Student	I didn't have fun, I don't like Grid, but Battle Ship was fun, I sunk his air-craft carrier and he didn't hit me yet. I like Battle Ship a lot.
Teacher	What are you learning about math when you play Battle Ship?
Student	Graphs

The next entry is responsive to the teacher's question:

	I had fun at PLATO today, we couldn't sign off after we were done, I played Grid Turtle things and Pico Fomi Mathematics. I like PLATO, but as you play it teaches you graphs and mathematics. I don't like Grid Turtle.
Student	I played Open Sentences, Pouring Pitchers, and had fun, but I don't know what it taught me.
Teacher	See me, please, let's discuss this.

Another set of interchanges in another student's log:

Student	I received Number Sentences again, also did Circle Stuff, things with circles. Had to stop in middle. It was boring.
Teacher	Why do you think they are having you do Circle Stuff? What does it have to do with math?
Student	First I did names for 2, then more interviewing of Open Sentences. Then I played Battle Ship, reviewing putting things on grids.
Teacher	In your next log, please explain how I would put the numbers (5,4) on a grid.

This student, too, is responsive to the teacher's wish for the articulation of the students' understanding of the instructional aims of the lessons:

Student	First I did Circle Stuff. I don't get what they are trying to review or teach us. Next I looked at the differences in the patterns in Guess My Rule. Then I did Problems, the problem was 1/2 x 1/4. One way I rewrote it was 600/800
Teacher	Isn't Circle Stuff a review of adding and subtracting?

Student I played Tic-Tac-Toe. I won the first game was a Then I played Ant Hill! At first I had to make up different names for 26 and had to choose my favorite from other people's. I think it is very fun. This one was a slight bit too easy.

Teacher What do you feel they were reviewing? What processes in math, etc.?

Student I played Boxes and Hexes. I reviewed Number Sentences and telling whether they are true, false, or open and making them true false and open.

Teacher Just what is an open sentence? Answer here:

Student $0 + 3 = \square$

The teacher's assessment of the PLATO curriculum was based on first-hand knowledge of the lessons and her own instructional aims and plans. She was open to PLATO lessons that presented material she considered relevant in a different way than she taught it, or carried the concepts further than classroom time allowed, but she did expect a close relationship between the content covered and wanted the PLATO materials at a level that would challenge the students:

> When I worked with it last summer, I thought we were going to have the graph strand, and I was comfortable with that because I felt it was an application type of situation, going above and beyond what we were doing.

But the Graph strand was available only at the beginning of the year, after which the Whole Number strand took its place for field testing, and CERL could not make more than one strand accessible at one time. Although M.E. felt the Whole Number strand was review for her students, she tried to convince them that the lessons offered new approaches and therefore could be a source of new insights. But her heart wasn't in it:

> I assume that when a student gets to me in advanced math after 6 years in this school, he knows how to add, subtract, multiply and divide. I don't do anything about teaching it.

Unlike some of the other teachers, M.E. did not regard facility in working with the computer beyond the ability to access and proceed through the lessons as one of the valued side effects. In fact, she found the students' exploratory activities with PLATO annoying on occasion, as when students spent time playing with passwords:

> I don't see any reason why a child needs to change their password...I don't see any need to spend any time letting them fool around with that.

Throughout the year, the teacher maintained a positive judgment of the quality of the PLATO lesson materials themselves. She felt many had good teaching ideas, and thought "they are all solid as far as their teaching technique." Her relationship with the CERL staff, however, had some problematic aspects. Her expectations for active participation in decision making, which were based in part on her previous experience with a curriculum development project but also on the CERL rhetoric regarding the role of teacher as researcher, were not fulfilled:

> I was disillusioned and disappointed that the classroom teachers did not have anything to do with the development of the math program. I was disappointed that it wasn't more of a team approach.

The process she anticipated was one where:

> The teachers and educators would do the curriculum and then the technicians would say whether it could be done or not. Then the technicians would see that it was properly done. .... I went to the June workshop and realized we were not going to be able to input into course development. We worked through what had been done, and spent half a day talking about suggestions for improving the lessons. That was my only input.

Minimal teacher input characterized not only lesson development but the decisions regarding allocation of terminals as well, from M.E.'s view. When she decided at the end of the year that her next year's students, all of whom ~~in~~ their present 5th grades were getting PLATO, would not benefit from another year's exposure to the same materials, she suggested that her terminals go to the other 4th-grade teacher, but "of course we were told we'd have nothing to say about where they went."

The teacher's relationship with CERL staff was also complicated by her ambivalence toward their visits to her classroom.

> They came into my room in the beginning quite often when it was getting started.... maybe they thought I didn't have time to work with them. When I'm trying to work with my students I don't welcome anyone coming in my room... I just don't have time to talk when I am teaching...I suspect they didn't feel welcome because I was too busy to talk to them.

She was however, not unappreciative of CERL efforts:

> They were there to see if the machine was working, they were available if I called them about problems, they came to put students on.

There were other sources of abrasion between M.E. and some members of the CERL staff. Her expectations for the periodic meetings held between the math staff and the teachers also proved to be disappointed:

> I don't mind going to meetings...but it does bother me to go to a meeting and sit on my tailbone and do absolutely nothing, and have the leader tell me he's got a meeting--he's sorry--and he gets up and goes. I figure I've taken my time to go wherever it is, and I feel they're the experts, all right, then let me learn some more expertise to use in the classroom. That's what I'm about, I'm about trying to find ways to improve my instruction.

The one meeting that did attend to instructional issues was well appreciated by M.E., reaffirming her judgment that "the experts could help some of us less expert people along quite a bit." Her expectancies of the experts were, however, overdrawn, and she gets impatient when faced with the limitations of the present state of the art:

> I asked at one meeting if they could get all 3 strands on at the same time. One expert said he didn't see any reason why not, another said, "Now you can't do that." All I'm doing, an old layman, is sitting here listening to the experts going back and forth on whether they can or can't. I don't have that kind of time. I want to go and figure out what my position is in this educational team, and what I'm going to be doing in the classroom that is going to correlate with that educational tool, so that we can get it to be most beneficial to the student.

The teacher asked the students themselves for their assessment of the benefits that accrued from PLATO. Thirty-one children responded to her questions:

> Has PLATO helped you with math? If so in what way? If not, why do you feel it has not?

The responses were generally positive. The approximately one-third of the students who did not think PLATO contributed to their learning offered the single reason of the materials being too easy. The responses of the class are reproduced in full. They are markedly similar in style, bearing the mark of the teacher's influence:

PLATO has helped me with math in helping me understand the math.

In some ways and some ways not. It helped me in some areas of fractions, that I didn't do good in regular math class. In some ways it didn't because some of the things were too easy.

It teaches me fractions decimals. it also teaches me when I'm having fun.

PLATO has helped in speeding me up in math.

It helped me with the number line so I can learn it better.

Yes, its helped me with fractions, facts, etc.

Yes, it has taught me to work with negative no.

Yes, it help me with speed in multiplication and division.

In some ways it has by introducing things and helping me with speed. It hasn't in other ways by giving the same lessons over.

In fractions, yes.

Yes it helped me with fractions and no because my teacher told us to put the decimals in a different place.

Yes, negative and positive numbers.

PLATO has helped me in math with all sorts of math.

Yes, negative and positive numbers and whole numbers, fractions, and mixed, and in measuring distances and a lot other things.

Yes, it helped me with fractions.

PLATO has helped me understand math in a fun way.

Yes, it has helped me with fractions.

Yes. It has taught me things like adding, subtracting, multiplying, and dividing, decimals fractions and negative numbers.

Yes, I feel PLATO has helped me review and improve my math skills.

PLATO has helped me in math by having good lessons that covered these subjects in math.

Yes, PLATO has helped me in fractions.

Yes. In Fractions. By the way they introduced me to them it made fractions easy, and by taking them step by step.

I think it has helped me a great deal with techniques on getting a math problem.

No at first, all review, review is good but we didn't learn anything new. Yes toward the end, it helped me understand fractions better.

No because it's too easy.

No, it was too easy.

Not really, all the things on PLATO have been review for me.

No, it hasn't because by the time we got a lesson we had already studied it in math.

No, because it almost always frustrates me when it says 'no that's not it.' to a correct answer.

I feel that I know the things that PLATO is teaching.

No, not much. I had already known almost all of it.

In her entries toward the end of the year the teacher reflects on and weighs her experiences with PLATO, and formulates the conditions for her continuing involvement. She comments on the pattern of scheduling students on the terminal throughout the day, which she found unacceptable, as it meant that students:

> missed another subject area and had to make that up. Therefore, students had to be put off PLATO when we had group work, which they resented. Many of the students had gaps in areas in other subjects because they could not or did not come in for extra conferences. For this reason, if I am to use PLATO another year, I will put students on before school, at noon, and after school. No one will be on during the day unless there are enough machines for its curriculum to become the class curriculum.

M.E. is also clear about the way the PLATO curriculum needs to be integrated with classroom instruction:

> I feel PLATO has much to offer. I feel, however, it should be a team with the regular classroom teacher and used with units of work rather than total programs. I would see units of work in areas such as processes, fractions, decimals, etc. being used in this way.
>
> A. Introduction to area
> B. Drill in an area
> C. Enrichment in an area
> D. Check-up in an area

<u>Summary</u>

Even this simplified account of the introduction of PLATO into one classroom testifies to the powerful interactions between the acceptance and utilization of new instructional resource and the priorities and practices prevalent in the classroom.

M.E., an able and dedicated teacher, was an interested and active participant during the first year of the field demonstrations. She honored her commitment to CERL to ensure the regular and attentive use of PLATO by the students. The cumulative usage data for the year confirm her account and show intensive utilization. The mean hours on terminal per student in twelve classes using the mathematics program was 50.1 hours, ranging from a low of 30.1 to a high of 73.1, ranking third in amount of use. In M.E.'s class, the students spent an average of 55.1 hours on the terminal. This figure masks the actual utilization of the terminals, as it represents average use by 39 students rather than the 23 students that was the norm in the other eleven classes.

The teacher also monitored the students' work on PLATO, as well as their attitudes towards the resource, in good detail. She regarded the lesson materials to be instructionally sound and liked the approach taken in many of them. Yet, PLATO did not take root in this room, and at the end of the year the teacher decided to terminate her participation in the project.

No single reason, rather the confluence of several factors, contributed to this outcome. Neither the teacher nor PLATO, in its present manifestation, had the flexibility to make the adjustments necessary for a continuing involvement. The teacher construed her role in a way that did not allow for a loosening or lessening of contact between her and the students, or for a more informal use of PLATO. She was reluctant to have students miss any instructional activity she planned. As she saw PLATO as a supplemental activity, she was uneasy when it was displacing other activities the instructional value of which she was confident. M.E.'s decision was also influenced by the exposure of her 6th-grade pupils-to-be to the PLATO lessons in grade 5, having found the materials none too challenging to her present 6th graders, who had had no previous experience with them. PLATO, on the other hand, was offering a limited set of instructional materials. It did not have the technological flexibility to have all three strands available simultaneously, thus enabling the teacher to select those lessons she thought relevant to her instructional plans.

M.E.'s view of the relationship between herself and the PLATO project also contributed to her decision to end her participation. She construed the relationship as reciprocal, in that she expected to contribute her practitioner's experience and know-how to the development and testing out of innovative instructional programs. She was disconcerted when the CERL staff did not avail themselves of the information she collected and the judgments she formed. In return, she hoped to draw on the expertise of curriculum specialists to benefit her own practice, and she was disappointed when that did not come to pass. M.E. was willing to make the effort, both in terms of time and some departure from preferred class routines, but she was not willing to continue in a passive role, nor to go beyond a certain point in jeopardizing the quality of her students' instruction.

The influence of PLATO on the students' mathematics achievement scores cannot be clearly assessed. The pretest scores of M.E.'s class on the California Test of Basic Skills averaged to 81.5, which was slightly higher than the pretest scores of the three other high-achieving sixth grades that were recruited to serve as control classes. These classes were drawn from another school in the district, School X11, and scored 78.5, 79.8, and 80.9 respectively. At the end of the year all three control classes averaged near 86.5, as did M.E.'s class. These scores however, were sufficiently close to the ceiling of the test to make comparisons inappropriate. It is clear that the groups of children were extremely competent in traditional mathematical skills, both before and after their PLATO experience.

4.6 Mathematics Case Study V

Four classrooms (the two fifth and the two sixth grades) participated in the PLATO elementary mathematics demonstration in School VI. In both pairs of rooms, the teachers had worked out a modified team arrangement, cross-grouping students in some subject areas, exchanging in others. The fifth-grade teachers, working in adjacent rooms, were in the eighth year of an apparently successful collaboration when the decision to enter the PLATO trials was made. This working arrangement reflected the teachers' individual strengths and preferences: students were cross-grouped for reading and math and exchanged for science and social studies. Children in both classrooms were assigned to C.D.* for science, while the other teacher took both groups for social studies. Even though math instruction was shared, C.D.'s greater interest in computer-aided instruction, combined with the judgment that responsibility for implementing PLATO had better rest with one person, led her to assume that task for students in both fifth grades.

A thumbnail sketch of C.D.'s teaching practices, along with the ideas and values that shape them, sets the context for the PLATO demonstration in this classroom.

The Classroom Context

The physical layout of C.D.'s class reflects her affinity for visible structure, much as the content of the room speaks of her active presence. The desks are arrayed in rows, and the students do most of their work at their assigned post. They can move about the room freely, but not without purpose. The room has no activity centers, but is rich in displays, bulle-

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*This teacher is coded PL5 in the test analyses.

tin boards, and live animals. The classroom observation records that aspect of the room:

> The bulletin boards are kept current. One illustrates the scientific definition of work--work is when you move an object through space. In the science corner is a fish tank with a newt and tadpoles. Also a terrarium with a toad in it. The window displays bones, pine cones, pussy willows, cactus, and a dried mushroom. Other bulletin boards display kites, "Get attracted to Magnets," a papier-mâché octopus with stories about an octopus, the metric system, and safety (keep away from parked cars).

The class rules are also posted. They are few and direct:

1. Don't disturb
2. Don't interrupt
3. Do your work
4. Do cooperate

An observation made at another time finds another set of displays.

> There are many pictures in the room. Under vertebrates there are octopus, starfish, spider, tarantula, butterfly and lobster. There are also shells, a star fish, clam and oyster shells. A picture of a starfish without one appendage has the caption What could a live starfish do about this? Another poster with the caption Adaptations had a cross-bill duck, hawk, cactus, giraffe, dead leaf, and butterfly. Also a picture of an ermine, brown in summer and white in winter.
>
> A turtle was walking around the room. It is the pet of one of the children. I asked if it didn't get stepped on--she indicated that it would not.

Time as well as space is clearly structured. The school day is divided into 45-minute to one-hour segments, each with its designated activity or subject-matter focus. This schedule is not inflexible: it accommodates the regrouping of students from the two classes for different subjects, bends for special events, and, as will be elaborated later, allows for scheduling students on PLATO.

The curriculum bears strong teacher imprint. C.D. determines not only broad directions but specific assignments. Text books and other instructional materials are largely teacher selected or approved, and occasional student contributions are expected. Students make few choices about the content of their learning. This considerable control exercized by the teacher over the students' classroom experiences is tempered by C.D.'s evident liking and concern for the children, her caring about the progress of each child. She is respectful of individual differences, not only along such global dimensions as ability, but she is also aware of how children manage their time and sees differences in the way they bring skills to bear on a problem. She expresses interest in the way children construe problems and in the course of instruction attempts to inquire into children's understandings, if mostly within the boundaries of class lessons and assignments.

The teacher and pupil roles are traditionally defined. The teacher expects children to put "their best foot forward" in school, whatever the circumstances of their lives outside of school. She in turn assumes responsibility for facilitating, as best she can, their learning in school. Students do not hesitate to ask for help, and the teacher spends a good portion of her time responding to individual needs. These interactions are friendly, purposeful, usually related to an assigned task. Collaborative work among the students is not a regularly planned aspect of instruction, but it is not discouraged as long as it remains low key. If one judges from occasional observations, interaction among students is cooperative on the whole.

Science

Science and mathematics have high priority in the room. Science often entails working directly with materials and phenomena, in an investigative, if not an entirely open-ended manner. The teacher speaks with understanding about the value of first-hand encounters with the processes and objects under study. She points to close observation and systematic recording of observations as strategic components of science activities.

Two brief excerpts from classroom observations, taken on separate occasions, impart some of the flavor of science instruction:

> During science children were comparing their own rocks to rock specimens. The teacher was interested in having the children really look and wanted description rather than naming. Children were interacting freely in this situation, showing each other their specimens and asking each other questions. The teacher would ask them how they knew two rocks were the same. One boy didn't have his own rocks. The teacher said why a couple of times, saying he must have them by afternoon, as they could be found anywhere.
>
> The teacher was finishing spelling and beginning an electricity unit. They have been working on power as a concept. Today she had given them a battery, a bulb and two wires, and they were to see how many ways they could light up the bulb. There are supposed to be four ways. She gave suggest ns to individuals, but all were free to discover their own ways. K 's could work together or individually. All were at their desks.

Mathematics

Science and mathematics instruction rarely intersect. Mathematics instruction shares top priority in the room with reading and language arts. The relevance of mathematics is broadly construed by the teacher. She articulates her view of the world, which she sees reflected in the logic of mathematics, evoking an image of an orderly, rule-governed, fathomable universe:

> This is a structured world--it has a plan and a pattern--there are keys. If something is not working, there is a reason, and there are ways of determining why.

She goes on to draw what, to her mind, are the pedagogical implications of this view:

> The name of the game is "do it over, search it out." This is the part the students hate the most--to do it over, to stick it out, to figure it out.

In discussing the math curriculum, the teacher professes problem solving to be her foremost concern. Some of her practices are specifically designed to help students acquire sound approaches to the solution of both applied and abstract problems. Students, for example, are expected not only to furnish a solution but to show how they reached it--to be able to talk about "how their mind works." By encouraging children to be reflective about their own thinking, C.D. hopes that errors as well as solutions will be noted, understood, and remembered. She frequently reminds children that there are multiple paths to most solutions and that an experimental posture and persistence are necessary ingredients to successful problem solving. The students' elucidation of their problem-solving processes is also used by the teacher to judge the nature of their understandings. "The trick is to find out how they are perceiving what they are doing."

The combination of valuing exploratory, reflective learning activities and a preference for well defined organizational and curricular structures results in a teaching style marked by a working tension between prescriptive instruction and classroom activities shaped by the students. C.D. seems in search of a balance between convergent, well defined tasks and independently pursued, investigative engagements. A similar balance is sought between allowing children to find their own way to solutions and the negative consequences of floundering, hitting too many dead ends.

In actual practice, the balance tends to tip in the direction of prescribed, convergent tasks and providing guidance for efficiency's sake. The focus of day-to-day instruction is more on basic operations, aimed at building proficiency in specified skills. In this, C.D. is guided by the objectives drawn up by the district Math Committee. A closer look at the math program illustrates some of these features of the math curriculum:

The approximately fifty children in the fifth grades are grouped at the beginning of the school year according to their computational ability, as assessed by a standardized achievement test. The students are then cross-grouped in a way that allows both teachers to work with the full range of student achievement, so that they share the "able" and "those who need extra help" about equally. The groupings are meant to be flexible, but they often remain stable for extended portions of the school year.

The content of instruction during the first semester was dominated by the teachers' concern with the students' computational skills. The first six weeks were devoted exclusively to skill building, the aim being to bring every student one level up in the basic operations.
Although keying all instruction to skills, C.D. introduced enumeration whenever she felt it appropriate, working in bases with one group.

After this period of somewhat narrow concentration, the district objectives were brought into focus, and the teachers determined to explore fractions "in some measure" with all the children. Toward the end of the year, some children were working with equivalent fractions, and others were multiplying and dividing. Decimals were also introduced, their importance to the money system stressed. Some geometry and the explication of the metric system also formed a part of the fifth-grade math curriculum.

Several texts were used: Houghton Mifflin, S.R.A., Heath Elementary Math, Addison-Wesley. Not all students used all the texts. The teacher selected and matched assignments based on her judgments of suitability and need. The texts were supplemented by workbooks and work sheets, some teacher-made, and, occasionally, by manipulative materials.

One hour of each school day is allotted to math instruction, which most commonly takes the form of differentiated assignments to the skill groups. Assignments are made weekly, allowing the students some leeway in timing. There is the tacit expectation however that some work will be done daily. The teacher intends the block assignments to be responsive to individual pacing, as well as to encourage independence and self-regulation. So that students may be free from constant teacher supervision, the children are paired into teams, less for collaborative problem solving than for checking each other's work, for which the teacher manuals are made available. The time in the instructional groups is used to discuss and elaborate on the assignments. The children then work on their lessons individually, occasionally interacting with other students. The teacher is quite accessible for individual consultation. An observational excerpt describes a math period:

> Assignments for all are on the board, and children work on them for fifteen minutes. Then they answer questions in the text together. The lesson is on estimating. They talk about estimating the time to get someplace. The teacher brings up the 55 mile speed limit and asks the children to figure out if you can average 55 miles an hour if the speed limit is 55. They say that an estimate is usually good to predict how long it takes to get someplace because it wouldn't matter if you were a little earlier or later. "Sometimes it would," a child says. The teacher quickly responds "Very good, when would it?"
>
> After the discussion the teacher shows the children a chart that they are to check thus :/: when their math is finished and if corrections are to be made, and check :X: when the corrections are completed.
>
> The teacher now calls people who are in the green book to a math group. They were doing subtraction with regrouping. She asks: "Was there anything that puzzled you?" Greta has a problem. The teacher encourages Steven to help her. Several children had trouble with one square of numbers that left it up to the child to make up a new square. The teacher has four children work problems on the board using different numbers and shows them how different answers can be found for the same problem. She tells the children to remember that there is a way to do the problem. What they have to do is figure out a way.

Another observation records a variant of the pattern:

> The teacher gave each group an assignment. She then spent the next 55 minutes walking around giving help where needed and encouraging people when they needed a push to get started. Most children raised their hand and the teacher went to them. At times there were kids who were obviously fooling around, and she would go to them.
>
> Some teacher comments heard were: "Great work," "Good girl, that's coming fine," "The best way is to get it done right away, you have a good mind, just sit down and do it." One girl said: "We got everything done for once!" Teacher asked, "Don't you feel good?"

> The kids basically worked very quietly, not talking much. A few kids worked together on their assignment. The level of talking was teacher controlled. "There is much talking now; this is not talking time" she would occasionally remind the class.

The observations are descriptive of the process of instruction, but the brief excerpts do not reveal as clearly as the cumulative reports over the year that the teacher finds her broader concerns difficult to implement. Many of the children are not yet well versed in the basic arithmetic operations, and as these are regarded prerequisite to developing problem-solving skills, they become a roadblock to the teacher's more general goals.

PLATO Involvement

C.D. learned about the opportunity to participate in the PLATO trials through district channels. She had been aware of PLATO's existence for some time, following it from a distance when it was being piloted in School V. Before agreeing to participate she talked to several people, including her principal, and at length with the sixth-grade teacher, with whom she collaborated on several projects and who was also to become one of the volunteer teachers.

The final decision was made jointly with her teammate, after devising the plan that called for C.D. to supervise PLATO use by students in both rooms. No sooner had these decisions been made than C.D. was confronted with the dissolution of her long-standing partnership, when ill health forced her colleague to leave the school. In selecting a new teacher, the principal was mindful of C.D.'s wish to continue working in a team arrangement. The teacher chosen for the post was indeed receptive to this mode of work, although the pattern of instructional responsibilities changed somewhat.

The beginning of the PLATO implementation thus coincided with a potentially significant change in C.D.'s working environment. The transition in fact appeared smooth, and a cooperative spirit was established with the new teacher.

The school year began with an altered configuration of cross-groupings. The new teacher was not comfortable working with a wide range of student achievement in math. C.D. accommodated by instructing the high and the low student groups, assigning the students in the middle range of achievement to the other teacher. The earlier decision to make C.D. responsible for the PLATO program remained in effect.

C.D.'s initial expectations of PLATO were positive, yet measured:

> For me it is an open question...you don't know till you've been through with the children. Potentially, it makes very good sense. You have great hopes, but you never find a panacea... I don't know that we should look for one.

She was aware of but sanguine about the departure from traditional teacher-pupil relationship it represented:

> I don't feel threatened. There must always be this kind of thing that works with the children directly. I know there are many different ways to approach children.

Year I

The terminals became functional toward the end of September. The six terminals allocated to the fifth grades were installed in the small antechamber of C.D.'s room. The effect was of a mini-computer room, partitioned off from the rest of the class, but with an unobstructed view through the glass windows. Early on, a sign was placed near the entrance: "PLATO admittance only when you are on."

Access to the terminal was designed to minimize interference with other classroom studies. The posted schedule specified that the terminals be used only during three periods in the day, first in the morning from 8:30 to 9:30, during lunch from 12:00 to 1:00, and at the end of the day from 2:00 to 3:00. When PLATO functioned reliably, this arrangement permitted 36 students their allotted half hour on terminal. The frequent malfunctions however upset this schedule, when more makeshift arrangements took over and caused interruptions in classroom routines. An observer reports a common situation:

> While C.D. was teaching, some kids worked at the terminal. Several times she had to go back to say: "You are too noisy. Unless you quiet down, you'll be off" or "If I see you back there again when it's not your turn, you won't have a turn today."

The teacher's log entries during the first two days with PLATO reveal close monitoring of the children at the terminal and concern with appropriate lesson content. C.D. also reflects on her own involvement, and is clearly feeling her way toward a suitable role vis à vis the new resource:

> Sign-in day for 37 children--a very special day. In general the sign-in practice and subsequent individual sessions in the afternoon worked well. We had one machine not working. Reported to repair, but it had not been done when I left school for a 3:30 meeting. We operated with five machines. Some children completed lessons. Nancy (apparently) could not complete a session for some reason. Others went on to games while her session did not. During the 2-3:00 session we allowed some "kibitzers" as some people were involved in games. I felt this was a good teaching opportunity, so that some confusion as to what to do when a graph turns up would be alleviated. I had some concern as to the understanding some people had initially of how to proceed with plotting points, in some games, but finally most seemed to work it out. I felt like I answered a few too many questions in order to keep things progressing for the child's first experience. I will try to "hold back."

The next day, she reports:

> Today went well even with PLATO shut-down 2:35-3:00 when four children were scheduled. We hope rescheduling tomorrow will complete their sessions. Some children completed sessions - for others progress was slow, but all with perhaps one or two exceptions did get to the second slot. Some I had to take out because of time limitations imposed by other activities when they were in the middle of a game. There was an unusual situation when two people were on from approximately 12:35 to 1:45. Shouldn't they have been routed out sooner? I allowed them to stay because I felt more learning was taking place for them there than in a library period when concentration is low.
>
> I have been able to "keep track" of things more easily than I imagined, and children have solved many of their own problems through their own thinking or with the help of a person at a neighboring terminal.
>
> I have been pleased with the good progress of some people who are not successful daily (except as it comes with encouragement and praise from teacher). Most children enjoy being able to do by themselves.

The mechanical and system problems that would accompany PLATO use throughout the year were present during the first week:

> Tom's note was not recorded. Henry was in <u>Battleship</u> for the whole session and I had to shift stop out for him. One of our six (Billy) was tossed out immediately "No computer room." Out approximately 7 minutes. This happened twice more with other machines, out for about the same length of time. Don [CERL staff member] had said that 12-1:00 was a good time, so because we were having a guest speaker at 12:45 I put all those who normally start at 12:20 on by 12:00. Before their session was completed PLATO went off. Great disappointment! Several times during the afternoon everything stopped. When the kids go back in they have to start over. Nevertheless, they showed great restraint-though really disappointed. I will congratulate them. Perhaps, from this they may learn valuable flexibility and perhaps a more real knowledge of the capacity of a machine.

By the following day, things look better:

> Things progressed pretty much without incident today. In an incidental way I check on the students at terminals periodically to see what areas are being covered. Scheduling took time at first but now seems to be settled in. We will always have to be flexible in our arrangements, just as we have to be to include our TV programs in the curriculum.
>
> There seems to be little change in the children's behavior toward each other or to me. They are very excited about this new learning tool, but we hope it will eventually become just part of our general picture.
>
> I have been pleased at the insight or intuitive understanding demonstrated bv some of the children who are not achieving at grade level in Math.

The teacher continues to monitor the students' work, and tries to assess the learning that results:

> I find I do spend a good deal of time with the people at the terminals. I believe this will improve. Usually the students can help each other. I don't see any specific changes in the behavior of students. There may be some who "help" each other who might not have been involved with each other. The Postman stories seem to be a particular problem in following the directions. Pico Fomi is a particular frustration to some children. Number Accumulator was the only other choice Thursday, Oct. 3, and it seemed as though the directions for the last part were not adequate for the children to get much out of the game.
>
> I am not sure what progress is being made. Mr. Cohen [CERL staff] will give us some interpretation of the student records tomorrow after school. At present I can get in to them, but am not sure what they mean.

The teacher's comments continue in a similar vein during the month of October.

> This began well, and in general things went well today. I am feeling I must reteach some things presented, as individuals have come to a standstill with some ideas.

The teacher also begins to differentiate among children's interactions with the terminal:

> Children were on, but lessons were difficult for them. Some had lessons they could manage. Others finally got into things they had had before. Some children did well in things I would not have been sure they could handle. Children who normally are ahead in Math managed well, of course. The divisions in ability became more apparent. Those who normally have trouble concentrating became just as inattentive at the machine. I am considering taking some people off.

The comments of a classroom observer echo some of the teacher's log entries:

> As I watched, most of the students were on <u>Guess My Rule</u>, which they seem to dislike a lot. I hear statements like "Can I go now, I got one true?" "I don't know what to put in, do you? I hate this."
>
> Most kids could not understand rules which were not just simple additions, e.g., $\square + 3 = \bigcirc$. They could not figure out something like $2\square + 2 = \bigcirc$.
>
> C.D. came by frequently, dropping hints. Finally she just had to help two students who were getting very frustrated. C.D. does not think the graph material is appropriate for most of her pupils. She thinks PLATO should supplement her math, but the current material is so hard she frequently has to supplement it. The children talked back and forth about how hard it was and who was getting what. There was no one student who helped. They all appeared fairly equally confused.

The teacher is making efforts to relate classroom instruction to the PLATO lessons:

> We worked on graphing black cats on large graph papers. Students placed points and connected to make the cats. This led to several students making their own drawings and recording points for others to follow - a good extension, we feel, of the plotting of points on PLATO. Students seem to be gaining in ability to work with <u>Open Sentences.</u> Some are faithful in keeping logs and others are not. I have not had as much time to check on student's work as I would like.

The need for more time to monitor work on PLATO is a recurring comment:

> This is conference week, and I have not been able to observe lessons as carefully as I would like. In general the students are continuing to find graphing games fun; i.e., Battleship. Open Sentences are difficult for low-achieving youngsters. Some "middle achievers" find them frustrating; others will try. Postman stories are possible for all but need assistance frequently. I am not sure how much learning is taking place. It is good training in following directions.
>
> Whole number strand seems to be working better for low-achieving students. All can do the column addition, and of course they love Speedway. The high-achieving math students keep track of fewer seconds on the Speedway. The others seem oblivious to the implications! Still, more may be taking place "inside."

The unreliability of PLATO delivery is taking its toll, although the teacher is sympathetic and is quick to recoup her optimism, given a chance. A sample of entries from November tells the tale:

> It has been very discouraging as there are so many interruptions with the computer not in service. We are managing, but we can't get continuity of work, and frankly, I cannot be sure that student records reflect the actual situation, so I cannot apply information to daily plans. I am having the students write daily in their logs and having them check off each date so we can be sure some of these things are recorded.
>
> Things have been going much better, I believe. According to my check of the lessons tonight the students are getting 25-30 minutes of work. Some of them spend a great deal of the time in Speedway, but that is good practice of multiplication facts. The touch panels, I believe, are causing some problems with column addition, as two good math students have recorded disasters twice. Both were on touch panels.
>
> Pitcher pouring is the all-time "un-favorite." I found it confusing myself as to what the object of the lesson is.
>
> We are having much difficulty with PLATO hung "off" several times during the sessions. This takes time. After, there is re-scheduling to be done. This is important in order to achieve continuity of experience--but also to meet the feelings of disappointment expressed

> by the children. If a brief time is involved, then the children often must sign back "in" returning to the beginning of a game or series of experiences. These mechanical failures cannot be helped, but they do affect progress for students.

The children's enthusiasm seemed undampened in the face of disappointment to the classroom observer reporting:

> C.D.'s class was finishing a science assignment in a unit on vertebrae. Six children immediately went to the PLATO terminals, and were disappointed to find them inoperative. The whole system was off. One boy's comment was "Dumb ole PLATO!" Before they realized the system was down two children argued about who would use which terminal. There is a schedule, but kids move down one terminal to the right each week.
>
> The teacher gave out the math assignments. As the class worked on them, children kept going to check to see if PLATO was up. They asked: "If PLATO comes up, can I make up a session after school? during reading? during science?" The answer was affirmative in most cases.
>
> The students keep individual logs, but these appeared to be little more than a listing of which activities they had been involved in that day.

The teacher reports looking at student records after hours, in addition to the time she can find during the school day. She is taking a diagnostic attitude towards the ills of PLATO:

> A survey of student records after school today indicated some progress through the series of lessons. A few students seem to make little improvement from one lesson to another. In general I feel that students are improving their records in various lessons. We have had two students who could not "get in." Finally were cleared by calling on the telephone. Could <u>not</u> take care of them by my going "in" on the terminal as we are supposed to be able to do in order to correct faulty records.
>
> We seem to have the most difficulty with <u>Column Addition</u>. I believe there is a problem with the directions for the lesson so that students do not know what is the next step, and they cannot resolve the impasse that results

> other than to Shift-Help "out," creating a record of a "disaster."
>
> Checking for recent disasters this morning I am convinced there is something out-of-order on Column Addition. All disasters shown on Column Addition were on touch panels. Invariably these "disasters" were for very able math students. This does not quite make sense.

The teacher's concerns are also captured in the notes of a classroom observer:

> C.D. is upset by some of the problems on PLATO. One problem was in Column Arithmetic. She complained several times, but no one seemed to be able to do anything about it. Finally Charles and Keith (CERL staff) came out, she showed them the lesson, but they could not duplicate the problem. Later, back at CERL they were able to do so. C.D. is upset about other problems, like terminal freeze, etc. She does not like to have to go to look at terminals when she is trying to do something else.

The limits of extended core storage have become severe enough to curtail PLATO access. Only half of the students can get on each day. An observer reports that "C.D. is not upset about this, she feels the kids will respect the terminal more if it isn't something they have every day." The v ing of PLATO because it is a scarce resource also encourages its use as a reinforcer and a means of control:

> We have made it a policy that being on the terminals is a privilege, so occasionally students may miss a session for the day if work has not been completed in Math for instance or spelling. This is the only way we can make sure that other work is not slighted which is the nitty-gritty of life. On the other hand, we have emphasized PLATO is not "play" but their work. A real balance is necessary to bring about a good attitude on both sides.

Repeated entries in the teacher's log testify to her continuing questioning of the benefits that children receive from PLATO. She is disappointed to see the same disfunctional patterns carry over to interactions with the terminal for some students. Several entries also speak to the help children need to overcome an impasse, help that may be given by students or the teacher.

> I would like to believe that PLATO helps all of the children who have problems with the traditional approach to teaching Math. So far when I look at Student Records I see the children who do not concentrate well, not concentrating to solve a problem on the terminal either. Those who are easily deterred by an obstacle in class are frustrated by anything on the terminal that does not immediately yield to immediate solution. However, I do see some evidence that children can encourage each other to "try" something to get over a little hurdle. Some able math students unfortunately also have the problem of becoming impatient if they cannot choose their math activity. We have had to encourage them to go through the lesson series carefully. Certainly, the continuous multiplication practice in <u>Speedway</u> should do some good. Sometimes students ask each other for x combination answers. I was told today by Danny, who is completely dedicated to the terminals, that some of the students--himself included--did not understand the <u>Claim game</u>, but that he was sticking with it, but that the others became frustrated. I will try to get their reactions, as I had not been aware of this before. The children seem to continue to enjoy the terminals.

PLATO delivery was disrupted by the addition of extended core storage capacity to the system in December/January. The teacher is also preoccupied with school routines and responsibilities. She notes in February:

> PLATO experiences for the children were rather irregular the past few weeks. I have at last been able to spend some time looking at records, since report cards and a special project, Father's coffee, are completed. From what I can see there has been improvement in understanding of what is to be done by most children. The outstanding

> point to me is that the children have not lost interest even though the difficulty of the work remains the same. The "game" format is an important factor. We wonder, however, about the children of low ability in math. I do not see a great deal of improvement. Still they must be getting some positive feelings from the operations. Yet we do not see the improvement in facility with basic operations that I would expect from the love they have for the game Speedway - which involves simple combinations repeated.

Although responsive to each child in the course of teaching, C.D. rarely uses her log to comment on individual children. An exception is a series of entries about James, spanning the better part of the school year.

> James had an especially good experience as he thought of a really good "name" for 24. Such success for James is wonderful. He was also able to help others sign-in.
>
> I am still learning things about James. Today he was doing factors of various numbers on Claim Game. I don't know if he completed the game well. (I can never stay to see a student complete even one thing.) However, to understand "factors" is an accomplishment which leads to being more able with division and fractions.
>
> James, mentioned in notes December 18, understands much and shows it. However, whenever he gets in a problem he can't solve, he gets one of the other students to tell him the answer so he can get out of the difficulty. I am not sure he learns from this. I am not sure I want to prevent this kind of communication, but from my own experience, I can be told repeatedly "how" to do something, but until fingers and brain combine to work through a process, I have not learned it.
>
> Today I had a chance during the math period to do some observing. James seems to be doing much better on the terminals than in classwork. He has never been listed as having trouble, but I had wondered if he might be getting help some way. I am pleased with this, and hope that he will be able to show what he has learned when taking achievement tests.

The last comment, made at the end of May, reports sadly:

> James still doesn't seem to understand how to find equivalent fractions.

In the middle of April, back in the classroom after a month out for surgery, the teacher expresses her pleasure with the new reporting format:

> We are receiving excellent print-outs of information as to how students are doing. The new format of reporting shows lessons with code identification as to how each student is progressing in the lessons available. This is helpful... It has been planned to be very simple-and _is_. Sometimes it is hard to find even a _few_ minutes.
>
> Studying the data in PLATO, either taking it off the terminal daily or using the print-out, I have been made aware of individual problems in understanding fractions. For example: two people who "operate" with fractions finding parts of wholes or groups-- even finding equivalent fractions, did not internalize this sufficiently to "operate" in _Cutting and Painting_ on the machine. I am returning to more concrete ideas regarding fractions and to their designing or making parts with paper and pencil.

She is also catching up with the student logs:

> The children's notes in their logs indicate some of their strongly competitive reactions to the games. With some children competition seems a strong force, but with others who feel they can never succeed, they seem to be a discouraging element.

At the end of her first year of experience with PLATO, C.D. reflects on the way she would like to use this resource, tries to assess its benefits, and reiterates some of her observations and concerns:

> I do not feel that I want to rely on PLATO to introduce or provide major instruction. I would feel it should reinforce and provide drill and practice. I used PLATO subject matter informally. For example, when someone seems confused about other names for fraction ideas I can refer to _Pizza place_ and _Cutting the Pizzas_. When something in our math material refers to points on a number line, I can mention _Darts_. I would say it is used to _reinforce_ concepts-

(not introduce) and to provide drill and practice. We are usually ahead of PLATO in presenting material. We believe it is mutual reinforcement. With a few people we see them doing OK with concepts on the terminal, but showing no carry-over to pencil and paper tasks unless it is specifically pointed out.

2. As I have noted previously there is some value in the typing skills and following directions. I am afraid there is not carry-over. As a matter of fact, students show the same work habits either on terminal or off. It is possible to "goof-off" on or off if you don't really understand. I wish I could see improved work habits. Unfortunately, I feel that "hard core" people with poor work habits show the same poor work habits on PLATO as off. There may be some improvement in borderline cases who need constant stimulation to maintain attention.

3. Record keeping and retrieval system have been a benefit, since I believe it would be impossible for a person to keep track of the work done by 38 people in one area with the fineness available by the "computer brain" and still plan and record for all the other areas.

   We are pleased with the way in which the fraction information is presented.

4. Our classroom management is always highly structured or task oriented on the one hand, while we are necessarily flexible as to time arrangements. A good plan helps to make this possible.

   PLATO keeps a few people from participating during some periods, so time has to be provided so that they do not miss out on important areas. The final word as to when students are "on" has to be with the teacher who should know how each person's time is best used.

5. There are complaints from the students when they have to remain in a lesson rather than getting the favorite games. In general they seem patient-perhaps too patient, as some at least don't seem to learn from their mistakes!

And finally:

As we come to the end of the year I am thinking over the progress of our Math students--wondering if they have reached a higher point of achievement. As I compare them with students other years. Terry and Andy have done better work than I would have expected them to do on

> fractions, since they customarily have had difficulties. Tracy and our two Marys seem to continue to have the same difficulties each day. Thomas still doesn't seem to understand how to find equivalent fractions, nor does Steven.
>
> On the other hand, middle achievers, I believe, have been exposed to a tremendous amount of practice, and I believe tests will show good results.
>
> Students who normally achieve at a high level have found math on PLATO interesting and fun, and I am sure they achieved at a high level as usual.

Year II

The two fifth-grade teachers continued to work as a team during the second year of the demonstration. The division of instructional responsibility remained the same. The students were divided into three ability-based groups; C.D. taught the low and high groups, while the other teacher took responsibility for the larger middle-level group of students. Instruction tended to be more differentiated for the two groups in C.D's charge; the eight students in the low group received daily assignments that were individually tailored, where whole-group instruction was more the prevailing mode with the middle-level students. The deployment of the terminals was altered. Instead of the six-terminal arrangement used by both classes last year, under the guidance of a single teacher, each of the fifth grades had four terminals, each teacher supervising the 24 children in their own room.

The schedule worked out in C.D.'s room was a mix of assigned and self-selected slots. The terminals were on before school, during lunch, and school hours, except from 9-10:30 and 2-3. Children were allowed to use their free reading time and some also their math time to go on PLATO, but they were held responsible for completing missed assignments--after school, if need be. The arrangement enabled each student to spend half an hour a day on terminal, unless breakdowns or other school activities intervened.

C.D. reported spending 15 to 30 minutes a day on the terminal, mostly after hours, checking student records at the beginning of the year. She also tried to observe children at the terminal periodically, when she spent as much as an hour a day, for a week or so, with students on PLATO. At other times, she was present only at times of crisis.

The teacher found the student record printouts extremely helpful, and she was appreciative as the formats improved. She looked at individual records for particular problems, at group records for the general spread and class progress. By the second semester, she only looked at printouts, rather than at on-line data. Although she was satisfied with the feedback procedures, there was recurrent mention of the lack of time to study them in sufficient detail.

The noise of the terminals remained bothersome throughout the year. Scheduling continued to be treated as an instructional challenge, the teacher weighing the value of alternate educational experiences for students. Scheduling, however, was efficient enough to enable students to spend an average of 61.4 hours on the terminal during the year, where the classroom mean was 49.4 hours, with a range from 10.2 to 68.3 hours.

The teacher found the children's reactions not very different from those of the previous year; they were taking PLATO a little more for granted, perhaps. She herself continued to regard it as a reinforcer, rather than as a source of primary instruction. Achievement results in this class were positive in computation, concepts and fractions, low but positive in graphs, but negative 1 point when compared to the school VII 5th grade in whole numbers.

Summary

The PLATO demonstration had the benefit of active, interested teacher support in this fifth-grade classroom, where mathematics had high priority. The teacher's first-year summary is the best expression of her perspective on PLATO. She regarded it as an additional resource with good potential, and she has been willing to expend considerable effort to explore its utility for her program. By the end of the first year, she identified the ways she wanted to use the resource--in a supplementary mode, retaining the role of primary instructor herself.

C.D. is sensitive to the differential responses students have to PLATO, and she is aware of the differential benefits students derive from it. Although she did not begin with clear expectations, there is a note of disappointment that students who have attentional and other difficulties seem to carry these over to their interactions with PLATO.

Although the classroom is high in PLATO use, this use is achieved by careful scheduling rather than by giving work on the terminal priority at all times. Scheduling, in fact, is seen as an instructional issue, not only as a logistical issue. The teacher sees her role as "to see to it that PLATO does not interfere with other areas" although she is aware that "You make some choices...I have a strong bias that if it can in any way help with approaching math from different direction...motivate, involve children with math in a way that they can see the usefulness of it.. ...it gets priority."

C.D. thus balanced her goals and placed PLATO in the scheme of her instructional concerns. This was evident in other aspects of her teaching: she would help children at the terminal, seeing that as an instructional opportunity, but she would not interrupt ongoing instruction with other students to give aid at the terminal. The students helped each other at the terminal, although the teacher did not generally encourage joint work, reacting more against its disadvantages, though acknowledging its benefits. She saw students as tending to help by giving the answer, a practice she considered dysfunctional, rather than explaining how to do a problem, a mode she aimed at inculcating in the children she asked to help others.

Her final comment about PLATO was this: "Just like any other method--it is only as good as the people who use it."

Chapter 5

Teachers, Students, and Curriculum

5.1 The Instruments

Three subsections with relatively narrow focus present aggregate data that have their source in single instruments. They are intended to give information about specific aspects of the implemention. These are led off by a summary of the responses of the whole group of participating teachers to an interview at the end of the 1975-76 school year, when the PLATO field trials were drawing to a close. In The Teachers' Views, the participating teachers express thoughts and sentiments that bear on their experiences with the PLATO resource.

Characterizations of the whole group of participant classrooms are presented in the Classroom Observation Summary subsection. The observations provided information that is used to depict the range of variation among the rooms along several dimensions descriptive of instructional environments. The checklist also contained a group of items designed to record the nature of PLATO integration with the ongoing curriculum.

The Observations of Students at the Terminal presents summaries of data gathered via an observation checklist used to record student behavior at the terminal. Reported here are the directly observable aspects of the students' interactions with the PLATO resource, unfiltered by the teachers' views or the passage of time.

Finally, a subsection on Teachers' Curriculum Coverage in Mathematics follows that presents data concerning the relative emphasis on various topics in mathematics instruction. This information was collected through a Math Coverage Questionnaire, completed by both PLATO and comparison teachers, and from PLATO records on strand use.

5.2 Teacher's Views

In order to round out the view from the classroom as it appears from the perspective of individual rooms, we will also summarize the experiences of the entire group of participating teachers as they were expressed in interviews at the end of the 1975-76 school year, when the field trials were drawing to a close. Twenty-six teachers in all were interviewed; 12 were early-grade reading teachers using the PLATO program, and 14 were middle-grade teachers using the math programs. Twenty of the teachers had two full years of experience with terminals in their rooms; six joined the project for only one year.

The interviews*, one to two hours long, covered a range of topics concerned with the effects of PLATO on the classroom, including change in classroom routines, the teachers' assessment of the PLATO curriculum and its integration into ongoing instruction, and the teachers' over-all assessment of PLATO as a classroom resource when compared to other resources, such as an aide. The interviews are selectively summarized, highlighting material that is not covered in other parts of this report.

Incorporating PLATO into the Classroom Setting

Installation of Terminals

The physical adoption of PLATO terminals into the classroom settings proved to be relatively trouble-free. It required some reorganization of

*See Interview Guidelines in Appendix X

classroom space, but in most cases this was accomplished early in the year. With the exception of two teachers who reported their classrooms as having become crowded, the installation of the terminals posed no significant space problems.

The operation of the terminals, however, had a noticeable effect on classroom noise levels. Some teachers (six) felt the noise of the terminal fans was disruptive in the beginning. To overcome the background noise from the terminals, students and teachers talked louder, a situation which resulted in a noticeably higher noise level for the class as a whole. Several teachers periodically turned the terminals off when the noise became severely disruptive to other activities in the room. However, most of the teachers -- even those who initially felt the background noise distracting -- adjusted to it after a while.

Even after the initial period of adoption, the presence of a complex and still-evolving technology continued to pose maintenance and usage problems. Besides the less frequent system failures, there were an assortment of mechanical failures and malfunctions related to the use of the audio devices, discs, keyboards, and touch panels. Such malfunctions required the children or the teacher to diagnose the problem, repair it if possible, or notify CERL. Although the teachers were sympathetic to CERL's problem of keeping so much equipment functioning, they also expressed concern about the effects on students, particularly the younger ones, of working with equipment that was sometimes unreliable.

Orienting Students to PLATO

Once the terminals were in place, the next major task was to acquaint students with the use of the terminal. The time taken by students to become independent at the terminal ranged from one day to more than a month, the median time about one week. It also varied from one class to another. In two kindergarten classes, some students still needed assistance during the last month of the school year. As might be expected, the K-2 classes took more time to be independent at the terminal than the more mature classes of fourth to sixth graders.

Student orientation was accomplished with substantial help from the CERL staff, particularly at the lower grades. The teachers' estimate of the amount of time spent by CERL staff in familiarizing students with the terminal revealed substantial differences between reading and math classes. Nine of the reading teachers recalled CERL staff's devoting 15 or more hours to the task; only one math teacher reported over ten hours of staff time spent on orientation. The teachers' estimate of their own time spent in helping students at the beginning of the year also reflected the differential needs of the two age groups: half of the reading teachers (six) reported spending up to a half hour daily with orientation, whereas only three of the math teachers did.

In the case of reading teachers, some had their aides spend considerable amounts of time -- as much as half of their allotted time in one instance -- helping students to take turns and to manipulate the machine.

Another source of assistance to students new to the terminal came from other students, particularly those who had had previous experience with PLATO. During the demonstration year, five math classes and two reading classes contained a significant number of students who had been previously exposed to PLATO. Over half the teachers (16) noted instances of more adept students helping others.

The teachers' accounts substantiated the considerable support needed by the younger children to become adept PLATO users. The early-grade children were not only new to school life and likely to be inexperienced in handling complex equipment, but they also had to learn to handle the audio device, which added considerably to the complexity of using PLATO. Notable too was the pervasive sentiment among the teachers that CERL staff was indispensable to the introduction of the terminals. Although teachers did contribute to the process, most (20) felt that they could not undertake the initial orientation of students during the regular course of instruction.

Scheduling

The remaining requirement for the systematic use of PLATO was the setting up of a schedule and of procedures regulating the students' access to the terminals. For a few classes, this was a year-long process of experimenting with different arrangements; for others, the patterns were established early and maintained for the remainder of the year. Most teachers (18) followed a fixed schedule; that is, a class list was posted and the students took turns according to the list, the student whose session had ended alerting the next student to go to the terminals. The time taken for the students to get adjusted to the schedule ranged from one week to one month. Some teachers attempting to implement a flexible schedule spent considerable time (as much as 20 min/day in one case) in working out the schedules. The flexible scheduling varied from giving verbal instructions to the students and grouping in terms of ability or reading levels to providing more time to slow learners.

In the beginning, the terminal breakdowns were a major problem to the teachers implementing fixed schedules. A change in fixed scheduling also became a necessity when some teachers, especially in the elementary reading program, began to prescribe lessons for individual students, a management option that became available during the latter period of the demonstration year.

Students' use of PLATO was primarily confined to within-school hours, with a few exceptions where students were scheduled at their convenience before the beginning of school hours and during lunch break. Most of the teachers accepted the PLATO staff's strong preference for equal time on PLATO for all students. Thus there were numerous instances of effort on the part of teachers to make up for students' time lost as a result of system breakdowns. PLATO was turned off, in most cases, during science, social studies, physical education, and music classes.

Although the great majority of students was willing, and indeed in many cases eager, to work on PLATO, there were some students in every class who were occasionally or consistently reluctant or unwilling to take their turn at the terminal. One teacher gauged that 5% of her students were in this group, probably a reasonable estimate of the proportion of disaffected students in other classes as well. A variety of reasons were offered to account for PLATO-phobic responses. A commonly cited explanation was student involvement in other activities: "If they were busy doing something, they'd like to stay with those activities." In other cases, students did not want to go to the terminal because of their previous failures there, inability to follow directions and to respond correctly (e.g., problems of reading for some students in math lessons), or unwillingness to subject themselves to an uncertain situation. Some students became frustrated by the failures of PLATO; others, particularly among the reading students, lost interest in the all-too-familiar material during the year; others still were reacting to specific curricular content. As one teacher reported: "Phonics turned them off. Kids kind of rebelled against phonics." Student resistance was also more prevalent in rooms with fixed schedules, and especially when their teachers wished to give equal time on PLATO to all students. In these rooms the students who wanted more than their share of time on the terminal, and who clustered around the terminals while othere were working, sometimes proved disruptive.

Use of PLATO by Teachers

The teachers were all volunteers to the project, yet there were marked differences in their interest in PLATO, their expectations regarding its utilization in the classroom, their depth of information about the resource, and their affinity to the technology itself. Although we have no direct and independent assessments of these aspects of the teachers' posture, the interviews did elicit accounts of the teachers' interactions with PLATO, which are good indicators of their preparedness to use the resource and their general investment in doing so. We will consider several aspects of teacher interaction with the terminal: the teachers' (a) proficiency in handling the terminal, (b) familiarity with the PLATO lessons, (c) utilization of feedback information, and (d) differentiation of PLATO lessons material.

Proficiency with the Terminal

A significant number of teachers (nine) felt that they were inadequately prepared to handle the terminal. Some of these teachers had had no previous acquaintance with PLATO. Typical comments were the following: "I don't know how PLATO works" and "Only within the last 3 months I became familiar enough that I can do something with this expensive equipment." Ultimately, of course, all teachers acquired sufficient skills to access the available feedback information about student performance, call in malfunctions, etc., although considerable difference in teacher-terminal relations persisted. One or two teachers developed some diagnostic and repair skills in coping with terminal malfunctions, while most shied away from maintenance functions and shut the terminal off when difficulties arose.

Familiarity with PLATO Lessons

Similarly, the extent of the teachers' familiarity with the PLATO lessons also varied. Convenient documentation, covering detailed descriptions and the rationale of PLATO lessons even when it became available later in the project, did not capture the quality of the lessons nearly as well as working through them on the system itself. Yet teachers' use of the terminal for getting acquainted with PLATO lessons was limited. Although teachers emphasized the importance of being familiar with the lessons, most also noted the lack of time to do so. Only four of the math teachers and one reading teacher reported going through most of the lessons. One teacher expressed her preference for the book with the description of the program and the lessons in it. Some teachers felt that they got a pretty good idea about the format and style of the lessons by just watching a few students at the terminals. Although one teacher mentioned talking with another teacher about PLATO, the communication among PLATO teachers about the program or lessons was minimal. Some teachers went through lessons only when they began to prescribe for individual students.

Utilization of Feedback Information

The relationship between the classroom and the PLATO curriculum, an issue that each teacher had to resolve in her own room, was one that the CERL staff engaged sporadically but never confronted directly. Understandably, there was reluctance to issue directives on a matter integral to teacher autonomy, yet prudence was only partly responsible for CERL's restraint. There was little consensus between the math and reading groups in this as in other matters; each group travelled pedagogically independent paths. There was no greater agreement within the projects' staff about preferred modes of integration. Some staff worked toward a free-standing curriculum, with no specified relationship to classroom instruction, whereas others saw the teacher as the principal determiner of the nature of integration, be that through the shaping of classroom instruction to accommodate PLATO lessons or the selective use of PLATO lessons to fit classroom instruction. The teachers of course had minimal influence on the content and presentation of PLATO lessons, but they did have intermittent, partial influence on the lesson materials prescribed for their students.

Monitoring student work on PLATO was a key indicator of the teachers' mode of utilizing PLATO. The on-line records and periodic paper printouts of these records were the only source of systematic information about the individual student's work on the terminal, providing a record of specific lessons covered along with a performance evaluation. The teacher needed prior familiarity with the lessons to make use of this information. The student performance records varied in quality and detail both over time and across strands. During the pilot year, the performance data were often unreliable, and the reporting formats were still being developed. During the demonstration year CERL provided more reliable data, following the fractions strand format, but differences in the quality of the information remained, as lesson designers set different priorities on feedback to teachers.

A wide variation was reported by teachers with respect to the use of on-line records. The frequency of monitoring ranged from checking in daily (one teacher) to weekly (13), to even less than weekly by almost half the teachers. The amount of time teachers estimated they had spent on the terminal paralleled these differences, five teachers spending one to three hours a week, a few reading teachers (four) more than three hours, but the majority less than one hour. The reading teachers as a group reported spending more time on the terminal than did the math teachers. Almost all the teachers commented on the need to spend more time monitoring student work, but also on the lack of time to do so.

Most teachers noted that the performance records were easily accessible and helpful in making instructional decisions. The most frequent use of on-line students' records and printouts was in identifying the students who needed immediate help and those who were progressing very rapidly. This information was used by teachers in represcribing lessons, assigning faster students to more advanced lessons, and forming groups for regular classroom instruction. A few teachers also designed worksheets in math and corollary activities in reading on the basis of information provided in the printouts.

Most teachers accepted the student performance evaluations provided at face value. A few of the reading teachers were aware of the unreliability of the data, particularly during the pilot year, but few questions were raised regarding the criteria used in making the judgments and subsequent routing decisions. One math teacher commented that she did not have a clear understanding of the criteria used to determine students' standing in the different strands.

Interpreting PLATO and Classroom Instruction

Any attempt to integrate classroom and PLATO instruction necessarily would depend on the teachers' knowledge of the PLATO lessons the children were receiving. The finding that only a few teachers sought out such information frequently enough to guide instruction confirms parallel evidence, from the teachers' logs, that PLATO tended to be an activity largely independent of the teachers' curriculum. One teacher said it for the majority: "It is not an integral part of my curriculum."

A closer fit between classroom and PLATO instruction could also be brought about by the selective use of PLATO lessons to complement classroom teaching. This option was not open to teachers for the most part, as they were well aware: "Integration with classroom activities is difficult because I don't have control on the programming"; "we could not really work on coordinating PLATO unless I started prescribing." A major shift occurred among the reading teachers when, during the last three months of the '75-'76 school year, they were freed from the central router and offered the option to prescribe lessons to individual children or groups of them. One teacher expressed a not uncommon sentiment: "I've not spent much time on terminal until the prescriber came. It forced me to find out about PLATO."

The significant changes after the introduction of the prescriber included greater degree of involvement, increased interest in the lessons, a feeling of control over the program, and a greater degree of integration with classroom teaching, including the increase in corollary activities related to PLATO lessons. One teacher commented: "Everything changed with the coming of the prescriber." Some of the teachers reported spending as much as 10-15 hours a week in prescribing lessons, certainly a significant increase in teachers' participation. Two teachers regretted that the prescriber came so late. "If the prescriber had come in the beginning, we could have achieved a lot." Not all reading teachers were, however, equally involved in and enthusiastic about prescribing lessons. Some relied completely on CERL staff to prescribe lessons.

In mathematics, a move was also made to teacher prescription in the demonstration year, although such prescription was quite general, consisting of choosing which days of the week would be devoted to each strand by individuals and groups within the classroom. Most teachers went along with the urging of CERL graph strand developers that children get some of each strand each week, but a few attempted to exercise more control, keeping some class members exclusively in whole numbers until they felt the students were ready for fractions, skipping most whole-numbers lessons in one case, and using essentially no on-line graphs material in another. In most cases, these mathematics assignments were made at the beginning of the year and changed not more than twice during the year, rather than responding to day-by-day or even month-by-month changes in mastery of material.

Teachers' View of the PLATO Lesson Materials

The PLATO lessons were the work of many hands and did not always present a consistent pedagogical or design approach. This diversity was more evident in the math materials, where the three strands were developed independently and the staff members responsible for each worked in parallel. The variety of specific lesson content also contributed to the varied modes of presentation, format, and pacing that characterized the lessons. The Pacer stories were of quite different character from the lessons dealing with letter-sound discrimination, as were the math games from the more didactic lessons. Given this diversity of materials, it was not surprising that the teachers' discussion of the PLATO lessons did not follow a simple pattern but rather revealed several organizing dimensions. Some teachers (14) discussed the lessons solely in relation to the way they fitted the perceived needs and abilities of the students: "The stories were too advanced for slow and average students"; "Some bright students did not like stories being read to them." To some teachers (five), the phonics lessons were "timely and effective," whereas others (four) found it "very frustrating and too early for some students." As the comments indicate, the same lessons were seen either positively or negatively, depending on the teacher. There was no agreement among the teachers about the general utility or suitability of particular lessons. These teachers were responding solely within the context of their particular room and the individual children in it.

A small group, composed mainly of math teachers, noted broader differences in the approaches adopted in the different strands: "The graph strand is very abstract, whereas the fraction strand has more illustrations and in-depth coverage"; "The fraction strand is very organized, systematic and consistent." Several teachers compared the approach in the PLATO lessons with their own: "PLATO introduces lessons in an open sort of a way, which I don't"; "PLATO is much more mobile, game oriented, and fun. It provides more effective reinforcement than the teacher does." The limiting aspects of PLATO, as indicated by teachers, included inadequate coverage of curriculum areas, and inappropriate emphases: "Some steps are missing in the whole number strand"; "PLATO should stay away from phonics. Because of the audio device, the sound is distorted."

The majority of comments constituted an assortment of judgments: "Graphs involve too much reading"; "Even some of the kids who did not get along with me got the idea of fractions from PLATO"; "I like the way PLATO teaches in a trial-and-error way"; "PLATO provides one-to-one attention which the teacher does not have time to do."

The teachers' discussion of the lesson materials did not yield common preferences, views, or judgments. It appears that the teachers' perceptions depended on personal preferences, the curricular materials they were using at the time, the students' reactions, and other aspects of the context where PLATO was used. The teachers were similarly divergent in their views on the utilization of materials. Most teachers consider PLATO as an effective means for providing reinforcement, practice, and individualization. Many reading teachers expressed preference for introducing new topics by themselves and for having PLATO follow up their teaching. However, some math teachers were of the opinion that PLATO could play an important role in introducing new topics in an interesting way. Two teachers emphasized that PLATO and regular teaching should be mutually reinforcing: "The teachers and PLATO have to be partners. Students take their work seriously when they know that the teacher and PLATO were together."

A number of teachers (5) felt strongly about a differentiation of functions between themselves and PLATO. They saw the introduction and review of concepts as their major function, PLATO providing only drill, practice, and games. A smaller number of teachers saw PLATO potentially suited to conduct both these instructional functions.

Some of the math lessons were considered "frills" by a few teachers: "Although we started with graphs, I took many students out of it and put them into whole numbers and fractions, because these are more relevant to practical life." Another commented: "Usually when kids were having problems, it was with new materials, like graphs. Kids need more basics. PLATO is great, but we ought to stick to basics."

Teachers' Assessment of Student Learnings

All the teachers in the project expected their students to benefit from exposure to PLATO, but the attribution of specific effects was no less difficult for the teachers than it was for the evaluators. The teachers' comments ranged from citing individual cases where they clearly saw PLATO-related influences, to generalizations about broad effects on groups of students. The reading teachers attributed a variety of learning outcomes to PLATO. These include, in order of most to least frequent: following directions (five), listening skills, tolerance, self-confidence, self-reliance, independence, keyboard typing, and creative writing. "Typing helped students spell better," noted one teacher. "Students' drawings are better and much more comprehensive as a result of PLATO experience," noted another. The teachers had difficulty articulating specifically reading-related learnings that were facilitated by the children's interaction with PLATO. Math teachers tended to view PLATO as a useful device in providing practice and reinforcement of topics already taught in the class (five). Very few teachers noted that students learned any new topics from PLATO, and only three teachers gave specific instances of students' learning topics from PLATO which the teachers had not themselves covered.

A high degree of agreement existed among teachers with respect to their perception of characteristics of students who benefitted most from PLATO. The majority consensus was that "the students who used to get the best out of schooling got the best from PLATO too." In general, the high-ability students were reported to have accepted the challenges offered by PLATO, really liked being in charge of the machine, interacted more, and benefitted most. These students explored PLATO beyond their lesson slots, as in the case of students in reading classes who went through math lessons. At least five reading teachers noted that either they put some kids on math after they finished reading lessons or students got into math lessons by themselves. In addition to general ability level, a positive attitude toward interacting with the machine and a real interest in PLATO lessons were seen as characterizing the students who used PLATO productively. Sex did not appear to be a pertinent factor in influencing students' interaction with PLATO.

A lesser degree of consensus existed among teachers with respect to low-ability students and what they gained from PLATO. These students generally "had difficulty in following directions," "got easily frustrated due to frequent failures," or were "unwilling to attempt when they were uncertain of being successful." The immature students in one morning kindergarten class felt controlled by PLATO, whereas the more mature and able students of the p.m. class felt in charge. In addition, certain characteristics of the lessons made it difficult for the slower learners to interact effectively and benefit optimally from PLATO lessons. The reading involved in the math lessons was reported to be a source of discouragement to the slower students.

In reading strands "some lessons are hard for the average and more so for the low-ability students."

Some teachers reported unique and appreciable gains made by a few withdrawn students. "Two withdrawn students in one class enjoyed working with PLATO and improved relations with others." To some students, PLATO was seen not so much as contributing to academic learning as to being independent and developing self-confidence. The tolerance on the part of PLATO toward slower learners seemed to help "those students who needed someone to hang on or individual support from someone." In addition, a student with learning disability in one class and a speech-defective student in another class were judged to have benefitted from PLATO. These special benefits from PLATO did not, however, spread across all shy and slow learners. Some instances of shy students' being more frustrated and slow learners' progressing even more slowly were noted by teachers.

Although some teachers cautiously pointed to the difficulty of singling out the main effects of PLATO, many noted changes in the rate of learning and students' attitude toward the subject matter. A number of teachers (nine) noted the shift of students' attitude toward the positive end. "The most noticeable thing as a result of PLATO is the students' relaxed attitude toward math." "They love everything they do in math now." "Students like to read more." No significant impact was seen upon students' learning approaches, although students were seen as more actively involved in the learning process while interacting with PLATO.

PLATO's Influence on Teacher Instruction

In addition to the primary goal of instructing students, the PLATO staff, particularly the math group, saw exposure to the pedagogical alternatives embedded in the PLATO lessons as a stimulus for teacher reflection and growth. There was some evidence in the teachers' accounts that, for a few teachers, this was indeed the case. Several (seven) math teachers and a few reading teachers (four) credited PLATO with showing them new approaches to teaching their subject areas. The extent to which these insights were incorporated into classroom instruction was difficult to judge. Some stated that they felt more relaxed with the subject matter, did more planning, and designed more activities in line with PLATO lessons. Some of these teachers felt they had acquired more knowledge about students' ways of learning. "It awakened me to some basic patterns of problem solving that the students follow," noted one teacher. The observation of students' progress at the terminal encouraged a few teachers to try out new ideas and become more involved in providing guidance to students individually or in small groups.

Yet another, more problematic, effect was articulated in detail by only one teacher, but it relates to an issue of general significance. The teacher credited the math lessons with increasing her understanding of some of the concepts treated, while at the same time revealing her limited grasp of some of the mathematics she was responsible for teaching. For this teacher, the benefits of PLATO were offset by her loss of confidence in her own competence. As there were no easily available opportunities for her to strengthen the areas she judged weak, the result was a dependency on PLATO that filled her with anxiety about the future, when the terminals would not be part of her classroom.

In summary, after a one- or two-year experience with PLATO, how do teachers feel about it? The responses varied from "It has definite pluses and minuses" to "It has great potentiality, but needs much improvement," to "It's a great asset. Disregarding the cost, it should be everywhere. The fascination is just endless." These comments reflected the general sentiment of a group of math teachers who, with one exception, would have liked to keep the terminals. The reading teachers, on the other hand, were less favorable. Several noted inconsistencies and inadequacies in the PLATO reading program. One teacher remarked, "We do not have good reading lessons on PLATO. PLATO has great potentiality to teach and some uniqueness. Let's use the unique feature of it rather than emulate teacher's style." Many teachers emphasized the need for reorganization of the reading curriculum to incorporate more basic and relevant lessons.

Although teachers were generally impressed with the PLATO demonstration, many had specific suggestions about the improvement and adequate implementation of the program. These suggestions include: the need for partnership between the CERL staff and teachers in designing the lessons, the inclusion of more relevant lessons, broadening of PLATO programs to include other curricular units, the provision for adequate teacher training, and the appropriate timing and availability of the lessons. These comments are also reflected in the teachers' choice between PLATO and aide. A significant number of math teachers chose PLATO, whereas a majority of reading teachers opted for an aide. Some reading teachers (five) who chose PLATO did so under the condition that PLATO would be improved.

5.3 Pilot and Demonstration Year Classroom Observations

This section will provide a description of classrooms in which PLATO was used during the 1974-75 and 1975-76 years; it is based on the observation checklist data. This information is intended to give the reader some sense of the variety of classrooms involved and to reveal certain commonalities among classrooms in setting, curriculum, and use of PLATO.

The observations were recorded in two parts, a checklist and narrative. The checklist provided categorical judgments and numerical ratings of the frequency or intensity of occurrence of a number of activities and characteristics (1 = none or never; 5 = extremely high level or constantly). The narrative provided an anecdotal account of what occurred during the observation. The narratives were primarily used in the formative stages of the checklist to aid in developing additional items and also to provide descriptive information for case studies.

Following are summaries of the data for classrooms participating in the reading and math programs, separately, during the pilot and demonstration years.

Reading Classroom Observations, 1974-75

During the 1974-75 year the checklist instrument underwent continuing revision and expansion, evolving through five forms. To provide a summary for each class, the two ETS observers recorded their overall impressions of each class at the end of the year, using the most recently developed checklist form. These summaries were based on an average of 6.2 observations per class. In four cases, the checklist summaries were independently prepared by both observers. Observer 1 prepared summaries of two classes, and observer 2 summarized the remaining three classes.

For the other five classes, two of the summary checklists were completed by observer 1, and three by observer 2.

Classroom Settings

The checklist data indicate a fairly wide range of classroom settings. In terms of the physical organization, the following table shows the distribution of classes among the categories of organization rated on the checklist.

Table 5.3.1

Distribution of
Physical Setting

Checklist categories	
Desks--rows and columns	1
Desks--informal arrangement	2
Balance of desks (tables) and activity centers	4
Activity centers predominate	2

The functional use of space reflected the type of physical organization. The following table gives the median and range of each ite.. In most classrooms, subgroups of children used different areas simultaneously.

Table 5.3.2

Where Children Work

	Median	Range
Checklist categories		
Activity centers	3	2-5
Student desks	4	(Bimodal) 4 1's, 4 5's
Circle or table	5	4-5
On the floor	3	2-5

Children in some reading classes spent a great deal of time at activity centers and on the floor and virtually no time at desks, while children in other classes were usually observed at desks and rarely at activity centers or on the floor. In all classes, some children were observed at work at tables or circles.

Noise level also varied. The characterization "quiet, children working" was seldom appropriate (median 2; range 1-3), while teacher-enforced quiet was sometimes observed in only two classrooms (median 1; range 1-3). The most common working environment was rated as a quiet hum of conversation (median 4; range 3-5), followed by "noisy, children working" (median 3; range 2-4). Six of the nine classrooms were described as never noisy and disruptive, two were characterized as seldom out of control, and one, a class of low-achieving 2nd graders, as often noisy and disruptive.

Teachers frequently worked with the class as a whole group (median 4; ange 3-5). Most often, there was a variety of activities going on in sub-groups of children (median 5; range 3-5). There was considerable variation in direction of activities by the teacher and self-direction by the children according to their own interests in school work (both with median 3; range 2-5). These two items, of course, were negatively interrelated.

Materials Resources and Reading Activities

Since this section of the observation checklist remained stable over its final three versions, the data here are drawn from the final three observations of each classroom rather than from end-of-year summaries, and thus they represent 2nd semester activities only.*

In terms of material resources in general, the most commonly used resources, across all classes, were concrete materials (noted in use in 74% of the observations), printed materials other than textbooks and workbooks (63%), textbooks (44%), and workbooks (44%). Visual aids were less commonly observed in use (15%).

*These data included eight sets of paired observations, used to determine inter-rater reliability. On categorical items, observers agreed on the presence of 49.7% of the characteristics, on the absence of 48.2%, and disagreed on 2.1%. On scaled items, raters agreed on 81.3%, differed by one scale point on 17.6%, by two points on 0.7%, and by three on 0.3%

Reading activities most commonly observed were: silent reading (71%), oral reading (59%), and learning word attack skills (52%). Children were often observed engaged in spelling and punctuation activities (41%), comprehension exercises (37%), writing exercises (37%), and handwriting and copying activities (33%). Least commonly observed were word meaning activities (22%) and child-dictated experience stories (15%).

The texts used for reading were most frequently standard textbooks and workbooks (56%). These materials were predominantly from the Economy Publishing Co., with Holt, Macmillan, and Scott-Foresman materials also noted. Also in use were child-selected stories (37%), child-generated stories (26%), and games (26%). Teacher-generated stories were occasionally employed (15%).

Interactions with PLATO

In general, reading teachers exhibited a low-to-moderate level of interaction with PLATO, at least during school time. Teachers, with one exception who used the terminal after school, seldom went to the terminal to get information from the system on student performance (median 2; range 1-3). Teachers did not, for the most part, use system information to change children's assignment on PLATO nor to group children for special instruction. All but one teacher were rated 1 on both items. The exception, a teacher who was generally not very involved with PLATO, made frequent assignments of "Pacer" stories to her better readers.

Teachers occasionally walked by to observe (median 3; range 1-4) and teachers or aides occasionally helped children at the terminals when called (median 2; range 2-4). Teachers seldom found it necessary to discipline children at the terminal (median 2; range 1-3) and almost never used turns on PLATO as reward or punishment (median 1; range 1-2). In all classes, other children at times clustered around the terminals, (median 2; range 2-3), this in spite of the barrier to communication with PLATO users caused by the wearing of headphones. The mode of interaction among children when at the terminal was usually socializing (median 2; range 2-3).

In a few classes, particularly those with a high level of teacher direction, children were explicitly expected to finish their activities before taking a turn on PLATO (median 3; range 1-5). Only the teacher with heaviest involvement with the system usually expected her children to drop what they were doing when their name appeared as next on PLATO. The observers noted that in two of the classes, there really were no expectations one way or the other; children simply used the terminals as they wished with infrequent reminders from the teacher to use the terminals. Formal schedules for PLATO were posted in only three classes.

Four scales relating to PLATO use were included in a section in which observers recorded more global impressions of the classroom. According to these observer judgments, PLATO was seldom in use as an integrated resource by the teacher (median 2; range 1-4), while teacher encouragement of PLATO use varied considerably (median 3; range 1-5). Consistent with the low degree of integration, teachers in all classes were rated as viewing PLATO, rather than themselves, as being in control of PLATO content (median 5; range 3-5). In the fourth global item, PLATO problems were rarely judged to disrupt other ongoing activities (median 1; range 1-2).

A working hypothesis in the development of the classroom observations was that classes exhibiting more student choice and individualized instruction would prove a more hospitable environment for PLATO. Although such aspects of classroom life as use of activity centers, working with individuals rather than groups, and teacher direction of children to tasks covaried strongly, none of the reading teachers used whole-group instruction as a major mode of teaching. Degree of teacher control was highest in the 2nd grade and two first-grade classes, moderate in the remaining first grades and one kindergarten, and lowest in the mixed classes. The hypothesized dimension was thus confounded with grade level, and the hypothesis was not confirmed.

Dividing the nine classes into groups of three on level of teacher versus student direction yielded means on teacher encouragement of PLATO use of 4.0, 3.0, and 2.7 for the teacher-directed, balanced, and student-directed classes, respectively, consistent with the more interventionist stance of the first group of teachers, but there was no clear relationship between PLATO integration, amount of usage, or teacher interaction with children at the terminal and this "centralization" dimension. PLATO was judged as slightly less disruptive in the less directly teacher-controlled classes (mean 1.2 vs. 1.7 for the moderate and highly teacher-centered rooms), but PLATO problems were rarely judged as disruptive in any classroom.

Reading Classroom Observations, 1975-76

In order to concentrate on mathematics classes, the observers' activities for the reading program were cut back during the 1975-76 demonstration year. A total of 19 complete kindergarten classroom observations were completed in the first semester of 1975, with an additional 15 visits restricted to coding the PLATO interaction section of the observation form, since reading was not being taught by the teacher during the hour. Two kindergarten classes were selected for intensive observation during the first semester teacher-as-own-control substudy. These two classes, PAK and PIK, received

7 and 8 observations, respectively, while the other two kindergarten classes involved in the program received two observations each. All four kindergarten teachers were new to PLATO in the demonstration year.

In summarizing the data for these classes, we shall report the median rating over individual observations for each class separately in those cases in which the classes appeared to differ. For convenience, classes of teachers PEK, PFK, PIK, and PAK will be designated A, B, C, and D respectively, reflecting an ordering from highest to lowest teacher direction of student movement.

Following are brief descriptions of the four classes by checklist heading.

Classroom setting: Three of the classes, A, B, and C, displayed a balance of activity centers and desks or tables; one, D, was characterized predominantly by activity centers. Children were most often observed to work at circles or tables (median rating for the classes was 4.5, where 1 = never and 5 = constantly). In class D, some children were at activity centers and on the floor during every observation; this happened less often in the other classes (median of 2.7 and 3.0 for activity centers and floor, respectively, for the other three classes). The noise level was predominantly a "hum of conversation" (3.5), occasionally "noisy, children working" (median 3 in classes A, B, D; 1 in C), never "noisy and disruptive" (1.0).

In classes C and D, children seldom or never raised their hands for permission (1.5), whereas in classes A and B, children almost always did (4.8). Similarly, classes C and D involved somewhat more movement from student to student (3.0), activity to activity (3.0), and to the teacher for help (3.0), whereas classes A and B received median ratings of 1.5, 1.7, and 1.7 on these three categories, respectively. Children seldom "wandered looking for something to do" in any of the classes (1.6).

In all classes, teachers worked with the whole classroom to some extent (3.2), and with individual children (2.9). In class D, the teacher worked with subgroups of children almost constantly, while this occurred infrequently (1.5) in the other classes. The teachers never (1.0) assigned tasks in which children were not allowed to interact with each other. In classes A, B, and C, the teachers fairly often (4.0) assigned tasks for the whole group in which interaction and discussion were permitted. However, teacher C frequently worked with individuals during whole-class activities. In class D, this was seldom observed; rather there were almost always activities going on in subgroups. Subgrouping occurred rarely in the other classes (1.8). Individual activities occurred at a low frequency (2.1) across all classes. This is in marked contrast to the predominance of activities in subgroups observed during the pilot year in grade 1, 2, and mixed-grade classes.

Children were nearly always permitted to suggest additional or alternative answers (4.5) and encouraged to experiment with their own ideas (4.0). Interestingly, the least centralized class, D, showed the lowest level of such freedom and the highest level of rote learning and adherence to narrow topics. This may be related to observers' impression that this class consisted of children who tended to be behind other classes in their mastery of basic skills.

Material resources and reading activities: Resources and activities were markedly different for these four kindergarten classes than for the first- and second-grade classes in 1974-75. Workbooks were not observed in use in any class, and textbooks were in use during 10% of the observations. Other printed materials were in use in 74% of the cases, and visual aids in 74%. Concrete materials were also frequently used (68%).

Teacher D was highest in use at games (43%); teacher C used teacher-generated stories most frequently (38%).

As would be expected, reading activities in general were observed much less frequently than in first-grade classes. The most commonly observed activity was word meaning exercises (32%), followed by word attack skills (15%), comprehension exercises (16%), and oral reading (15%). Handwriting and copying activities (11%), silent reading (5%), and child-dictated experience stories (5%) were very infrequent. Writing and spelling activities were not observed. Teacher-generated stories (26%) and games (16%) were the most common sources of texts for reading.

No teacher references to PLATO were observed during the reading lessons and activities in these 19 observations of reading or reading readiness teaching.

Interactions with PLATO*: According to the data from this section, teachers A, B, and D were never observed to use the terminal to get information on children's work, and teacher C in only one case; and in no case to use such information either to change a child's PLATO assignment or to group for special PLATO-related instruction. Teachers did at times help children at terminals (2.0), walk by to observe them (2.0) or discipline them (median 1 for teachers A, B, C; 2 for D). They were never observed to use a child's turn at PLATO as a reward or punishment or to restrict use for educational reasons. In terms of scheduling, all classes had a schedule posted which the children were to follow. In three classes, A, B, and C, children were generally expected to leave their activities unfinished to go on PLATO when it was their turn (4.0).

*In addition to the full observation checklists, a few "abbreviated checklists" were completed which consisted of the "interactions with PLATO" section of the full checklist. Hence, in this section, the number of actual observations were 11, 11, 6, and 6, for classes A-D, respectively.

This occurred rarely in the least teacher-centered centralized class, D (2.0). In D, children were more frequently expected to finish their activities before taking their turn (3). Hence, it appears that PLATO scheduling was more strongly adhered to among these kindergarten classes than had been the case among the nine classes in the pilot year, in which only three of the nine maintained formal scheduling, but teacher involvement with PLATO was again low.

Neither PLATO progress charts nor PLATO-related off-line materials were noted in any of the observations.

Children seldom gathered around the terminals (1.6), doing so most frequently in room D. When children did interact at the terminals it was largely to relate in a social way (2.3), and rarely to help a child (1.3). In no instances were children observed to take over control or work together in a cooperative way. Negative interaction at the terminal was observed in only one case in room D. Headphones of course made any interaction difficult.

Mathematics Classroom Observations, 1974-75

The 11 mathematics classrooms involved in the pilot demonstration year 1974-75 also spanned a broad range of settings. Two members of ETS field staff observed in 10 of the classes during the year, visiting each of the classes from five to eight times. The remaining PLATO class PM5, in school VI, did not contain PLATO terminals during the pilot year, students being sent to teacher PL5's room, which contained 6 PLATO terminals, for mathematics instruction and for PLATO sessions. Two teachers, PA 4-6 and PB 4-6, taught mathematics to 60 children in a three-teacher mixed grade 4-6 "open classroom" suite and hence were identical in classroom-setting variables. This "triple classroom" differed from the others on most dimensions. As with the reading classes, the observations were recorded in both checklist and narrative form. Again, because of changes in the instrument during the year, the observers prepared a 'summary checklist' for each class that summarized their observations over the year. Each class was rated independently by both observers. Following is a description of the 10 classrooms based on these summary checklists.

Classroom Setting

Among the 10 classrooms there was a considerable range in the nature of the physical settings.

Physical Setting

Checklist categories	
Desks--rows and columns	2
Desks--informal arrangement	3
Balance of desks (tables) and activity centers	3
Activity centers predominate	2

The functional use of the space reflected the physical settings. Following is the mean estimated frequency of occurrence, again on a 1 to 5 scale where 1 = never, and 5 = constantly, of children working in various settings.

Where Children Work

Checklist categories	Median	Range
Activity centers	2	1-5
Student desks	5	1-5
Circle or table	3	1-5
On the floor	1.5	1-5

(1 = never, 2 = seldom, 3 = sometimes, 4 = often, 5 = constantly)

Children worked primarily at desks in nearly all classes, with the exception of the triple classroom, in which children were as likely to work at activity centers and on the floor as at desks.

The patterns of movement of children were related to the settings. In the triple classroom and the 5th grade "contract system" class of teacher PF5, pupils never raised their hands for permission to move and this degree of teacher control of movement was observed often only in the class of teacher PN6. All other classes were given a rating of 2. Movement from activity to activity and student to student (both median 3; range 2-5) was most frequent in the classes in which permission was not required, although the occurrence of children going to the teacher for help was frequent in all classes other than PN6 (median 4; range 2-5).

The predominant noise level for all but three classes was a "hum of conversation" In classes PH4, PF5, and PN6 the noise level was rated as being equally or more frequently "quiet [with] children working."

Material Resources and Math Activities

As with reading, in the pilot year, this section of the instrument achieved final form early in the development of the checklist, and the data here are drawn from the 30 observations which were recorded on the final version of the section, rather than on observers' summaries. Hence beginning-of-the-year activities are not represented.

The most frequently used resource across classes was printed materials other than textbooks and workbooks (usually teacher-made worksheets) which were in use by children in 53% of observations. Textbooks were used in 43% of observations, concrete materials in 27%, workbooks in 20%, and visual aids (usually blackboards) in 17%.

The types of mathematics activities most frequently observed involved drill and practice of operations and rules (60%). Less often observed was the introduction of rules followed by examples (37%); the eliciting from children of illustrations of concepts through drawing or manipulation of materials (33%); the introduction of rules by a "discovery" or inductive approach (23%). New concepts and principles, as opposed to rules, were introduced infrequently (10%).

The most commonly observed topics were: fractions (43%), whole numbers (40%), mathematics vocabulary (37%), estimation (23%), writing open sentences and equations (20%), and word problems (17%). The following topics were less frequently observed: decimals (10%), graphing (10%), and geometry (7%).

The math problems used were generally teacher-generated (47%) or drawn from textbooks or workbooks (30%). Problems were seldom child-generated (10%) or 'real-life' ones drawn from school or home environment (7%).

<u>Interactions with PLATO</u>: Mathematics teachers in general interacted to a low or moderate degree with PLATO, at least during school hours. Teachers sometimes walked by terminals to observe pupils' work (median 3; range 1-4) or helped pupils at the terminal. They also at times "went to terminals to get information from the system on pupil performance" (median 2.4; range 1-4). This information was sometimes used to group pupils for special PLATO-related instruction or remediation (median 2.5; range 1-4). It was rarely used during the observation period to change a pupil's assignment on PLATO (median 1.5; range 1-3). Teachers seldom found it necessary to discipline pupils at the terminal (median 2; range 2-3).

Unlike the situation in pilot-year reading classes, children in most mathematics classes expected to leave their activities unfinished when it was their turn on PLATO (median 4; range 2-5). Seven of the ten teachers (including both teachers in the triple classroom) posted a schedule which was not followed.

The only instances of teachers using a child's turn on PLATO as a reward or punishment or "restricting a child's PLATO use for educational reasons" occurred in the triple class, in which negotiation over activities rather than structured teacher direction was the norm.

PLATO-related interactions among children were as follows. Children fairly often gathered around children at terminals (median 3.5; range 2-4). The interactions among children at the terminals most frequently consisted of "socializing--interacting in a social way" (median 3.5; range 2-5). Less frequently observed were the following modes of interaction: "working in cooperative interaction with child at terminal" (median 2.5; range 2-4), "helping child at terminal with a problem" (median 2; range 2-4); "interacting in a negative way with child at the terminal" (median 1.5; range 1-2); and "taking over control" (median 1.5; range 1-2).

Four items included in the global ratings section of the checklist dealt with PLATO integration, encouragement of PLATO use, control of content, and PLATO disruptiveness. PLATO was judged a more isolated than integrated resource in half the classrooms, (median 2.7; range 2-4), classrooms with high total hours of PLATO usage also receiving higher integration ratings. A similar pattern was evidenced in teacher encouragement of PLATO use, which occurred at a high level except in the triple classroom, (median 4.5; range 2-5). Both of these items were generally rated higher in mathematics than in reading classrooms. However, as with the reading teacher, PLATO rather than the teacher was seen as responsible for PLATO content, (median 4.5; range 3-5). Finally, PLATO problems seldom were disruptive of other ongoing activities (median 2; range 1-3), although such disruptions were observed at times in all but one class.

Mathematics Classroom Observations, 1975-76

Observations were again conducted in classrooms during the final demonstration year. Between four and fifteen observations were conducted in each room with a mean of 8.2 per room (the classroom receiving fifteen observations was intended to be the object of a case study). The final version of the observation checklist, revised over the summer, was used throughout the year, with a checklist completed for each observation. Using the median rating for each item of all checklists completed for a class, a summary for each classroom was obtained. The summary ratings obtained in this way tended to be lower than the observers' summary judgments at the end of the 1974-75 year, so that cross-year comparisons should be made with caution.

One teacher who had been included in the 1974-75 checklist summaries left the program at the end of the year. This teacher had been included in the high-centralization group. Another teacher, who had been in the medium-centralization group, left her job midyear in the 1975-76 school year and was replaced by a teacher who also fell in the medium-centralization range. Both of these teachers are included in the summary.

Of the 99 observations, 41% included teacher-led math lessons, and an additional 46% included periods in which math activities were being done by children, but not accompanied by direct instruction from the teacher. In 13% of the observations neither math lessons nor math activities occurred during the observation period.

The average ratings of the nine classes which were being observed for the second year in 1975-76 generally showed a relative pattern of results similar to the 1974-75 summary data, although the real-time frequency ratings tended to be lower in value in 1975-76 than had the pilot year retrospective summaries.

Two teachers joined the program at the beginning of the 1975-76 year. A third teacher, whose class had received PLATO lessons and mathematics instruction with another teacher in 1974-75, received terminals and was also included in the 1975-76 observations. In the triple classroom, only the 4th grade children and their mathematics teachers were observed, 5th and 6th graders from this group being reserved for CERL formative evaluation. Hence there was a total of twelve classes observed in the final year, with nine of the teachers having also been observed the previous year.

The three new classes, however, tended to be markedly different in almost all areas. Following is a description, organized by checklist sections, of how these classes were rated in relation to the others. The last section dealing with teacher and child interactions with PLATO is summarized in greater detail than others, since it contains important information as to how PLATO was implemented in the final demonstration year. In addition, new items developed to give more detail concerning PLATO integration in 1975-76 are discussed.

Classroom setting: The three new classes consisted of two classrooms with an informal arrangement of desks and one with rows and columns of desks. Students were almost always observed working at desks, seldom at activity centers, circles or tables, or on the floor. The noise level was less frequently a "hum of conversation," and more frequently quiet, than any of the second-year groups.

Children more often raised their hands for permission to move, and there was less movement in general than in the second-year groups. It appears that in new and 2nd-year rooms, children went to the teacher for help with about equal frequency.

	New Median	New Range	2nd year Median	2nd year Range
Children				
raise hand for permission	2	2-3	1	1-2
move from activity to activity	1	1	2.5	1-5
go to teacher for help	3	2-4	3	2-4

Classroom organization: As in '74-75, the classrooms varied widely in the extent to which they used whole-group instruction. The newly entering teachers showed a comparable range of working with individuals, but none used subgroups, while small group instruction was a feature of all but two of the nine 2nd-year classes.

	New Median	New Range	2nd year Median	2nd year Range
Teacher works with				
whole classroom	2	1-5	1.5	1-5
subgroups	1	1	3	1-5
single pupils	3	2-4	3	2-4

The new classes were also characterized by tighter control on the part of the teacher.

	New Median	New Range	2nd year Median	2nd year Range
Teacher directs children to activities	5	4-5	2	2-4
Children direct themselves	1	1-2	3.5	2-4

Material resources and math activities: This section will be described in somewhat greater detail as it provides information supplementary to that of the Math Coverage Questionnaire regarding what sort of exposure to mathematics children had independently of PLATO during the final demonstration year.

The three new classes did appear to use concrete materials relatively less frequently than the others. They also were less frequently observed to cover such topics as geometry, graphing, and estimation, and were more often observed working on whole number operations. It appears that CERL's attempts to recruit additional lower-SES students enriched the PLATO sample with classes which differed in focus as well as in organization from those of the pilot year.

In terms of topics covered, there was extremely wide variation from class to class, because of small sample size and the great variation in topics within a class over time. Hence it is difficult to draw conclusions about coverage in a particular class.

The data will, therefore, be presented by grade rather than by class. The seventeen observations drawn from mixed-grade classes will not be included here except in the discussion of instructional methods.

The first set of items pertained to the materials being used in the classroom. The table below presents the percentage of observations in which particular materials were in use.

	Grade 4	5	6
No. of observations	23	32	27
Checklist categories			
textbooks	61%	50%	44%
workbooks	22	19	11
other printed materials	74	78	56
visual aids	61	62	44
concrete materials	30	16	15

Printed materials (usually teacher-made worksheets), other than workbooks and textbooks, were the most commonly used resource in all classes. The fourth-grade classes used concrete materials much more often than the other grades. At all grades, practicing of operations was the most frequently observed task (88% in grade 6, to 100% in grade 4 and mixed-grade classes).

The mixed-grade classes did not seem markedly different from the average fifth grade. The most frequently observed topics being covered during the observation periods were:

whole numbers, fractions, math vocabulary, and decimals.

	4	5	6
Math topics	19	31	24
No. of observations			
Checklist categories			
Whole numbers	79%	81%	62%
Fractions	58	64	67
Math vocabulary	47	61	38
Decimals	16	19	67
Estimation	32	32	21
Word problems	26	29	12
Measurement	26	19	0
Graphing	21	6	8
Geometry	5	10	4
Open sentences, equations	10	9	4

The fifth grades had highest coverage of math vocabulary and geometry, and the sixth grades had the highest coverage of decimals. Surprisingly, the fourth grades had a higher coverage of graphing and measurement than other grades.

The sources of math problems were most often textbooks and workbooks, or were teacher-generated.

	4	5	6
Source of problems			
No. of observations	19	31	24
Checklist categories			
Textbook/workbook	63%	71%	50%
Teacher-generated	63	64	75
Child-generated	16	3	0
Real-life based on school or home environment	16	23	25

A final item in this section related to references to PLATO during the period in which math was being worked on. Of the 87 observations in which the math period was included, PLATO or activities based on PLATO materials were referred to in 16 observations. These 16 represented 42% of the 4th-grade observations, 10% or the 5th-grade observations and 12% of the 6th-grade observations.

<u>Interactions with PLATO</u>: Only one pair of items showed any apparent difference between the three new classes and the second-year groups. These were again related to the more strongly teacher controlled and scheduled nature of these rooms.

	New		2nd year	
	Median	Range	Median	Range
P's expected to leave activities unfinished when it's their turn on PLATO	4	4-5	3	2-4
P's expected to finish activities before taking turn on PLATO	1	1-2	2	1-2

In the new group, PLATO scheduling was slightly more strictly adhered to, taking precedence over other activities.

There was generally a low degree of interaction of teachers with the terminals.

	New		2nd year	
	Median	Range	Median	Range
Teacher walks by terminal to observe p's work	2	1-2	2	1-2
Teacher helps p's at terminal	1	1-2	2	1-3
Teacher disciplines p's at the terminal	1	1-2	2	1-2

With regard to teachers obtaining and using information from the terminals, observers rated this as occurring "never" during a majority of observations in all classes. Following are the percentage of observations in which such behavior did occur.

Teacher goes to terminal to to get information from system on pupils performance	8%
Teacher uses feedback from system to change p's assignment on PLATO	13%
Teacher uses feedback from system to group p's for special PLATO-related instruction or remediation	11%

Only teachers PH4, PL5, PM5, and PJ6 were observed to interact with the terminal or use PLATO-derived data on more than one observation occasion. In this final year it was as frequently observed that the teachers used information from the system to change children's assignment on PLATO, as to group them for PLATO-related instruction or remediation in contrast to the behavior observed in the pilot year. This probably reflects the increased number of teacher options for controlling children's PLATO assignments in the demonstration year.

It was almost never observed that teachers used children's turns on PLATO as a reward or punishment (3 instances in 99 observations), and only one instance was observed of teachers restricting PLATO use for educational reasons.

Children occasionally gathered around the terminals in all classes (median 2; range 2-3). The content of interactions at the terminal was largely socializing, as had been the case in 1974-75.

	New		2nd year	
	Median	Range	Median	Range
Mode of interaction at terminal:				
Socializing	4	2-4	3	2-4
Working cooperatively	1	1-2	1	1-3
Helping	2	1-2	2	1-3
Interfering	1	1-2	1	1-3
Controlling	1	1	1	1

Five items relevant to PLATO integration were included in the "global ratings" section of the checklist. These indicate the observers' general impressions of the classroom, rather than ratings of specific behaviors.

	New		2nd year	
	Median	Range	Median	Range
PLATO used as an integrated resource, rather than isolated resource	2	2	2	1-4
PLATO seen as responsible for PLATO content, rather than the teacher	5	4-5	3.5	2-5
Teacher was encouraging of PLATO use	4	4	4	2-5
Teacher was enthusiastic about PLATO	3	3	3	2-5
PLATO problems disrupted other activities	1	1-2	1	1-3

The triple class seemed to have the least teacher interest in and integration of PLATO. Otherwise teachers were generally very supportive of PLATO use and moderately to highly enthusiastic about PLATO. The teachers of the three new classes were judged as seeing themselves least responsible for PLATO content; this could in part be a result of less familiarity with the system. It appeared that the classes in the middle range of teacher-direction had the highest degree of interest in, and integration of, PLATO.

PLATO integration: Additional items devoted to other indications of PLATO integration within the classroom was added to the checklist early in the demonstration year. A total of 80 of these sections were completed. Following is a summary of these data.

Transfer between PLATO and classroom: Instances of teachers making specific efforts to relate PLATO content to their teaching were observed infrequently in the 80 observations. There were 4 instances of teachers reminding children of a PLATO lesson model or explanation to assist in their understanding some aspect of classwork. Since only 41% of the observations included actual teacher-led math lessons, and an additional 46% included math activities without direct instruction by the teacher, these 4 instances represent a higher proportion of the actual math lessons observed (12%). There were 3 other instances of teachers reminding children of a PLATO lesson technique, algorithm or procedure to help them understand class work. In 2 instances teachers provided explanations or exercises designed to help children understand a PLATO lesson. More frequently, in 17 of the 80 observations, teachers used PLATO-related supplementary materials provided by CERL. In three cases teachers used PLATO-related supplementary materials which they had prepared themselves.

Discussions about PLATO: Teachers very rarely led class discussions about PLATO, this occurring in only 3 of the 80 observations. In 4 cases, teachers did talk with individual children about one or more aspects of PLATO content or procedures.

Students occasionally talked among themselves about PLATO. In 8 cases groups of students (not at PLATO) were observed talking about PLATO content i.. 4 cases students talked about PLATO procedures, and in one case there was talk about PLATO hardware.

In 33 of the 80 observations teachers made unsolicited favorable comments to the observer or to others in the class relating to children's learning from PLATO; only 3 negative comments were noted. Children, similarly, were recorded as making positive comments about learning from PLATO in 26 instances, negative comments in 2 instances.

Children commented positively in 42 observations about PLATO as enjoyable or fun. In 9 cases they commented on PLATO as boring or frustrating. Teachers made remarks about PLATO being enjoyable or fun in 14 instances, and about it being boring or frustrating in 4 instances.

Positive comments about the system, terminal, or touch panel reliability were made in 13 cases by teachers and 5 cases by children. Negative comments related to performance were noted 9 times for teachers and 5 times for children.

In 5 instances teachers specifically praised a child for good work on PLATO.

Time on PLATO: Children quite often spent time at the terminals outside of school hours. In 49 of the 80 observations children came in before or after school to work on PLATO (This information was obtained from the teacher rather than specifically observed.) In 23 instances children worked on PLATO during recess, in 26 instances during their lunch hour.

Of the 49 observations in which children were observed to "hang around" the terminals, boys and girls were about evenly represented in 39 cases, boys predominating in 9 cases, and girls predominating in 1 case. Of the 10 observations in which children were taking extra time at the terminal, beyond their allotted half hour, boys and girls were evenly represented in 8 cases, and mostly boys were observed in two cases.

Presence of CERL staff: CERL staff members were present in the classroom in 13 of the 80 observations, performing such functions as helping with equipment, observing, and talking to the teacher about PLATO topics or other issues in mathematics instruction.

The PLATO terminals were a salient presence in the classrooms, which, in addition, was accompanied by the training and maintenance activities of CERL and the evaluative activities of ETS. While the terminals and the associated activities did occasionally become dominant in some classrooms, the option to shut the terminals off was there, and teachers did so when disruption threatened or highly valued activities were impeded. On the whole, the utilization of terminals was consonant with the prevailing classroom pattern of the use of instructional resources, as the classroom case studies illustrate.

The question of the absolute amount of intrusion into or modification of classroom process which is considered disruptive or beneficial is of course a matter of individual judgment and varies from teacher to teacher. One PLATO-derived interruption per hour may be minor to some teachers and intolerable to others.

The ultimate meaning of these observed events in the classroom ecology resides in the teachers' perceptions of their importance; these have been covered in the section summarizing the teacher interviews.

5.4 Student Interaction with the Terminal

Information about the children's responses to PLATO and the nature of their interactions with the terminal, was available from several sources: the teachers, the CERL staff, and the students themselves. The most systematic and least obstructed view of the student at the terminal came from an observation procedure specifically designed to record student-terminal interactions.

Observations of children working at the terminals were conducted routinely in conjunction with the classroom observations. Generally, after completing the global classroom observations, the observers would move to the terminal area, select one child, and observe until the end of the child's session, at which point another child would be observed for the duration of a session. Usually several such individual observations were conducted after a global classroom observation.

The observations were recorded in two parts. A checklist[1] designed to document student interactions in a quantifiable form was filled out during the course of the observation. The observers also added a narrative summary on the back of the checklist, which was usually completed after the actual observation, based on notes taken during the observation period.[2] The checklist, by necessity, focussed on observable behavior and did not attempt to provide a close description of the students' progress through a particular lesson or the thinking processes attendant on it. Even so, several of the categories are highly inferential, particularly so with the younger students, whose behavior was more difficult to interpret.

[1]See Volume II for observation instrument.

[2]All the student-terminal observations were carried out by the two observers who did the global classroom observations. On seven sets of paired observations, observers agreed on 98.1% of items (25.9% agree present, 72.2% agree absent, 1.9% disagree).

Another caution that should be noted is that the observers' attempt to be unobtrusive was less successful in the case of the student-terminal interactions than in the global observations. In order to see the student work at the terminal, the observer had to be in close proximity, and thus possibly influence the observed interactions. Some aspects of the student-terminal interface were unlikely to be affected, such as system functions, but other aspects, such as help-seeking, were probably influenced by the presence of the observers. The results of the observation are then presented as suggestive rather than as fully descriptive of the students' experiences with the system and the programs it delivered.

The data presented here are from observations in the 1975-76 schoolyear, the final demonstration year. Although children were observed at terminals during the 1974-75 year, the observations were used to pilot and refine the instrument, which went through several revisions.

The summaries are based on the number of <u>lessons</u>, rather than the number of <u>students</u>. That is, each observation of a child's session at the terminal included several lessons (3-4 on the average, ranging from one to six) which were independently rated on the checklist. Given the variety of system features used from lesson to lesson, it was decided to use the lessons as the primary unit of observation rather than average the several lessons that made up a session. To guard against the possibility of bias that this mode of analysis might introduce (e.g., the more interested or able children might have completed more lessons in a session and hence would be disproportionately represented), a summary by the first lesson in each observation and a summary by all lessons were compared, for both the reading and math groups. No significant difference was found in the general pattern of results.

A total of 417 lessons was observed in kindergarten, 166 in first grade. This represented 125 observations of individual children's sessions on PLATO in kindergarten and 45 in first grade. Hence there was an average of 3.4 lessons observed per child's sessions for the primary grades. For grades 4, 5, and 6, respectively, 225,302, and 234 lessons were observed. This represents about 4.3 lessons on the average per child's session in these grades. This sample represents roughly 1% of all sessions in the 1975-76 year.

The checklist covered six broad aspects of student interaction with the terminal:

A. Facility with Terminal Devices
B. Lesson Procedures and Content
C. Attentional and Affective Responses
D. Requests for Help
E. Interaction among Students

The following account is based on information from both the structured observations and narrative records. The checklist categories are used as primary organizers, and additional observations are drawn from the narratives. The reading and math programs are discussed together, in order for us to highlight the similarities and contrasts between the two age groups.

Facility with Terminal Devices

The first section on the checklist dealt with the extent to which children mastered the mechanics of the PLATO terminal and the extent to which the system functioned smoothly. The students' facility with the four major terminal devices, (a) the keyboard, (b) the audio unit, (c) the microfiche, and (d) the touch panel, are reported separately, followed by data on (e) hardware and system problems, (f) student reactions to such problems, and (g) portion of each lesson received.

1. Student facility with keyboard: The keyboard closely resembled that of a standard typewriter, with several extra keys for particular

commands such as NEXT, BACK, EDIT, etc. Only a few of these keys, primarily NEXT, were used in the elementary programs. The keyboard was the main communication link to the terminal, and as can be seen from the table below, almost all the lessons required its use.

Percent of lessons involving keyboard

	Grade				
	K	1	4	5	6
Total number lessons observed	417	166	225	302	234
Percent of total lessons involving keyboard	89	83	99	98	97

In almost all cases, students used the keyboard effectively enough to get through lessons. As the table below shows, in only 2% of the lessons observed in which the keyboard was used were the younger students using the reading programs unable to get through a lesson because of insufficient skill in handling the keyboard. None of the older students working with math lessons had this degree of difficulty.

Student facility with keyboard

	Grade				
	K	1	4	5	6
	Percentage of lessons involving keyboard in each category				
Observation categories:					
indiscriminate typing not connected with lesson	1	3	0	1	0
insufficient skill to get through lesson	2	2	0	0	0
makes mistakes but can get through lesson	5	6	4	1	0
slow, but correct	36	31	21	18	26
fast and correct	57	60	75	80	74

In all grades, the majority of children were judged to be fast and accurate in their use of the keyboard, but a substantial minority in each grade was judged slow, but correct. Children made mistakes on the keyboard in very few lessons--5-6% in reading, and 0-4% in math.

Occasionally, in 1-3% of lessons in the primary grades, a child was observed to type randomly. The observers attributed this at times to boredom or frustration but at other times found no discerneble reason.

2. Student facility with audio unit: The audio unit was used in the primary grades only. The unit consisted of a record play and headphones. The unit played flexible plastic discs, which had to be located and placed on the player by the child. The checklist focused specifically on the child's facility in handling this disc-changing procedure. changes were found to be required with about half of the lessons, for both K and first grade (51% and 54% of total lessons, respectively):

Student facility with audio device

	Percentage of lessons requiring disc changes in each category	
Observation categories:	K	1
Attends to visual message (directing child to get particular disc)	100	95
Little or no trouble finding proper disc	96	96
Little or no trouble putting on or taking off disc	95	85

The kindergarteners' apparently greater facility with the disc change may be due to the fact that they were the first to receive the improved, second-generation audio devices.

In only 4% of lessons did children have difficulty finding the proper disc, while 5-15% had difficulty placing it in the record holder. There were considerable mechanical problems during the fall with the audio. The logs of one of the CERL staff members indicated that she had spent a considerable portion of her time in the fall going from class to class to deal with breakdowns of the audio device. Problems continued to be mentioned in the observation narratives throughout the spring. Commonly mentioned problems were placing the wrong disc on the unit, placing a disc upside down, or not engaging the record in the holder.

The narratives indicated that the children did not seem much bothered by such problems in general. There were occasional instances of a child's working through an entire lesson with the wrong disc, hence receiving totally inappropriate audio inputs. As these instances were only discovered when an extra set of earphones was available for the observers to listen in with, we cannot estimate how often this occurred. With many lessons, the audio was superfluous if the child could read the display on the screen. Nevertheless, this must have been confusing and possibly harmful for a child just learning to read.

The observers also recorded the time taken up with the disc change, starting from the appearance of the disc message which instructed the child to put a new disc on the audio. These were tabulated in ranges. The median time range, in both K and 1st grade, was 21-30 seconds. In 9% of the K lessons and 19% of the first grade lessons, the disc change took longer than 100 seconds, or more than one-ninth of the total lesson time of 15 minutes. As disc changes were required in about half of the lessons, occasionally a fair percentage of lesson time was spent changing discs.

3. <u>Student facility with microfiche</u>: The microfiche was very seldom used. The device consisted of a holder at the top of the terminal that had to be pulled out and opened to have the fiche inserted, then pushed in

again. The fiche itself was a small plastic card. Teachers' comments in interviews and logs indicated that this device was very difficult for the children to handle.

The microfiche was used in only 28 of the total of 583 K and 1st-grade lessons observed and in none of the math lessons. Of these 28 times, the children were observed to have difficulty inserting them in 8 lessons (29%).

Percent of lessons involving panel

	Grade				
	K	1	4	5	6
% of total lessons involving touch panel	83	87	25	18	21

Student facility with touch panel

	Percent of lessons involving touch panel in each category				
always touches it in correct fashion	80	85	91	88	96
touches it accidentally at times	10	4	5	5	4
touches it indiscriminately at times	10	10	4	7	0

The younger children were observed to touch the panel indiscriminately fairly often (in 10% of the lessons). No sixth grader was observed to do this, but a few 4th and 5th graders were. Following is an example from the narratives of this kind of occurrence:

> J. worked through the lessons but either didn't understand or didn't care how he did because he tapped through them willy-nilly.

The kindergarten children also were observed to touch the panel accidentally in 10% of lessons.

> L. studies the pictures and takes a long time to read the story. Her hand sometimes gets in the wrong place and she gets a word rather than a sentence read aloud on the audio.

4. Hardware and system problems: Observers recorded the frequency of system and hardware failures. "System" here refers to the curriculum materials or courseware, software, and computing processes, and "hardware" to the terminal, communication lines, and associated devices. At times it was difficult to distinguish system from hardware failures; in such cases the observers noted their best guess.

Equipment Failure

	Grade				
	K	1	4	5	6
	Percent of lessons in which each category occurred				
System failure	3	4	2	1	0
Hardware failure	21	14	2	5	3
Total system and hardware failures	24	18	4	6	3

System failures were relatively rare (0-4% of lessons across grades). Some common types of system malfunctions observed were:

- blank screen, no response to key press
- inappropriate pictures
- inappropriate text
- random signals on screen
- premature lesson termination

More frequently, especially in the reading lessons, the children encountered hardware problems. At the primary grades, about 85% of the problems experienced consisted of hardware failures. Some of the kinds of hardware failures noted by the observers included:

- touch panel doesn't respond to touch
- audio keeps repeating message "Typing does not work,"

- microfiche doesn't access properly, screen goes blank
- faint extra audio track in the background interfering with message
- audio is inaudible.
- child taps right answer on touch panel but gets message he's wrong.

For the math classes, the combined frequency of hardware and system problems was low--3 to 6% of lessons. However, for the reading lessons there were difficulties of either a system or hardware nature in about a fifth of the lessons. Usually, the difficulties were massed, appearing in several lessons within a child's session, so in general the children were likely to go through some sessions without difficulty and then encounter several problems in one session.

5. Reactions to hardware and system problems: Children's reactions to hardware and system malfunctions varied. Following is a distribution of the types of responses observed: (It should be noted that multiple responses by a child could be displayed during a single incident.)

Number of malfunctions and reaction types observed

	Grade				
	K	1	4	5	6
Number of reactions noted	122	37	18	29	11
Number of system and hardware failures noted	101	31	10	19	8

Student reaction to machine or system failure

	Percent of mechanical failures in which particular reaction occurred				
Observation categories:					
tries various keys	8	10	50	53	50
tries touch panel	14	26	20	5	12
asks for help	13	6	40	37	12
signs of upset	10	26	10	16	12
reacts calmly	76	52	60	42	50

Combining K and 1, the children responded with exploring the keyboard or touch panel in about 25% of the cases. In grades 4-5-6, such exploratory behavior occurred in about 60% of the cases. This may be an indication that the older children took a more active approach to dealing with mechanical problems, but it may also be that the nature of difficulty was different. For instance, the narratives indicate that many of the technical difficulties in the reading lessons involved the audio--which the upper grades did not use--and the audio was constructed in such a way that there was little a child could do if it was not functioning well, whereas the keyboard and touch panel could sometimes be "un-stuck" by random pressing.

For K and 1 combined, and also for grades 4-6, the children reacted with some degree of upset in 14% of the lessons in which mechanical problems were observed. A calm reaction was observed more frequently (70%) in grades K-1 than in grades 4-6 (49%). However, the calm-reaction category did not differentiate between disinterest, confusion, or tolerance. Following are some descriptions from the narratives of children's reactions to problems:

Grade	
K	Becky worked through these lessons easily. The discs were overriding on talk and confusing. Becky did her best and didn't appear to be bothered.
1	D. would get to a lesson and the audio would be off as well as the terminal (would not accept touches). He did not get angry or upset, just touched everything, and then asked for help.
K	S. had a temper tantrum as a result of the audio not working. He shouted, kicked, threw things, disturbed the whole room. (He has done this in other contexts than PLATO.)
K	Danny doesn't seem to mind that he has the wrong fiche. The fiche is not very clear anyway. There is a mistake in the record, and when a line is pressed the audio said "chased," which wasn't even a word in the sentence. When I asked him if he liked the story, he said "yes."

6 T. worked through his lessons quickly and confidently. When there was a system problem of overwriting on the panel, he calmly pushed the error button and cleared the screen.

6 S. was more than half way through his second lesson when the terminal "froze." He shifted out, then had to begin all over again. He seemed disgusted to have to do all of it again, said "I hate this."

In the primary grades combined, children asked for help in about 11% of the instances of mechanical failure; in the upper grades this occurred 32% of the time. There are several possible reasons for the lower frequency of help-asking in the lower grades. The younger children may have been less aware that a problem was occurring, or more likely to accept it passively or give up.

The low incidence of seeking help on the part of the younger children, combined with the greater failure rate of the reading lesson hardware, may well have resulted in a greater number of unproductive, or even confusing, interactions with the terminal for these children. The older students benefited not only from a more active posture toward the terminal, and a consequently greater facility in solving problems, but also (as reported in the narratives) from more joint troubleshooting and support that did the younger children.

6. Portion of lesson received: One type of system error caused students to be "bumped" out of lessons before they had finished. The following observational categories were designed to provide an indication of how frequently lessons were prematurely terminated:

	Grade K	1	4	5	6
	Percentage of lessons in each category				
Portion of lesson received by child					
none at all	2	8	4	3	2
part	5	9	8	11	6
full lesson	92	82	88	86	92

During the year, the math students learned to remove themselves voluntarily from lessons by pressing certain keys, and some of them used this option extensively to get out of lessons they didn't like. So the greater percentage of incomplete lessons, in comparison with the primary grades, may have been due to these voluntary terminations. For the primary grades, 82-92% of the lessons were completed.

Lesson Procedures and Content

The observers also tried to assess the degree of the children's understanding of PLATO procedures and content and the way in which children interacted with the system. The section includes four sets of items relating to (a) procedures, (b) lesson content, (c) lesson difficulty, and (d) mode of student interactions with the terminal.

The observers found that when a child was having difficulty proceeding through a lesson, it was not always clear whether the difficulty lay in a lack of understanding of the lesson content, or a confusion as to what to do next procedurally, or some other factor. Also, the cues that might indicate the nature of the problem were hard to prespecify. Hence, the ratings in this section are based on the observers' impressions rather than on specific behavioral indicators.

1. Student's understanding of directions: The first set of

items concerned directions or procedures.

Understanding of directions

Observation categories:	K	1	4	5	6
	Grade				
	Percent of lessons in each category				
does not understand--cannot proceed	2	3	3	0	0
has some understanding--makes mistakes	14	8	11	6	2
understands--few or no mistakes	84	89	86	93	98

As would be expected, understanding of procedures increased with age. Although the vast majority of children had few or no problems with the directions, the reading group and 4th-grade math group had a substantial number of lessons (8-14%) in which children did make mistakes because of lack of understanding, and, in 2-3% of lessons at these grades, the difficulty was so severe that the child could not proceed with the lesson.

2. Student's understanding of content: A second set of similar items involved understanding of the curricular content of the lessons:

Understanding of content

Observation categories:	K	1	4	5	6
	Grade				
	Percent of lessons in each category				
does not understand--cannot proceed	3	5	5	1	2
some understanding--can muddle through	15	11	14	16	11
understands--few or no mistakes	82	84	81	83	87

Here again, understanding increased with age, although the range is much narrower and begins at a lower percentage than with understanding of directions (e.g., grades 4-6 here range from 81-87% while, in the previous set, the range was 86-98%). At all grade levels there were a number of lessons (11-16%) in which children experienced difficulty in understanding the content. In 1-5% of lessons, children were unable to proceed due to lack of understanding.

3. Difficulty of lessons: A third set of items related to difficulty level in general.

Overall difficulty of lesson for student

	Grade				
	K	1	4	5	6
	Percent of lessons in each category				
Observation categories:					
too easy	10	22	4	1	3
about right	83	69	86	97	90.5
too hard	7	9	10	2	6.5

In all grades except first, at least 80% of the lessons seemed to be about the right level of difficulty for the child being observed. Typical narratives were:

> D. worked slowly but correctly through the lessons.

> C. did all the lessons quickly and well. She appeared to enjoy herself.

> S. worked quietly and confidently. She appeared to enjoy Happy--sad a lot.

In first grade, a high percentage, 22%, of the lessons appeared too easy for the child. In addition, because of the limited amount of appropriate materials, children received the same lessons repeatedly. This was corroborated by teachers in interviews and also evidenced in the narratives.

> M. Went through these rapidly. He can read already and this was no challenge.

F. worked through these in a confident manner, obviously bored. This child can read fluently already.

D. already knows how to read, and doesn't want to go through the lesson Phonics practice. He leaves his ear phones off and just randomly hits the screen to get through.

In 10% of the lessons at both 4th and 6th grade the content was judged too difficult for the child. At 5th grade most of the material, 97%, was judged appropriate (it should be noted that the math curriculum was designed primarily for the 5th-grade level). At the 6th grade, 10% of the lessons seemed too difficult, while at the 5th grade only 2% fell in this category.

In summary, PLATO lessons were judged appropriate to students' understanding in the majority of lessons. In only a small percentage of cases (1-5%) were children sufficiently confused by directions or content that they could not proceed through the lesson. In the reading classes, especially in first grade, a fair percentage of lessons seemed too easy for the child; this was not a problem in the math classes.

4. Mode of student interaction: The final set of items in this section attempts a stylistic categorization of the students' responses at the terminal:

Types of response

	Grade K	1	4	5	6
	Percentage of lessons in which each category was observed				
Observation categories:*					
Impulsive--makes a response before looking or thinking	13	10	10	5	2
hesitant--waits more than average before responding	7	5	15	11	7
slow but confident	33	27	27	31	30
fast and accurate	54	55	62	58	61
tries to beat system	1	4	0	3	1

*more than one could occur in a given lesson

The primary grades were higher in frequency of impulsiveness and lower in hesitancy than grades 4-6, as might be expected of younger children. The primary grades also made fewer "fast and accurate" responses. In general, the "fast and accurate" responses were the most frequently observed ones across ages (in 54-61% of the lessons).

About a third of all the ratings fell into the "slow but confident" category. Examples from the narratives include the following:

> K Jane didn't do well on the lessons learning the new words "you," "and," and "run." She thought she knew the words and looked puzzled when the audio said she was wrong. But she remained confident, and repeated the lessons, working slowly.

> K Eddie didn't do very well on the last three lessons but stayed relaxed and confident. He would just "poke away" until he got something done right.

> 6 Joel was a very methodical child. He read slowly and did slowly everything the computer said to do. He did it well and with confidence.

The response type "tries to beat system" was included, as during the pilot year the observers and some teachers had noticed that children occasionally tried to outwit the PLATO system. Lesson and router changes were instituted to prevent this, and seemed to be successful. Still, during the demonstration year, this kind of behavior did occur with low frequency, 0-4%, across grades. Examples of this behavior from the narratives include the following:

> 1 T. presses both the "yes" and "no" responses when asked if sound matches letter on screen. Most of the time it works and she is rewarded by the audio saying "right."

> 6 J. and others in L's room have a system for getting extra time. After he went through Horse race (about 7 minutes), he pushed STOP on the page that says "Wait," then pressed STOP again, signed in, and it was as though he had not had the 7 minutes at all. He had 21 minutes of Horse race, but only 7 registered in his record.

Attentional and Affective Reactions

The observers also attempted to assess the child's attitude and degree of involvement in working with PLATO. This section includes ratings of (a) the child's attentiveness to the terminal, (b) apparent affective reaction, and (c) kinds of verbalization.

1. Attention to PLATO: The first set of items dealt with degree of attention to the PLATO terminal. Generally, involvement was very high in all grades.

Student's attention to PLATO

	Grade				
	K	1	4	5	6
	Percentage of lessons in each category				
Observation categories:					
pays little or no attention	0	4	0	1	0
pays some attention	11	14	6	3	10
pays all attention	89	82	93	96	90

Evidencing the same pattern as the items on lesson appropriateness, 5th grade children were most attentive to the curriculum among the math grades, and kindergarten children were more attentive than the first grade children. That is, those grades for whom the curriculum seemed most appropriate in terms of difficulty were also the grades which displayed greatest attentiveness. The older children were in general somewhat more attentive than the younger.

2. Children's affective reactions: Another set of items related to children's apparent feelings.

Student's attention while on PLATO

Observation categories:	K	1	4	5	6
	Grade				
	Percent of lessons in which reaction was observed				
tense-nervous	2	-	1	1	0
relaxed	94	87	93	95	95
happy-excited	11	11	6	6	4
frustrated	8	5	8	10	4
angry	3	0	1	1	4
bored	4	14	4	1	3
confident	88	75	86	79	86
discouraged	3	2	7	5	6

If we keep in mind the high inference level of this set of categories, it is notable that in the majority of instances the children appeared relaxed and confident at the terminal.

The first grade children evinced a "bored" reaction much more (in 14% of lessons) than in any other grade. This is congruent with the observation that 22% of the reading lessons appeared too easy for first grade. Following are illustrations of a happy-excited and discouraged response while on PLATO:

K B. enjoys the up and down animation in Up and Down. He laughs as he watches, and talks to himself. When he makes sentences, he says them aloud, "The girl is sad, the boy is happy," smiling. He is excited when the bridge is out for the dog and cat in the next lesson.

4 T. appears to be a slow child. She goes through the lessons, giving up when she doesn't understand the concept. She doesn't ask for help--just shifts out of half the lessons.

Interestingly, in the math program, the 5th graders were judged more frequently "frustrated" than in the other grades. As the 5th grade also displayed a higher degree of attentiveness to the lessons, it might be that they had a generally higher level of involvement in the program, and were thus more liable to become frustrated when problems arose.

By far the most common attitude displayed while on PLATO in all grades was a 'relaxed' (87-95%), confident (75-88%) one. At the primary grades, happy-excited reactions occurred more frequently than any of the negative reactions.

3. Verbalization: Observers also noted the extent, type, and affective tone of verbalizations of children at the terminals.

Student verbalizations

	Grade K	1	4	5	6
	Percent of lessons in which each category was observed				
Observation categories:*					
to self	13	18	29	17	8
to PLATO	7	2	3	4	0
to other children	7	5	27	31	23
to adult	25	22	16	8	6
no verbalization observed	59	60	47	54	62

*more than one category may have been observed in a given lesson

There are striking differences between the patterns of results for the reading and the math group. The older children talked much more (23-31%) to other children than did the younger (5-7%), while the younger children talked more to adults (22-25%) than the older (6-16%). The adults consisted of the teacher, aide, or the ETS observer. The observers also noted that in most classes the primary-grade children were not allowed to talk to other children while on the terminal and were encouraged to seek help from the teacher or aide. Also, the headphones inhibited casual interaction with other children.

In the math grades, the 4th graders tended much more to talk to themselves and to adults than other grades; all in all they verbalized substantially more than other grades. The sixth grade, on the other hand, verbalized substantially less than all other grades, although students in one School V classroom did not follow this pattern, verbalization being noted in 59% of lessons.

Affective tone verbalizations

	Grade K	1	4	5	6
	Percent of verbalizations rated in each category				
negative	22	26	16	16	27
neutral	46	63	63	53	44
positive	32	11	20	31	30

Kindergarten children tended to have fewer neutral verbalizations, and also were more positive, than first graders, while having overall the same frequency of verbalization as indicated in the previous table. The 4th graders, on the other hand, had a higher percentage of neutral responses and displayed less positiveness than 5th or 6th graders. The 6th graders, while making the fewest verbalizations (as indicated in the previous table), displayed a less neutral tone than 4th or 5th graders, and tended to be more negative in tone than the lower grades.

If we look at the affective tone within types of verbalization, there is no particular pattern within the categories of "verbalizing to self" and "verbalizing to PLATO." For the category, "verbalizing to other children," the verbalizations are more frequently positive than negative in each grade, while for the category, "verbalizing to adults," the opposite is true for 4 out of 5 grades.

Tone by target of verbalization

	Grade K	1	4	5	6
	Percent of lessons in which category occurred				
Verbalizing to other children					
negative	1	0	3	3	3
neutral	3	4	19	16	11
positive	3	1	5	9	9
Verbalizing to adults					
negative	7	5	2	2	2
neutral	10	11	8	4	2
positive	6	2	5	1	1

Following are some examples of verbalization from the narratives which indicate the typical tone and content of children's remarks.

K P. gets excited over the animation, "Look at those boots walking. Ohhhh. The birds are flying."

K D. didn't like the phonics lesson, and said, "I'm tired of this. This is boring. I can't find the words."

K H. says, "I'll race the turtle." She spells her name out loud as she types it. Then, "I beat the turtle!" She lost the second time and got angry, "I'm gonna beat that turtle." Later she tells L., "Ha Ha, I got 19 before you did--Look, I got a big list!"

4 M. says, "Oh, you got Make a Monster Lucky you." K. says, "Yeah". M. wants a game slot after his third lesson, and says, "Oh, no" when he gets another lesson instead. He doesn't do too well on Sticks and strings. He says, "Oh, oh, I wasn't very close, was I?" Finally he gets the games slot and says, "All right, I got the games slot. I haven't played Battleship this week.: He chooses Battleship and starts to play, talking to himself. "Boy, I'm gonna get him quick. Man, I got him on the first move. This time I'm gonna attack so he can't get me."

6 H. kept getting repetitions of the same two lessons and began to get bored. She said to PLATO, "God, I wonder how long they are going to make me do this."

Requests for Help

This subsection describes the frequency and nature of children's requests for help, and the nature of the responses they received to such requests.

The number of direct requests for assistance to the teacher was surprisingly small. This was suggested in the classroom observation data as well, in which it appeared that most teachers spent very little time at the terminals. The presence of the observers had a demonstrable effect on the requests for help--8-9% of the requests in the primary grades, and 0-5% in grades 4-6, were directed to the observers. In most cases, observers deflected the requests, responding occasionally to solve minor problems. These requests may signal a real need for more assistance to children working at terminals, or it may simply represent the desire to approach new adults in the room.

Whether these requests would have reached the teacher in the absence of observers is difficult to judge.

Requests for Help

	Grade K	1	4	5	6
	Percent of lessons in each category				
Observation categories:*					
made to teacher	1	2	2	2	0
made to other child	0	0	4	2	0
made to CERL staff member	1	0	0	0	0
made to ETS observer	9	8	5	4	0

*more than one category may have been observed in a given lesson

The results here parallel the findings for verbalizations, in that the primary grade children asked for help more frequently from adults than did the upper grade children, who were more likely to approach other children for help.

For all categories except "request to ETS observer" there were three subcategories in the checklist indicating the type of response given to the child at the terminal. Given the small incidence of requests these data were not very informative. Collapsing numbers of children across the upper grades we get the following information on the 'request made to other child' category:

Type of response made by other child

	Number of responses in each category (grade 4-6)
Observation categories:	
doing for the child	4
guiding or giving information	11
acknowledging but not helping	6

This is some indication that children did help each other, more frequently by guiding or giving information than by taking over control of the lesson.

There was also a set of items pertaining to the nature of the request for help.

Types of requests

	Grade				
	K	1	4	5	6
	Percent of lessons in which each category occurred				
Observation categories:					
request due to mechanical/ system failure	5	4	1	4	0
request due to problem in understanding content or directions	6	5	8	4	0
nature of request unclassifiable	2	1	1	0	0
No request made	83	87	90	91	98

For all grades except 4th, the cause of requests for help were mechanical difficulties about as often as they were lack of understanding of the lesson content or directions. In 4th grade, requests were less often related to malfunctions than to questions about procedure and content. This fits with previous data indicating that the 4th graders had more problems with procedure and content than did 5th or 6th graders. The overall percentage of requests declines with increasing grade.

Interactions Among Children

The final section of the checklist concerns additional interactions that took place around the terminal, other than requests for help. The purpose of the section was to give some indication of the degree and nature of social interactions occurring in the terminal area, and of how they involved the child at the terminal. The first set of questions concerned the initiation of interactions.

Initiation of Interactions at Terminal

Observation categories:*	Grade K	1	4	5	6
	Percent of lessons in which each category occurred				
by student on terminal (other than requests for help)	4	1	3	8	11
by other children on terminals	6	3	26	17	8
by other children not on terminals	2	4	13	17	15
by teacher	1	4	0	1	1
by CERL staff	1	0	0	0	0
by other adult	5	5	6	3	2
No additional interactions	81	82	57	63	71

*More than one category may have occurred in a given lesson

Consistent with other data, the math group shows a much higher frequency of interaction with other children than the primary grades, and in the primary grades there is a higher frequency of interaction initiated by adults. The primary grades show a lower frequency of interaction in general than the upper grades. Grades 4, 5, and 6, show progressively less interaction, although the 6th grade is still at a higher level than the primary grades. Interestingly, the higher grades also show a progressively higher proportion of interactions initiated by the student himself or herself, and a decreasing percentage of interactions initiated by other children at terminals (at 4th grade a very high percentage of interactions, 26%, are initiated by other children at terminals). This asymmetry may reflect the inhibiting effect of an adult-observer to increasingly peer-oriented older children. It appears as though the terminal area was a more intensely social setting for the 4th graders than for any other grade. It was necessarily less social in the primary grades than in any of the upper grades, with only two, rather than four, children at the terminals and with the additional constraint of headphones.

A second set of items were devoted to the substance of the interaction.

Substance of Interactions

	K	1	4	5	6
	Percent of lessons in which each category occurred				
Observation categories:*					
PLATO procedure	8	7	6	7	4
PLATO content	9	8	33	26	22
unrelated matters	2	2	4	6	12

*More than one category may have occurred in a given lesson

In grades 4-6, interactions involved PLATO content much more than procedure. At 4th grade, 77% of all interactions (other than requests for help) involved PLATO content; this is substantiated by the narratives in which it is clear that children frequently discuss aspects of lessons with each other. The percentage involving content declined from 4th to 6th grade, from 77% in 4th to 65% in 5th and 58% in 6th. At the same time the percentage of interactions based on matters unrelated to PLATO rose, from 8% at 4th, to 15% at 5th, to 32% at 6th.

The final set of items involved the mode of interaction among children, to indicate the nature of the social environment among children in the terminal area.

Modes of Interaction

Observation categories:*	K	1	4	5	6
	Percent of lessons in which each category occurred				
involving--work in cooperative interaction	0	0	0	3	1
helpin--help with a problem	2	3	10	12	6
interfering--interact negatively	0	0	0	1	1
controlling--take over control	0	0	0	1	2
socializing--interact in a social way	6	1	29	35	26
playing games	0	0	3	4	4
simply watching	1	2	4	6	7

(Column heading: Grade)

*More than one category may have occurred in a given lesson

At all grades except first grade, the most commonly observed type of interaction was socializing. For grades 4, 5, and 6, socializing represented 61%, 57%, and 55% respectively of all the interactions rated. In the primary grades, socializing represented 55% for K and 1 combined. The total number of ratings was very low for the primary grades, 36 and 11 ratings for K and 1 respectively. The second most frequently occurring type of interaction in most grades was helping. Helping constituted 21% of the total 4th grade ratings of interactions, 19% of the 5th grade, 13% of the 6th, and 25% of the primary grades combined. There was a consistent decline with age in this mode.

There was a consistent increase with age in watching and game-playing behavior in grades 4-6. Watching represented 9% of 4th-grade ratings, 10% of 5th, and 14% of 6th. Game-playing represented 6% of the 4th-grade ratings, 7% of 5th, 9% of 6th. Game-playing did not occur in any of the primary grade observations, while watching represented 15% of the ratings of K and 1 combined.

The two negative modes of interaction, interfering and controlling, occurred seldom. They represented 2% of the 4th-grade ratings of interactions, 3% of 5th grade, 6% of the 6th grade, and 4% of the primary-grade ratings (the last representing only two actual instances).

"Involving" as a mode, or working together in cooperative interaction, also occurred with very low frequency. It was not observed at all in the primary grades and represented 1% of 4th-grade interaction ratings, 4% of 5th grade and 2% of 6th grade.

In summary, there were very few instances of interactions among children in the primary grades; specifically there were 47 ratings among the total of 583 lessons observed in K and 1 combined. Of these, socializing, and to a lesser extent, helping, behavior constituted a large majority (86%) of the ratings.

In grades 4-6 there were clear trends in the types of interactions observed. The younger children tended to interact in social or helping ways. The proportion of ratings in these two categories declined with grade level, while the proportion of watching, game-playing, and interfering/controlling rose.

Following are several narratives from the math program grades, which are illustrative of the children's interactions at the terminal:

4 Ted went through the work quickly. He then played Torpedo with a friend and also had a friend stand behind him who offered game-playing suggestions.

4 Margo says about Try these, "I'm perfect at those, I've never missed one after I learned how to do it." She chooses Equivalent numbers and Jeff, who is at an adjacent terminal says, "I hate those." She says, "Well, so do I, that's why I'm trying to get out of them." Margo says she's going to finish this lesson before she goes to any new game. She watches Jeff play Fractions basketball, which is new to her and Jeff. Another child also watches. Margo tells Jill not to just write any answer for Try these. She says, "You shouldn't, I'll help you."

5 Sally finds paper and pencil to work multiplication problems. In both Rubber stamp and Column addition, she says, "It's easy." A little girl asks her, "What's Egg factory?" She says "I don't know." Sally helps Paula next to her with a terminal failure. Girls talk about how easy lessons are. Nora asks Sally for scrap paper. Sally tells her where to find it in her desk. Sally uses paper and pencil to add her numbers in Wheel of fortune. At the end she writes a note to CERL staff: "I have been having troble [sic] in the last 2 days. Yesterday I did not get my full time." Paula tells her that 'trouble' was spelled incorrectly. Sally says, "They don't care," and goes on to write, "The terminal I was on was all mixed up and still is! and one other thing, the lessons today were too easy." At this point the terminal froze for a minute or two. Sally tries to go on with another name. The other girls convince her not to.

5 "Oh no," Jim says, "I have to go through this." Benny helps Jim by doing the problems to get him out of Multiplying B. Jim is happy to get Gimme. Benny talked Jim into playing Fractions basketball so he could play with him. The kids count "1, 2, 3, 4, 5" etc. as the basket bounces along. They talk a lot. Jim has to go to get ready for the Mother's Day program so Benny finishes up his turn. He calls another kid over to finish the basketball game.

5 Lee and Jack get excited about the Sky-writing patterns. They discuss the patterns and speculate which direction the pattern will take. Lee says, "Wouldn't it be cool if it was in different colors?" Later, Lee plays Torpedo with Kristine.

For some children the social aspect of the terminal interaction seemed quite important, for others less so:

5 Other children on the terminals talked and discussed their lessons but Cheryl worked by herself, not bothered by other children's chatter, as they played games.

6 Karen began working on the machine quietly and very efficiently. Later in the session, several kids gathered around her and got her 'rattled'. They talked and offered suggestions about answers and really made more problems than positive help.

As indicated in the data on verbalization, about half of the lessons were done without verbalization by children. Nevertheless, there was a fair degree of socializing (observed in 26-35% of lessons) and sharing of help (in 6-12% of lessons) observed in the upper grades. Given the average of about 4 lessons per session, there were actually few sessions in which no interactions at all among children were observed.

It is interesting to speculate that such socializing and helping at the terminals represented a significant dimension of the childrens' experience with PLATO and might have contributed to the positive attitudes toward PLATO.

Despite some reports of negative interactions during the pilot year (such as the bullying of smaller children at the terminals by older or bigger children), the interactions observed seemed mostly positive. Interfering and controlling occurred in only 0-3% of lessons in the upper grades, and generally consisted of mild teasing, or giving of unwanted advice. Competitiveness was occasionally reported in the narratives.

> Josie figures she'll beat Daniel in Make a bundle. Kids talk about who the top person is. Daniel has a record of 4,000, so Josie won't be able to beat him with her score of 2,000.

Additional Information from the Narratives

The observation narratives bring to life aspects of the child-terminal interaction that are not captured by the quantitative summaries. They also indicate some underlying dynamics and problems that are of interest. Following are several excerpts from the narratives, relating to (a) nature of the children's involvement, (b) difficulties in the child-terminal interaction, (c) degree of understanding of the nature of the system, and (d) children's use of the "notes" option.

1. Nature of involvement: As the data on attention to the terminal indicated, nearly all children displayed high involvement with PLATO. For most children the character of this involvement was one of relaxed, confident interaction, at times accompanied by informal chatting with other children about various aspects of the system. Some of the narratives capture the quality of this absorption:

5 John does very well on all of the check-ups [outline tests]. He says "They'll probably give me 15 minutes of games now. When I finish that fast they always give me games." He notes that he has a page of choices and says, "See. They give me all these cinchy things, see now I'll play <u>Fractions basketball</u>." I asked him who gave him the games. He said, "I don't know." As he plays the game he talks to himself, "Oh boy, oh no, all right...16 to 8, runaway!" Later he plays <u>Battleship</u> and talks to himself during the whole game. He has trouble finding PLATO's battleship, and keeps saying, "He ain't on the board!" Finally he hits it and says, "Dynamite!"

5 Roy says, "Ah, I love this" when he gets to story problems. He reads story problems to himself. A boy brought him a note from Dorothy which says, "Dear Roy, I love you. Can you go to Jeff's house after school, I can. Love, Dorothy." He does <u>Shuttle puzzle</u>, and likes it. Says, "I'm gonna do <u>Shuttle puzzle</u> again. I love <u>Shuttle puzzle</u>." He helps boy next to him with story problem. Says, "I want something harder. Oh, oh, this <u>is</u> getting a little harder. What piece should I move?... I wanta move 5 next...all right, I got it made." In <u>Speedway</u>, he makes up 'Santa Clause' for the name of his car. "Oh, these are easy...God, look at these...easy division. I got a bad time. Nobody's gonna see my time...23 seconds!" Kid next to him says, "What's <u>Claim Game</u> like?" Roy says, "I don't know." "Ah, look at this, 12 seconds. My best time." Dorothy comes by. Roy says, "I can go to Jeff's house." He presses add rather than subtract and says, "Oh, you big dummy."

5 Although there is general confusion in the room, Jane pays all attention to PLATO. Jane chooses <u>Wheel of fortune</u> for the game slot. She uses paper to figure out the large numbers, in adding up her fortune. She goes into it again, seems terribly interested. She tries to add her numbers as fast as she can. A girl tries to interrupt her. She goes on working.

2. <u>Difficulties in the child-terminal interaction</u>: The observation narratives also yielded some information about a variety of unanticipated problems in the child-terminal interface, which occurred infrequently but nevertheless deserve mention:

- Lack of reading ability in the math program:

5 Aley generally worked through lessons slowly. He appears to be a slow reader. In <u>Arrays</u> and <u>Speedway</u> he just didn't read the directions well enough to do the work well. He finally shifted out of <u>Speedway</u> because he wasn't succeeding.

4 Ben had trouble reading. He does well as long as directions are read for him, but flounders on his own.

- Lack of understanding of story sequencing in reading program:

K Jan had PLATO read the story, but in a very fragmented, mixed-up way. Sometimes by sentence, or by word, sometimes backward.

K Jerry had no idea how to proceed. Sometimes he skipped pages, sometimes had a word read, or a sentence.

- Apparent lack of engagement and learning:

K Tommy spent all of his session repeating the first lesson. He didn't appear to be excited over it. He just didn't want to do anything else.

1 Pete really didn't want to be on. He put on the wrong disc and didn't care. He wanted to play with clay.

5 Joel was mostly fooling around during the whole session. Every time he got Try these he would run his fingers idly across the keyboard. He didn't seem to understand that he had to do Try these successfully in order to go on with the schedule. He did the same kind of random typing on Pinball. When asked why, he said "It's fun."

3. Degree of understanding of the nature of the system: The narratives also reflected the considerable knowledge acquired by many of the older students about the router system and its workings. Most students were aware of the time they were allotted for each session, and monitored the system:

> As the session ends, Mark says, "I got 33 minutes on my lesson. That's pretty good."
>
> Tom's session is terminated before 30 minutes are up. He says, "That's the second time this week they cut me out."

Many also keeping track of the lesson slots, particularly of the place of the game slot. (After several instructional lessons in a session children were automatically routed to a game, or "games slot."

> Tim shifted out when it came time for the game slot. He wanted to save that for a later time during the day.

> Peter didn't get a game and was annoyed. He wrote a note to CERL, "I didn't get a games slot today. And I hate those stupid lessons."
>
> Sara says that you have to wait 15 seconds to choose a game when the game slot option comes up, or you will have to go back to the main slot.

A number of narratives indicated that children would work in a perfunctory way through lessons or less preferred games to get to the games they wanted.

> Joan appeared to be a bright girl. Every option that was offered she selected the easiest possible problem, e.g., in a lesson on doubling she chose to double '1' and '2'. She wanted to get to the games and that was clearly all she wanted.
>
> Cloressa just typed randomly to get through Hockey so she could have Speedway.

At the other extreme, some of the children, particularly the children in the primary grades, tended to see PLATO not as a mechanical system which they could manipulate, but as something approaching a conscious intelligence with which they were in communication.

> K In How fast can you type your name?, Danny became angry that he could not beat the turtle and say 'STOP, STOP!' He'd get so excited he'd forget to type and thus lose.
>
> 1 Mary says, "I love this" in Train test. When she can't get her 'word stars' she says, "Where are my stars?" Finally, she says, "I'm not gonna play this anymore, so there!" and hits the screen and leaves.

4. Use and significance of the "notes" option: Another phenomenon related to personalization of the PLATO system, was the frequent use of the online "notes" option by the children in the upper grades to send notes to the CERL staff. The notes were an important link to PLATO for many of the older children. The CERL staff realized this and made a considerable effort to respond to student notes in the pilot year. The next year, they encouraged teachers to take on the task, but, as the notes indicate, were

still actively involved themselves.

Children's notes were informal and social in tone, at times complaining, teasing, and even affectionate. Following are excerpts from the narratives which describe some typical notes:

6 Pat worked slowly but didn't seem to mind. She left a note that said: "It was fun. I enjoyed it very much. I'll see you later. Good-bye."

4 Jacques left a note, "Why didn't this PLATO work for two days?"

5 Larry is a bright child who was bored with some of the lessons. He loved Wheel of fortune and wrote a note, "No autographs please, even though I am the richest kid in the world."

5 Jeff's note said: "i want moonwar
i want moonwar
i want moonwar
i want moonwar"

4 Jeannie writes a note: "Bonnie I am getting mad why aren't you sending me anymore letters. are you sick but if you are, get well soon, please ask somebody to write a note to me. I am getting lonely. i liked my lesson to sincerely Jeannie"

5.5 Curriculum Coverage in Mathematics

Neither the global classroom observations nor the observations of students working at the terminal were designed to provide information about the specifics of curriculum content coverage in the classrooms, as taught by the teacher or presented by PLATO. To describe this instructional context of the demonstration and, particularly, provide a basis for interpreting the achievement results, a Math Coverage Questionnaire was administered at the end of the demonstration year to the upper-grade control and PLATO teachers* and on-line strand usage data were analyzed.

In this section we document the variation in curriculum emphasis among PLATO and comparison teachers and the variation in time and coverage in the PLATO strands.

The relative emphasis accorded to whole numbers, fractions, concepts such as place value and estimation, and graphing varied widely among teachers. Thus the "add-on" PLATO treatment was added to quite different curricula in different classrooms and was compared to quite different curricula in different schools. As would be expected, 4th-grade teachers placed the most emphasis on basic whole number operations, but the two PLATO teachers who responded to the questionnaire devoted more time to this area than did control teachers. While relative emphasis on whole numbers dropped in grade 5, to about 25% of the total, it did not drop further in grade 6. The two teachers with lowest reported emphasis on whole numbers were both PLATO teachers, PF5 and PJ6. They differed

*Gathering equivalent information from the reading teachers was not attempted, given the generally global nature of reading instruction, which is not readily separable into curricular topics.

considerably in their reported reasons for this low emphasis however. Teacher PF5 marked the option "children already know topic" for all addition and subtraction entries and high emphasis only for division, devoting 30% of his reported coverage to fractions and a great deal of time (40%) to the more advanced concepts and graphing topics. This teacher prescribed few whole numbers lessons on PLATO as well, consistent with his belief that the children had already mastered these topics. Most of the whole numbers PLATO exposure in this class came not in sequential lessons, but in games. Teacher PJ6, on the other hand, left most whole numbers and concepts and all graphing topics to PLATO, focussing most of her teaching effort (54%) on fractions, and geometry and the metric system also receiving heavy emphasis. In this class, children spent over 50% of their PLATO time in whole numbers strand sequences.

Fractions coverage increased markedly from grade 4 to 5, representing over one-third of reported emphasis for most 5th- and 6th-grade teachers, and 45-46% of emphasis for the two control teachers in School III. The two 6th-grade PLATO teachers in School V showed considerable variation in fractions as well as whole numbers emphasis, but both were lower than their School VI comparison teacher in whole numbers emphasis and higher in emphasis on fractions. Surprisingly, all 4th-grade teachers, PLATO and control, reported some class time spent on graphing (2-5%), while most 5th- and 6th-grade control teachers and three 5th- and 6th-grade PLATO teachers reported no time spent on the subject.

Examination of the on-line strand usage figures, which are approximate,* reveals considerable variation not just in total time, but in allocation of

*The figures used linear corrections for days in which system crashes destroyed data, for children who left lessons before completing them, and contained some misclassifications of lessons and students.

Table 5.5.1

PLATO Mathematics
Strand Usage 1975-76
For Students with Complete Evaluation Data

GRADE	TEACHER	n	W	F	G	T	CPU
4	PA,PB	19	895	211	231	34.18	1.62
	PE	10	1804	633	204	48.36	1.39
	PH	22	1709	1325	201	68.23	2.05
5	PD	7	1199	511	542	50.67	1.47
	PE	5	1683	571	190	45.12	1.34
	PF	28	1223	1060	340	62.72	1.99
	PI	24	1146	1026	430	57.83	2.17
	PL	22	1523	958	492	69.90	2.23
	PM	23	1223	1396	279	61.96	1.93
6	PD	14	1016	384	407	42.95	1.48
	PE	4	1419	498	160	38.04	0.93
	PG	23	1619	1157	490	73.78	2.48
	PJ	24	1483	988	365	67.97	2.40
	PK	26	1197	978	523	55.99	2.13

W = Whole Numbers — min./student

F = Fractions — min./student

G = Graphs — min./student

T = Total Connect Time — hrs./student

CPU = Index of Processor Usage

time among strands. All teachers of 4th graders devoted more than 50% of their PLATO time to whole numbers lessons, two of the three classes devoting two-thirds of all time to this strand. Fifth-grade and sixth-grade classes showed a narrower range, from an average of 42% to 53% in whole numbers lessons. Usage of fractions material was more varied, with PLATO classes in Schools I and II (primarily consisting of fourth graders) devoting less than 25% of their time to fractions lessons, while the School V fourth graders spent 41% of their PLATO time in fractions. Other high users of fractions lessons were 5th-grade teachers in Schools III and V, and one of the two 5th-grade teachers in School VI. The graphs lessons, used only 14% of the time overall, showed considerable variation among classes, from a low of 6% in the School V fourth grade to a high of 25% in the School I mixed 5th and 6th grade, a class containing several children in their second year of PLATO exposure. Grade 6 classes tended to be above average in percentage of time devoted to graphs, but 4th graders in School I were also above average in usage of these lessons, at the expense of time spent in fractions. To the extent that time in strand reflects teacher prescribing decisions and hence teacher emphasis, these data might lead to expectations of different outcomes on the curriculum-referenced tests across grade level: e.g., more growth in whole numbers in grade 4 and less growth in graphs, and across schools within grade level; e.g., more growth in graphs in School I grades 5 and 6 than in School II. Again, it must be remembered that PLATO teachers' emphases in their regular teaching did not necessarily parallel their PLATO emphases, so that heavy usage of fractions lessons on-line could be associated with strong or with little emphasis off-line. Low off-line emphasis could stem from the belief that PLATO itself was adequately covering the material.

Table 5.5.2 gives relative progress through the curriculum, with percentages of students in a class finishing introductory and intermediate "chapters" of each strand.

Comparison of PLATO usage and chapter coverage figures reveals that no simple relationship exists among time spent in strands and number of lessons completed in those strands. Lessons could be presented in sequence by the mathematics router, through teacher prescription, which may or may not have taken sequence into account, or particularly in the case of certain whole numbers lessons, as games, with no hierarchical movement through a sequence of learnings. Such games as Speedway, Darts, and Torpedo were extremely popular. Indeed, at one point late in the year, 25% of all elementary mathematics student time was being logged in the Torpedo game. However, time so expended did not advance children through the curriculum.

It must be kept in mind that progress through strands is not a simple measure of exposure, as time on system might be construed to be. Clearly, the ability of the student, the appropriateness of lessons, the degree of prescription, assistance, and integration from the teacher, and peer behavior and attitudes may affect how time on the system is used. To some extent, the student who gets farther in a strand has given evidence not just of exposure but of learning, and to note a correlation of progesss with achievement gain would be simply to verify PLATO's efficacy as an assessment device rather than to demonstrate that the system was responsible for the gains. However, the observed variations in topic coverage are so extreme as to weaken any case for considering PLATO mathematics to have been a uniform treatment.

In particular, 4th-grade pupils in School I, while spending less than half as much time per pupil in whole numbers as did 4th graders in School II,

Table 5.5.2

Strand Coverage 1975-76
Percentage of Students Completing Introductory and Intermediate Chapters

			W		F		G	
Total Number of Chapters			5		6		4	
GRADE	SCHOOL	TEACHER	% COMPLETING 2	% COMPLETING 3	% COMPLETING 2	% COMPLETING 4	% COMPLETING 1	% COMPLETING 2
4	I	PA, PB	51	41	28	0	30	0
	II	PE	30	0	10	0	0	0
	V	PH	100	55	100	24	0	0
5	I	PD	82	55	30	0	82	15
	II	PE	38	12	25	0	0	0
	III	PF	3	0	67	13	30	3
	V	PI	76	30	84	56	56	16
	VI	PL	68	25	65	13	50	17
	VI	PM	40	6	96	12	12	0
6	I	PD	67	50	55	13	45	45
	II	PE	25	0	0	0	0	0
	IV	PG	51	44	72	16	36	0
	V	PJ	96	80	92	24	20	12
	V	PM	62	45	86	28	60	40

progressed considerably beyond the School II children, 41% completing the intermediate multiplication lessons of chapter 3, while none of the School II students proceeded this far. School III 5th graders received virtually no whole numbers instruction (one child completed chapter 1), but most completed at least two chapters of fractions, whereas in School II, about one-third of the PLATO children finished the introductory whole numbers lessons; 10%, 25% and none of the 4th, 5th, and 6th graders were exposed to significant portions of the fractions material; and no one finished even the first chapter of graphs. In the three 4th-grade classrooms, only School I children completed introductory graphs lessons, and just 30% of these children did so. On the other hand, School I 4th and 5th graders went less far with PLATO fractions lessons than any other PLATO pupils, with the exceptions of those in School II. Fifth-grade PLATO teachers in School VI and 6th-grade PLATO teachers in School V showed considerable variations in progress. In School VI, teacher PL's children progressed reasonably far in all three strands while teacher PM's class made most pr _:ess in beginning fractions lessons. However, in School V, PJ's class covered much of whole numbers, making little progress in graphs, in contrast to PK's children, only 45% of whom finished chapter 3 of whole numbers and a comparable number finishing half of the graphs curriculum.

If having completed a significant body of lessons, rather than only PLATO exposure, were to be considered the treatment, teachers PE, PF, and PM would be excluded from the whole numbers group; teachers PA and PB at grade 4, PD at grade 5, and PE at all grades would be dropped from the fractions treatment group and teachers PE, PH, PJ, and PM from the graphs group. Any PLATO effects on the achievement are ~~likely~~ to be attenuated by the inclusion of these classes. However, since the availability of PLATO is defined as the treatment in this study, and the natural variations in its use are one of the outcomes, these classes are included, and differential outcomes are examined to find the degree to which they reflect variations in teacher emphasis and PLATO usage.

The major discrepancies between time in strand and progress through strand occur in whole numbers with teachers PE (School II) and PF (School III) ranking high on time and low on lessons completed, and in fractions among teacher P.D.'s 6th graders, low in time but high in progress. In this latter case, most 6th graders were in their second year of PLATO and went through many fractions lessons in review or "fast state."

The two large whole numbers discrepancies seem to have occurred for different reasons. In the case of teacher PE, reading difficulties and a generally chaotic classroom atmosphere contributed to a lack of efficiency in terminal use, whereas in the case of teacher PF, whole numbers strand time was not prescribed for many children, and much of their whole numbers lesson time was accumulated in games.

Table 5.5.3 summarizes relative curriculum coverage, PLATO time, and PLATO coverage.

While reported teacher coverage and PLATO coverage overlap to unknown degrees, combining rankings from the two sources leads to certain expectations for some of the within-school contrasts.

In grade 4, teachers PE (School II) and PH (School V) combined high usage of PLATO whole numbers lessons with higher in-class coverage of whole numbers topics than did their same-school comparison teachers. In fractions, teacher PE used PLATO relatively little but concentrated more of her classroom teaching on that topic than did her control colleague, CE, while teacher PH was high in usage of PLATO lessons and relatively low in her classroom emphasis of the

Table 5.5.3

Curriculum Emphasis, PLATO Time, and PLATO Coverage
for Mathematics Strands

		A Whole Numbers				B Fractions				C Graphs			
GRADE	SCHOOL	T P	T C	P time	P cov	T P	T C	P time	P cov	T P	T C	P time	P cov
4	I		37	+	+		17	+	+		4	+	+
	II	49	36	++	0	30	15	++	0	3	3	+	0
	V	52	41	++	++	25	18	+++	++	5	2	+	0
5	I	25	34	+	++	36	33	+	+	0	3	++	+
	II	49	36	++	+	30	15	+	+	3	3	0	0
	III	18	25	+	0	30	45	++	++	11	0	+	+
	V		21	+	++		36	++	++		7	++	++
	VI	23		++	++	33		++	++	5		++	++
	VI	29		+	+	44		++	++	2		+	0
	VII		34				29				0		
6	I	25	34	+	+	36	33	+	+	0	3	+	++
	II	49	36	++	0	30	15	+	0	3	3	0	0
	IV	37	37	++	+	24	24	++	++	0	0	++	+
	V	25		++	++	54		++	++	0		+	+
	V	8		+	+	39		++	++	6		++	++
	VII		28				31				3		

topic. PLATO whole numbers and fractions usage were low in School I. Thus, in grade 4, whole numbers PLATO-by-school interactions are difficult to interpret while a clear School V advantage in fractions would be attributable to PLATO.

On the average, fourth graders received fewer than four hours of graphing instruction in the school year. Thus, 4th-grade school differences in apparent PLATO graphing effects are likely to be attributable to varying teacher emphasis on integrating graphing into the curriculum. Here, teacher PH in School V might be anticipated to show a larger gain than teacher PE because of more in-class attention to the subject than was reported by the School V comparison teacher.

In grade 5, PLATO teachers in School III and VI reported less in-class emphasis on whole numbers than did corresponding comparison teachers, while the School I teacher reported about the same emphasis as the School I comparison, but far less than the 45% emphasis reported by teacher CC5-6. Variation in amount of PLATO whole numbers usage was relatively narrow, lowest in School V and highest in School II. Certain popular games contributed to the whole number lesson total, and teacher prescription records show that teacher PF used relatively few sequential whole numbers strand lessons.

In grade 6, only teacher PE in School II spent more time on whole numbers instruction than did her opposite number. Thus, any whole number results in favor of PLATO in other grade-six classrooms were probably attributable to PLATO. The lack of progress in any of the strands by the small band of School II 6th graders suggests that, as with the 4th graders in this school, the PLATO curriculum was not appropriate. Observers and the teacher noted that many children in this low-achieving mixed-grade classroom could not read the instructions in the PLATO lessons. Despite additional coaching by CERL staff, the problem was evidently not overcome.

In fractions, all PLATO teachers reported at least as much class time as did their counterparts, and only in School IV, in which the same teacher taught both PLATO and control classes, can a PLATO-control difference be unambiguously attributed to PLATO. In graphs, little time was reported by any teachers, School III teacher PF5 with 11% vs. 0 for CR5, and School V teacher PH4 with 5% vs. 2% for CJ4 representing the major discrepancies, and except in these cases, it is likely that PLATO is responsible for differential outcomes.

In summary, nontrivial variation in curriculum emphasis was found among PLATO and comparison teachers, and similar variation in time and in coverage of the PLATO strands. It is clearly not justified to consider PLATO to be a single "treatment" or classes from the same grade and school to be comparable in curriculum, except for the addition of PLATO to some. In the mathematics result section we shall return to the implications of these variations for inferences concerning PLATO effects.

Chapter 6

Achievement and Attitude Scale Results

In this chapter, we first present the analytic model employed in the several regression analyses to be reported. Several issues in interpretation arising from violations of assumptions of this general model are raised.

The model is then applied to the results of the standardized achievement subtests and curriculum-referenced tests in mathematics. Estimated PLATO effects in different schools are then compared with the information concerning PLATO and teacher curriculum coverage in those schools, as initially described in Chapter 5. Attitude scale results are then presented and discussed.

The discussion of results first treats main effects in each grade, and then moves to consideration of interactions. School-by-treatment interactions are discussed in detail. In the instances in which PLATO appeared to have different effects in a given grade across different schools, information obtained from observations, interviews, and questionnaires is applied in an attempt to determine the extent to which these different effects mirror differences in teacher implementation and curriculum coverage practices. Schools I and V, the more innovative schools in the study, School II, with predominantly low-income children, and the fifth grades of School III, with an unusual pattern of curriculum coverage in the PLATO class, figure prominently in these school-by-treatment interactions. Interactions of the treatment(s) with student pretest scores and sex are also discussed. School by pretest interactions, added to the basic model primarily to improve the fit, are not policy-relevant and are not discussed in detail.

The analytic model is finally applied to achievement data from a small sample of kindergarten reading teachers, in a design in which each teacher taught both PLATO and control classes for the first semester of the demonstration year. First-grade reading achievement and attitude data are treated descriptively.

6.1 The Analytic Strategy

The analytic model. The general approach to the analysis consists of the estimation of the parameters of a model, corresponding estimates of the standard errors of the parameter estimates, and appropriate statistical tests of the significance of differences of interest between parameter estimates. The initial problem is to specify the mathematical model and to identify the parameters to be estimated. It is assumed that (1) there are well-defined treatment (T) and control (C) conditions; (2) each subject is in one of these conditions; and (3) some time after the initiation of the T and C conditions, the value of a dependent variable (Y) is obtained for all subjects. The basic conception of the effect of the treatment follows Rubin (1974) in which the critical (but unmeasurable) quantity of interest is, for each treatment subject, the difference between the value of Y he has in the T condition and the value he would have had, had he been in the C condition. Note that this is not a "gain score," or difference for each subject between pre- and posttest scores.

It is, of course, impossible to have each subject in both the T and C conditions in this study. Therefore, as an approximation, it is necessary to compare the values of Y for subjects in the T condition with the corresponding values of Y estimated from "similar" subjects in the C condition. In order to talk about subjects being "similar," it is necessary to introduce the notion of covariates. In this study, a covariate is any characteristic or trait that is measured for every subject before the initiation of the T and C conditions (or which could not be changed by the T or C conditions, such as school or sex). The vector of all such covariates is denoted by X. Two subjects with identical values of X are considered "identical" as far as the relevant set of data is concerned--they are the same on every characteristic measured prior to the initiation of the treatment, and thus the predicted score of a subject in the treatment condition is that of an "identical" subject in the control condition, plus an effect attributed to the treatment and its interactions with the covariates.

A final concept that needs to be introduced before the model can be stated, is the population (P) of which the subjects are to be regarded as representative. In this study, there are a number of populations of potential interest; for example, the students of a given sex in a particular grade within a school, or all students in that grade within and across schools. Pooling subpopulations across classrooms, grades, schools, and even the T and C conditions to increase sensitivity, can be done only if measures and their interrelations are comparable. At the statistical level, it is possible to pool across groups if "parallel" (even though curvilinear) response functions in the groups can be justified. Such pooling increases the relative sample size and thereby improves the parameter estimates. Obviously, however, if the posttest instruments are different even for otherwise identical situations, pooling populations is not possible.

To specify the mathematical model, the dependent variable Y and the vector of covariates X are regarded as having a joint probability distribution over the population P, and the form of this distribution is conditional on whether the subjects are in the T or C condition. The average value of Y for subjects from P with covariates $X = x$ who receive the treatment T is denoted by

$$\mu_T(x) = E_P(Y|X = x,T).$$

Similarly, the average value of Y for subjects from P with covariates $X = x$ who receive the control condition C is denoted by

$$\mu_C(x) = E_P(Y|X = x,C).$$

The functions $\mu_T(x)$ and $\mu_C(x)$ are sometimes called the response functions.

Since they represent the average values of Y in the two conditions (T or C) for subjects from P with identical covariate values x, their difference

$$\tau(x) = \mu_T(x) - \mu_C(x)$$

is the average difference in the value of Y for "identical" subjects (i.e., those whose covariate values are both equal to x). The expression $\tau(x)$ is the "treatment effect at x." If $\tau(x)$ is averaged over the population P, then the "treatment effect in the population P" is denoted by

$$\tau_P = E_P(\tau(X)).$$

The purpose of the analysis is to estimate for each population P and dependent variable Y the treatment effect τ_P. If the estimate of τ_P is denoted by $\hat{\tau}_P$, then $\hat{\tau}_P$ will have a distribution with standard error $\sigma_{\hat{\tau}_P}$. The estimate of this standard error will be denoted by $\hat{\sigma}_{\hat{\tau}_P}$.

For each population, the analysis will report the values of $\hat{\tau}_P$ and $\hat{\sigma}_{\hat{\tau}_P}$.

The analysis was carried out in three stages. In <u>stage I</u>, for a given population P, the response functions $\mu_T(x)$ and $\mu_C(x)$ were estimated. It was not necessary that the response functions be linear and/or parallel. If they were, the analysis was appropriately simplified. In this stage, exploratory analyses were used in an attempt to simplify the response functions by fitting powers of covariates and different sets of interactions and by examining the effects of outliers. Where parallel response functions could be justified, appropriate "pooling" was done in stage I to permit better estimates of $\hat{\tau}_P$ and $\hat{\sigma}_{\hat{\tau}_P}$.

In <u>stage II</u>, the estimated response functions $\hat{\mu}_T(x)$ and $\hat{\mu}_C(x)$ were used to estimate the "treatment effect at x"

$$\hat{\tau}(x) = \hat{\mu}_T(x) - \hat{\mu}_C(x).$$

This is the best estimate of the average increase (or decrease) in Y due to T for subjects with covariate values x. In general, the analysis entailed computing $\hat{\tau}(x_i)$ for every observation i in each application of the model and averaging the values to obtain the final estimate of the treatment effect. When significant interactions of treatment with school, sex, or pretest occur, the average treatment effect is of less interest than is the size of the effect for various values of the covariate. Figures 1-3 illustrate the simplest cases of these outcomes.

In S ge III, the estimated standard error $\hat{\sigma}_{\hat{\tau}_P}$ was computed using the standard error of regression in the T and C groups, the functional forms of $\hat{\mu}_T(x)$ and $\hat{\mu}_C(x)$, and the number of individuals and corresponding covariate values used in determining $\hat{\tau}_P$, the estimated treatment effect. A t test was then performed to assess the significance of $\hat{\tau}_P$.

In the above description of the analysis strategy, Y, X, P, T, and C are abstract entities related to each other in ways that are independent of any interpretation they might have in specific contexts. In dealing with this study's data, we gave substantive interpretations to each abstract entity.

Application of the model. The previously described mathematical model and statistical strategies were applied to the elementary component of the PLATO study, and various specific meanings were given to Y, X, P, T, and C. Y is a specific achievement or attitude test in each analysis; X, however, includes school effects, sex, and various pretests, as well as their interactions. P stands normally for all children with complete data at a given grade; however, in some instances, subpopulations were examined.

After several trial regression analyses in which a large number of variables and their interactions were examined, the following basic regression analysis was applied to each dependent posttest variable Y to estimate $\mu_T(x) - \mu_C(x)$ in each grade:

Figure 6.1.1

"Parallel" Regressions

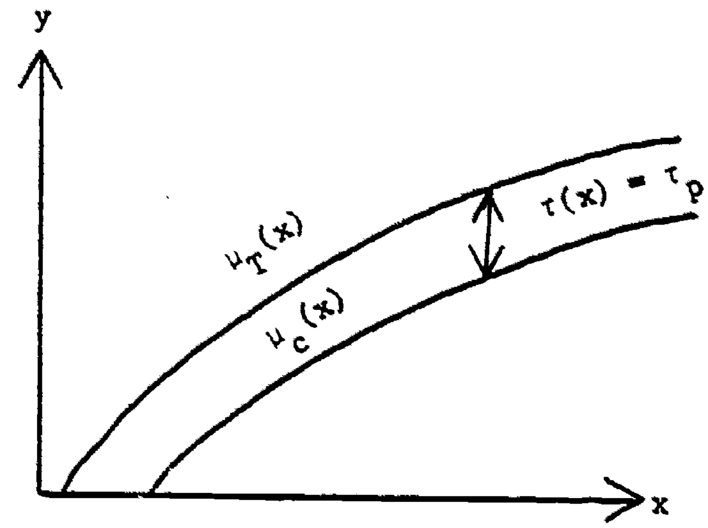


Figure 6.1.2

Treatment by Pretest Interaction

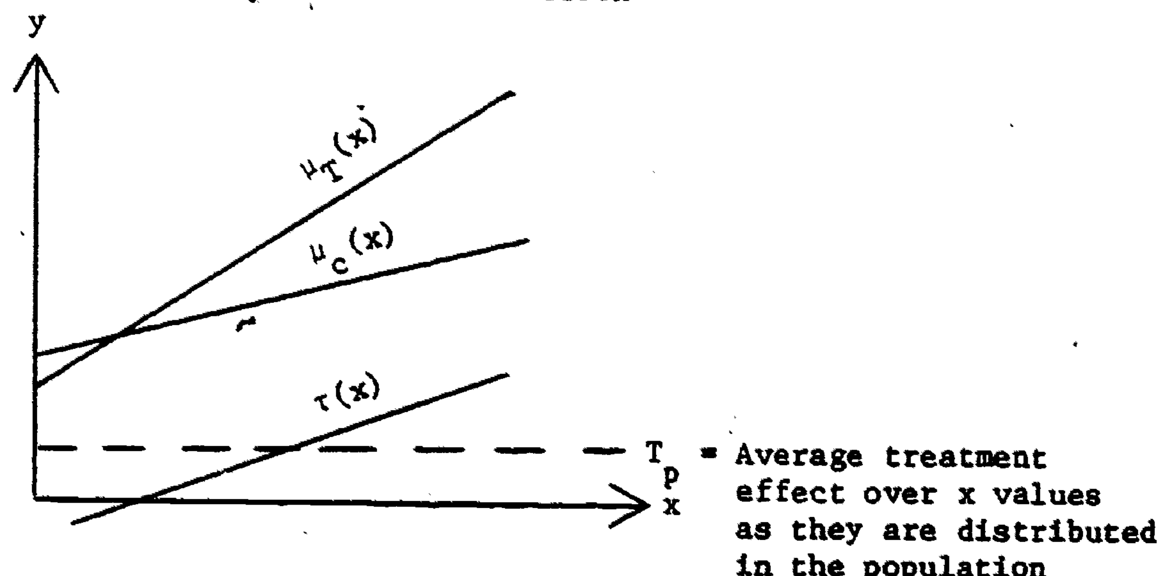
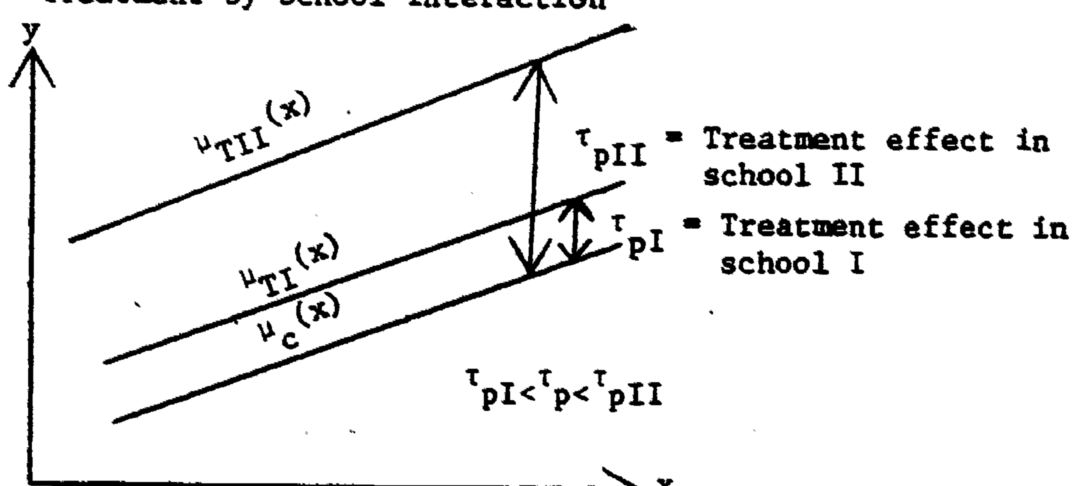


Figure 6.1.3

Treatment by School Interaction



$\mu_c(x)$ = control response function (school main effects removed)

$\mu_{TI}(x)$ = treatment response function in school I

$\mu_{TII}(x)$ = treatment response function in school II

$$\hat{Y}_T(x) = b_0 + b_1 Y_{pre} + b_2 X_1 + b_3 Z + \sum_i c_i R_i + \tau$$

$$\hat{Y}_C(x) = b_0 + b_1 Y_{pre} + b_2 X_1 + b_3 Z + \sum_i c_i R_i$$

Where Y_{pre} is the pretest value of the dependent variable of interest, X_1 is the pretest value of the CTBS Level 2 computation test, Z represents sex of subject (0 = M, 1 = F), and the R_i are dummy variables representing those schools which contain both PLATO and control classes. (In grade four, two binary variables suffice for two schools, the third school taking the value 0 on both. In grades five and six, the cross-school PLATO-Control comparisons, schools VI vs. VII and V vs. VII are coded 0 on all school variables, so no unconfounded school effect can be estimated for school VI in grade 5 or school V in grade 6. Except for these two comparisons with control school VII, estimation of a separate PLATO effect was thus possible in each school.)

These basic regressions represent an attempted pooling within T and C populations to obtain a single response function differing only by the treatment effect, T.

Interactions. The next step was to test the adequacy of this simple model, by examining interactions of school and sex variables with treatment and pretest scores. Significant school or sex by pretest interactions suggest that more parameters, allowing different regression slopes among schools or the sexes, should be incorporated to improve precision of the estimated response functions. The inclusion of such parameters maintains the assumption of parallel slopes between treatment and control subjects within a school or sex group.

Because of the nesting of teachers within treatment conditions, the value of T for each school includes teacher differences in that school, as well as treatment effects. Thus a significant treatment-by-school interaction indicates that the assumption of a uniform PLATO effect, independent of teacher differences, is not supported by the data. Differential treatment effects due to school context irrespective of teacher effect are also confounded with teacher effects in this interaction. In a random-effects model, this interaction variance would be a component of the error term. The teacher contrasts in this study were not the result of random assignment, and a major strength of the analysis is the recognition of, and allowance for, this fact -- as opposed to the more usual attempt to consign this variance to error. A significant school-by-treatment interaction, then, is evidence that treatment effects exhibited notably more variance across different teacher pairs than within them, and requires the recognition that teacher effects are a substantial component of outcome.

Treatment-by-sex interactions, if significant, were also incorporated into the final model, revealing dependent variables for which the treatment effect was substantially different for boys and girls.

Finally, treatment-by-pretest and sex-by-pretest interactions were incorporated into the model in those cases in which the constraint of a common regression on pretest in treatment and control groups or among boys and girls led to a significant decrease in predictive power. In these cases, the treatment effect is reported as a function of pretest score or of sex. Three-way interactions were not examined, since the small n in some cells would have made them extremely difficult to interpret. For the same reason, school-by-sex interactions were not considered. The final model is thus quite complex in some cases, but, unless it was necessary to fit treatment-or sex-by-pretest interactions, it yields a refined estimate of the treatment effect in each school which can be related to our knowledge of the mode of PLATO usage in that school. A weakness of the analysis for this explanatory purpose is the relative scarcity of information about control teachers. Though much is known concerning ways in which t[illegible]ent teachers differed in curriculum emphases and use of PLATO, only the self-reported curriculum emphases of control teachers are available. Thus the hypothesis cannot be ruled out that a particular PLATO teacher appeared less effective, not because of his or her behavior but because the comparison teacher was unusually effective.

The Populations

In the elementary mathematics demonstration, thirteen groups received some form of the PLATO curriculum. Of these, two (the fifth and sixth grades of the 4-5-6 combination in school I) in which all children had a year of PLATO exposure were reserved for formative trials by the developers, leaving eleven classrooms for study.

Although PLATO teachers were self-selected, schools did not modify their usual procedures for assigning students to teachers (with the exception of teacher PI, who allowed fifth graders with previous PLATO experience to choose whether or not to continue with PLATO).

Although these procedures were not random, it seems reasonable to assume that PLATO and control students, although not teachers, at a given grade level and school represented samples from the same populations. By pooling across schools, we arrived at six populations, one for each grade (4,5,6) and sex combination.

The grades were considered separately to reflect the differing role of this add-on PLATO curriculum at each grade level: the material on whole numbers covers (in new ways) normal material for fourth graders, but it provides review for some fifth and most sixth graders; fractions represent enrichment in grade four and normal fare for grade five; and graphs probably represent enrichment to all but certain sixth-grade classes.

The sexes were analyzed separately because of the suggestion of treatment-by-sex interactions in the pilot year's data. If these interactions were to be replicated, there would be implications for revision of the design or utilization of the curriculum. Table 6.1.1 shows the number of subjects with complete data by sex, grade level, and treatment condition.

TABLE 6.1.1

Numbers of Subjects

	T		C	
	M	F	M	F
4	24	27	26	31
5	55	54	63	61
6	48	43	47	49

The Dependent Variables

Dependent variables fall into three classes:

Standardized achievement posttests. The computation subtest of the Comprehensive Tests of Basic Skills (Form R Level 2) was administered to all subjects. Several fifth- and sixth-grade PLATO and control classes received the Level 3 form of this subtest as well. Sixth graders in schools V and VII also received the Level 3 Concepts and Applications subtests, but all other subjects received Level 2. The Level 3 tests were used in those classrooms in which pilot-year experience suggested that ceiling effects might be encountered in using Level 2 instruments at posttest. Whereas nearly all items in the test of computation skills (except those dealing with percent) and over half of the items in the test of application skills ("word problems") were judged relevant to the curriculum by the CERL authors who had worked on whole numbers and fractions, only one-third of the content of the concepts test was so judged. Thus the computation subtest would be expected to be the most sensitive to PLATO effects of the standardized instruments.

Curriculum-referenced tests. Three specially constructed instruments were developed to measure the learning of objectives specifically emphasized by the PLATO mathematics curriculum and inadequately represented by the standardized tests. These curriculum-referenced tests assess understanding and representation of operations with whole numbers and fractions, signed numbers, and linear graphs, rather than computational facility or vocabulary. Developed in a constructed-response (testtaker fills in the blanks) rather than multiple-choice format, the instruments were scored so as to credit any response that was mathematically correct, regardless of form.

Attitude posttest. Three scales, representing attitudes towards mathematics, reading, and locus of control were used in the comparative outcome analysis. In addition, items relating to attitude toward PLATO were collected from PLATO subjects and are treated descriptively.

The Covariates

For a variable to serve as a covariate it must be demonstrably unaffected by administration of the T and C conditions. Thus, all the pretest variables qualify as covariates, since they preceded the treatment. Although it may be the case that attitude pretest information does not help predict achievement posttest scores and vice versa, the analysis lets the data decide that rather than assume it a priori. Thus, the basic set of covariates for each dependent variable is the entire set of pretest data -- attitude and achievement subtests, sex, school, etc. If in the process of building a model for $\mu_T(x)$ and $\mu_C(x)$, we discovered a need to include interaction and quadratic terms, these were also added to the list of covariates. In practice, sample sizes necessitated winnowing this list of covariates, but in principle, enough prior information was available, measured with sufficient reliability and sample to raise the possibility of developing extremely powerful models, accounting in some cases for as much as 80% of posttest variance.

6.2 Demonstration Year Mathematics Achievement Results

In this section we will first present the average PLATO effects on standardized and curriculum-referenced achievement tests yielded by the basic regression equations. We will then examine significant interactions of PLATO with school, pretest, and sex, to determine those cases in which the PLATO mathematics curriculum exhibited significantly different effects in differing subpopulations.

Although these results are complex, they create a reasonable pattern when interpreted in the light of what we know about variations in curriculum and PLATO usage across grades, and in curriculum and PLATO emphasis across individual teachers. We offer our interpretation of the results on the basis of these classroom differences.

In the analysis of the Concepts and Applications results, as well as those of the curriculum-referenced tests, the CTBS Computation pretest was employed as covariate in addition to the pretest score on the dependent variable. This was done to improve estimation of the response function and to compensate for initially occurring group differences. A sex effect was also included in the model. In those cases in which both PLATO and control classes were available in the same school (all three grade-4 schools, four of the five grade-5 PLATO schools, and three of the five grade-6 PLATO schools), a school effect was fitted to further decrease error variance. Unmatched classroom differences remain in the general treatment effect, representing teacher and school differences between schools VI and VII in grade 5, and V and VII in grade 6. In one case, grade-6 school IV, on teacher taught mathematics to one PLATO and two control groups. In all other cases, PLATO and control differences were confounded with teacher differences, even when school was held constant.

Various interaction terms were examined for inclusion in the regression estimates of average treatment effects. In the basic regressions, school-by-pretest interactions were included in those cases in which they proved significant, to allow for the possibility of different slopes in different schools.

Average achievement results. Table 6.2.1 gives the basic regression results for the CTBS and curriculum referenced instruments, and indicates those interactions found to be significant. The treatment effect, T_p, is accompanied by a t test of significance. The multiple R^2 represents the percentage of total variance accounted for by the basic regression.

The estimates of T_p in these basic regressions are best estimates of the average effect of PLATO over all children in the study at a given grade level. Examination of the significance of these effects suggests that PLATO did indeed show a positive impact on the standardized test of computation in grades 4 and 6, and on the Level 3 computation and the applications subtest in grade 5. As had been predicted by the developers, no significant main effect was found for the concepts test at any grade. Curriculum-referenced tests revealed a significant positive impact in all but graphs in grade 4 and whole numbers in grades 5 and 6.

Because school IV represented the only case in which the same mathematics teacher taught both PLATO and control classes, a separate analysis was performed on school IV data. The results confirm the general pattern obtained from all sixth graders: a significant PLATO effect in computation ($t = 2.84$) with a nearly significant negative pretest-by-treatment interaction ($t = 1.86$), although the treatment-by-sex interaction did not approach significance ($t = -.56$). On the Concepts test, treatment effects were negligible ($t = .08$). On the test of .plications, treatment effects were positive though not significant ($t = 1.19$), but the treatment-by-Computation pretest interaction ($t = -1.92$) suggested a ceiling effect.

Table 6.2.1

Basic Regression
Summary Results

Grade Four

Comprehensive Tests of Basic Skills	No. of Students	Associated Variance(R^2)	Average PLATO Effect ($\bar{x}_p$)	Probability $\bar{x}_p$	PLATO School Interaction P	Other Interactions
Computation	108	.535	4.77	<.0011	ns	
Concepts	107	.665	0.72	ns	ns	
Applications	108	.610	0.75	ns	ns	
Curriculum Referenced Tests						
Whole Numbers	99	.659	2.79	<.01	<.001	
Fractions	95	.755	5.36	<.0001	ns	School x Pretest Sex x Pretest PLATO x Pretest
Graphs	99	.572	.389	ns	<.001	

Grade Five

Comprehensive Tests of Basic Skills	No. of Students	Associated Variance(R^2)	Average PLATO Effect ($\bar{x}_p$)	Probability $\bar{x}_p$	PLATO School Interaction P	Other Interactions
Computation						
Level 2	233	.544	0.49	ns	<.001	
Level 3	99	.585	3.42	<.05	ns	PLATO x Pretest
Concepts	227	.702	0.66	ns	<.01	
Applications	227	.664	1.21	<.05	ns	
Curriculum Referenced Tests						
Whole Numbers	223	.705	.119	ns	<.05	
Fractions	219	.686	3.21	<.01	<.01	School x Pretest
Graphs	214	.592	2.34	<.001	<.05	PLATO x Pretest School x Pretest

Grade Six

Comprehensive Tests of Basic Skills	No. of Students	Associated Variance(R^2)	Average PLATO Effect ($\bar{x}_p$)	Probability $\bar{x}_p$	PLATO School Interaction P	Other Interactions
Computation						
Level 2	187	.613	1.61	<.05	ns	PLATO x Sex
Level 3	104	.647	2.87	<.05	ns	
Concepts						
Level 2	112	.696	0.13	ns	<.01	
Level 3	65	.742	-0.33	ns	ns	
Applications						
Level 2	109	.694	-0.02	ns	<.05	
Level 3	66	.763	1.15	ns	ns	
Curriculum Referenced Tests						
Whole Numbers	173	.742	.589	ns	<.05	
Fractions	178	.815	2.78	<.001	<.05	School x Pretest
Graphs	170	.664	2.16	.001	ns	School x Pretest

The more difficult Level 3 of the Computation posttest was administered to grade 5 children in schools I, V, VI and VII and to grade 6 children in schools II, V, and VII. For these higher achieving children, a significant positive treatment effect appeared in both grades 5 and 6. For the total group on the easier Level 2 computation test, only the 6th graders had enjoyed a significant computation effect. The remaining two Level-3 subtests, administered only to school V and VII sixth graders, showed no significant PLATO effect (t = -.34 and 1.61).

The difference in 5th-grade achievement outcome for the two levels of the Computation test appears to be more a result of restricting the Level-3 testing to more able children than of any ceiling effects on the Level-2 test in grade 5. A separate analysis of Level-2 results for this restricted sample also showed a significant positive achievement effect (T = 3.06, t = 3.17). Additional evidence in the form of PLATO by pretest interactions, suggests that the PLATO mathematics curriculum generally showed a larger positive impact on more able students.

Summarizing the average mathematics test results, we found that PLATO classes showed a significant gain over non-PLATO classes in computation skills in grades 4 and 6 and a significant advantage in applications for 5th-grade students. Curriculum-referenced tests showed significant PLATO advantages ranging from two to five points in fractions at all grades, graphs at grades five and six, and whole numbers in grade 4.

<u>PLATO by school interactions</u>. Because PLATO-control differences were confounded with teacher differences, we probed further for evidence of the appropriateness of summing the PLATO effect pooled across schools. The interaction P's in Table 6.2.1 measure the significance of adding PLATO-by-school interactions to the basic regressions. Significant values suggest that the apparent effects for PLATO varied greatly among schools. That is, either the relative effectiveness

or curriculum emphasis of the PLATO and control teachers in a given school or the mode of PLATO utilization differed sufficiently from school to school to suggest that examining only the average effect of PLATO would mask significant variations in effectiveness across different pairs of teachers. Other interaction terms -- PLATO-by-pretest and PLATO by sex -- were also examined to determine the appropriateness of including them in the model. As the probabilities indicate, in seven of the twenty-two cases, additional interaction terms were found to add significantly to the explanatory power of the model.

Table 6.2.2 presents these more detailed results. They indicate that in certain cases in which the average PLATO effect was not significantly different from zero, this result came about because of wide differences in apparent PLATO effects, differences too great to attribute to chance. That these PLATO-by-school interactions appear even in the CTBS concepts test, on which PLATO was expected to have little impact, supports the hypothesis that teacher effects account for a significant portion of the variance. If there are significant outcome differences on a measure that does not reflect PLATO input, it is reasonable to conclude that they reflect the other major source of input variation: teacher differences. This should serve to remind us that the design is capable of detecting average PLATO effects only when they are sufficiently large to overcome variance in teacher effectiveness and emphasis. We will first examine significant PLATO-by-school CTBS interactions, which occurred only in grades 5 and 6. We will then examine curriculum-referenced test interactions at all grades, again linking results to our knowledge of classroom differences. Because of concern that CAI might affect boys and girls differently, we conclude with an examination of an apparent treatment-by-sex interaction and give evidence that this interaction is the result of differing initial abilities and a test ceiling effect.

Table 6.2.2

Estimated Interaction Effects for Significant Treatment Interactions

Grade	Instrument	School I	School II	School V	Other Interactions
4	A Whole Numbers	1.06	.82	6.49	
			R = .705		
	B Fractions	5.36	5.36	5.36	PLATO by Fraction Pretest
	C Graphs	-2.13	0.74	2.63	PLATO by Computation Pretest
			R = .634		

Grade	Instrument	School I	School II	School III	School V	School (VI vs. VII)	Other Interactions
5	CTBS Computation (2)	6.60	-.85	-5.37	.83	4.48	
			R = .617				
	CTBS Computation (3)	3.42			3.42	3.42	
	CTBS Concepts	5.05	-1.19	-.08	-.80	1.01	PLATO by Computation Pretest
			R = .713				
	A Whole Numbers	1.71	-.13	-.30	2.07	-1.08	
			R = .719				
	B Fractions	7.57	2.61	0.39	5.25	4.43	II x Computation Pretest III x Fraction Pretest V x Computation Pretest
			R = .723				
	C Graphs	5.60	2.01	3.37	1.48	1.22	I x Computation Pretest II x Graphs Pretest
			R = .665				

Grade	Instrument	School I	School II	School IV	School (V vs. VII)	Other Interactions
6	CTBS Computation		2.87		2.87	Sex: Girls = -.26 Boys = 3.27 R^2 = .624
	CTBS Concepts	1.13	-7.75	0.77	——	
			R = .727			
	CTBS Applications	-0.25	-4.61	0.87	——	
			R = .716			
	A Whole Numbers	.95	-2.44	2.51	-.67	
			R = .760			
	B Fractions	2.15	2.20	5.71	.75	
			R = .828			
	C Graphs	2.16	2.16	2.16	2.16	I x Computation Pretest II x Computation Pretest

Examination of the patterns of school effects reveals certain consistencies across tests and across grades for those schools in which a single teacher taught a mixed grade. In particular, school II, where a single teacher (PE) taught a mixed low-achieving group of 4th, 5th, and 6th graders, shows a consistent negative PLATO effect for the five 5th-graders in the group on computation and concepts, and an even greater negative effect for the four 6th-graders on the concepts and applications tests, when compared to the non-PLATO group in that school.

We can better assess this general school II outcome by noting that teacher PE was new to PLATO in the demonstration year, and an initial interview revealed that she had received little orientation to the curriculum or to the use of the system. Her initial expectation seemed to be that students would ask questions of the terminal when they did not understand a math problem in their textbook and that the terminal would answer any questions raised. When the curriculum began to be delivered in November, constant interruptions of her teaching arose because many students could not comprehend directions sufficiently to get through lessons unaided.

Two of the CERL mathematics staff responded by devoting nearly a month to be at the terminals with the students in an attempt to teach them to read lesson directions. Total PLATO use was low in this class, but the general disruption, coupled with reading difficulties, may have contributed to the negative outcomes.

However, even if the negative results in school II are disregarded as having resulted from atypical implementation, the treatment effect on CTBS tests was not consistently positive for the remaining 5th- and 6th-grade classes. In grade 5, school I showed a large positive effect in both computation and concepts and school III a large negative treatment effect in computation but no difference in concepts. In this latter school, the PLATO teacher reported skipping much work on whole numbers in his teaching as well as on PLATO, reasoning that his class already knew the material. Control teachers in the school reportedly placed heavy emphasis on basic operations and whole numbers, according to the mathematics curriculum questionnaire. This difference in emphasis, reported in detail in section 5.5, may explain the inconsistency in school III effects in grade 5.

The pattern of results for computation and concepts in the other fifth grades was consistent; the largest effect was experienced in school I, followed by the contrast between schools VI and VII, then school V, and finally the negative effects of school II. If effects on the Concepts subtest were indeed largely owing to teacher differences, the PLATO teacher in school III was not generally less effective--supporting the interpretation of differing emphasis of the preceding paragraph.

The cells in Table 6.2.2 do not contain level 2 Applications and Concepts data for schools V and VII, where the 6th graders were administered the Level 3 test only. On both subtests,school II showed large negative treatment effects and school IV a small positive result. School I yielded a positive treatment effect on the concepts test and no difference in applications.

Turning to the curriculum-referenced test interactions: in grade 4, the significant PLATO effect on whole numbers is seen to be largely the result of the school V PLATO/control contrast, with an estimated 6.5-point PLATO advantage at this school and PLATO effects of approximately 1 point in the other two schools. The large and highly significant grade-4 effect in fractions does not differ appreciably across schools, but there is evidence of PLATO-by-pretest interactions; this outcome suggests that those children with higher computations or fractions pretest scores benefited more from exposure to PLATO. The overall effect of the graphing lessons was not significant in grade 4, but the PLATO-by-school interaction showed an apparent negative PLATO effect in school I, a slight positive effect in school II, and a positive effect in school V. However, very little time was spent by any 4th grader on PLATO graphing lessons, and evidence will be presented that the school V PLATO graphing effect is as likely to have resulted from the teacher's off-line emphasis on PLATO-derived graphing activities as from the minimal direct exposure of her students to PLATO graphing lessons.

In grade 5, the results for whole numbers yield negative PLATO effects for schools II, III and VI, with larger, positive effects for schools I and V. On the fractions test, all school effects are positive, but range from 1/2 point in school III to 7.57 points in school I, with schools V and VI yielding adjusted PLATO effects of approximately 5 points. In graphing, school I again showed the largest treatment effect, more than 5.5 points, and schools V and VI were low, with the school II effect moderate. School III showed a large PLATO gain in graphing, in contrast to the school III results in whole numbers and fractions, again supporting the hypothesis that PLATO effects were mediated by teacher emphasis.

Grade 6 results for whole numbers again indicated a lack of PLATO benefit in the school II mixed 4th-, 5th-, and 6th-grade class. A one-point positive effect and a small negative effect emerged in schools I and V, while school IV registered a 2.5 point advantage for its PLATO students. This last comparison is of special interest, since the same teacher taught mathematics in the PLATO and control classes, thereby eliminating the confounding of teacher and treatment effects present in other schools and grades. School IV maintained a substantial PLATO advantage in fractions, with a PLATO effect of 5.71 points, as well as in graphing, where a single positive PLATO effect fitted all grade-6 comparisons. The remaining grade-6 PLATO effects on fractions were also positive -- .7 for the cross-school V-VI comparison, and slightly over 2 points in schools I and II. For graphs in 6th grade, fitting a steeper pretest regression slope in school I PLATO and control classes (a school-by-pretest interaction) raised the estimated average PLATO effect from 1.98 to 2.16 points ($\underline{t}$ = 4.91).

The negligible PLATO effects on whole numbers and fractions in the 5th-grade class in school II were consistent with the negative outcome for this class in the CTBS Computation test. School II's mixed-grade PLATO students' increasingly poor performance on whole numbers as grade levels became progressively higher parallels the average time on system data (as reported in Chapter 4) in school II for children at grades 4, 5, and 6, but is not consistent with the results on fractions and graphs for the same teacher. The possibility remains that this teacher devoted relatively less class time to instruction in whole numbers with her older children than did the school II comparison teacher, although neither reported differential emphasis by grade level in responding to the questionnaire on mathematics curriculum coverage.

PLATO by sex interaction. In grade 6, the significant Computations main effect is seen to have been due to a three-point advantage for boys in the PLATO treatment, coupled with a negligible effect for girls. This finding should be interpreted with extreme caution, because it is partly attributable to a differential ceiling effect: both the treatment-by-sex interaction and a negative treatment-by-pretest interaction are significant at the .05 level separately (t = -2.42 and -2.19), and entering either interaction into the model causes the other to drop below significance.

PLATO girls began with a 5-point advantage over control girls, whereas PLATO boys had an initial 1.5 point advantage over control boys, both male groups starting below control girls. Inspection of the scatter plots suggests that a ceiling effect is indeed operating against the PLATO girls, over one-third of whom (16) scored 45 or better on the 48-item posttest, a result achieved by fewer than one-tenth (4) of the control girls. Because we anticipated ceiling problems in grade 6, children from the higher achieving PLATO and control schools were tested with the more difficult Level 3 Computation posttest; as is indicated, the treatment effect was significant for this subset of the sample, but the sex interaction was not.

The interactions, when interpreted in the light of patterns of usage and curriculum emphasis, thus present a coherent picture. When classes were indeed comparable, significant positive PLATO effects on the CTBS Computation test were apparent. When classes were not comparable, effects were enhanced or attenuated accordingly. A clear PLATO effect on the standardized Applications test was apparent only in grade 5, as indicated by the basic regression. Examination of the interactions led us to conclude that the whole numbers curriculum-referenced test did show positive PLATO effects in comparable 5th grade classrooms, contrary to the conclusion which the basic regression suggests, but that no effect on the graphs test attributable to PLATO was hidden in the significant 4th-grade PLATO-by school interaction.

Finally, although initially more able students apparently benefited more from PLATO in several instances, the one instance of a negative treatment-by-pretest interaction was seen to be a ceiling effect, one which initially masqueraded as a treatment-by sex interaction.

6.3 Relations between Test Results and Curriculum Coverage

The mathematics curriculum coverage questionnaire revealed considerable variation in emphasis on whole numbers, fractions, graphs, and concepts topics across grades and between PLATO and control teachers within the same grade and school. Completed questionnaires were obtained from all teachers except the PLATO grade 4 school I and grade 5 school V teachers. Individual topics, such as multiplication of two digit by two digit whole numbers or addition of fractions with like denominators were rated as "covered," "emphasized," or "omitted," with the reason for omission--"children already knew it, PLATO covered it, less important, or insufficient time." Individual topics were categorized as whole numbers, fractions, concepts, graphing, or other, one point assigned for coverage and two for emphasis, and a total emphasis score as a percentage of all topics computed in each category. Table 6.3.1 presents the results of these curriculum emphasis ratings for PLATO and control teachers.

A central feature of the strategy of this evaluation is the recognition that PLATO and control teachers were not a random sample of some population, also differences in PLATO effects at different schools and grade levels are not random "error," but are potentially lawful. Incompleteness of information and imprecision of measurement may make it impossible to "explain" variations in outcomes, but where available contextual knowledge allows plausible attribution of apparent positive or negative "PLATO effects" to other sources of variation, the attempt should be made, and only those effects for which no strong evidence appears of alternative causal mechanisms should be attributed to the treatment. This approach carries with it the possibility of explaining away all apparent PLATO effects as resulting from differences among self-selected teachers, but it also offers the possibility of detecting some order in the fluctuating estimated PLATO effects in different classroom pairs for certain variables and for different variables within certain classroom pairings.

One crude taxonomy focuses on the overall content emphasis at grades 4, 5, and 6, disregarding children's ability or teachers' individual preferences. Here, the curriculum questionnaire reveals generally high emphasis on whole numbers in grade 4. There was a tendency to decrease this emphasis in grade 5, but no further decrease in grade 6. Lower emphasis on fractions was given in grade 4, but higher emphasis in grades 5 and 6. There was low emphasis on graphing in all three grades, but grade 5 showed a slight peak in emphasis. It is possible to categorize the strands on the average as "remedial," "standard," or "enrichment" according to these emphases, again ignoring the variations in student abilities across schools. The emphases and outcomes are shown in the diagram of Table 6.3.1.

Table 6.3.1 Content Emphasis and Outcomes

	Grade 4	Grade 5	Grade 6
Whole Numbers	Standard +	Remedial 0	Remedial 0
Fractions	Enrichment ++	Standard ++	Standard +
Graphs	Enrichment 0	Enrichment ++	Enrichment+

0: No Effect +Significant Effect ++Highly Significant Effect

Comparing average outcomes with the cells of Table 6.3.1 suggests that the whole numbers material was effective as standard but not as remedial fare. Fractions was effective as both enrichment and standard supplement to the teachers' activities, and graphs was effective as enrichment only in grades 5 and 6, this outcome perhaps suggesting that the material was too advanced for 4th graders.

Such an overall characterization of outcome agrees with teachers' comments and observers' reactions to the general level of the lessons and with the evaluator's assessment of their appropriateness for the average child at each grade level. However, the curriculum coverage questionnaire offers evidence bearing on variations within strand and grade. Relative emphasis by teacher pair within school is displayed in Table 6.3.2.

In grade 4, the two PLATO teachers reporting their curriculum coverage spent as much or more classroom time on each of the strands than their same school control peer did. Thus, the most conservative interpretation of the fourth-grade results would suggest that the combination of PLATO and teacher as a team, both focussing on a given topic, significantly enhanced performance on that topic, but that no significant achievement effect could be uniquely attributed to PLATO. Little PLATO progress in whole numbers was recorded for Teacher PG's students in school II, despite a heavy relative teacher emphasis reported and considerable student time spent in PLATO lessons on the topic. In this case, the PLATO advantage was .82, less than one point. In contrast, her colleague in school V, with a smaller excess in emphasis over her control partner and extensive student progress in whole numbers lessons, enjoyed a 6.5 point advantage. Progress through PLATO lessons may be as much an effect as a cause of learning, but either differing student ability to profit from PLATO lessons or differing degrees of teacher encouragement and integration of PLATO with classroom approaches appears to have mediated the effect of mere exposure to PLATO here and elsewhere. Observers rated the school V teacher high in PLATO integration (5.61) and the school II teacher low (-4.28), but school V fourth graders were also initially higher

TABLE 6.3.2

Curriculum-Referenced Test School Effects
by Relative Teacher Emphasis

Greater Topic Emphasis	Control Teacher's Emphasis Greater than PLATO Teacher's	Same	PLATO Teacher's Emphasis Greater than Control Teacher's
Grade 4 Test	School Effect	School Effect	School Effect
Whole No.'s			II .82 V 6.49
Fractions			II 5.33 V 5.33
Graphs		II .74	V 2.63
Grade 5 Test			
Whole No.'s	I 1.71 III -.3 VI -1.08		II -.19
Fractions	III .48	I 7.65	II .51 VI 4.35
Graphs	I 4.61	II -.57	III 3.39 VI 1.28
Grade 6 Test			
Whole No.'s	I .95 V -.67	IV 2.51	II -2.44
Fractions		I 2.15 IV 5.71	II 2.20 V .70
Graphs	I 2.16	II 2.16 IV 2.16 V 2.16	

in ability than were their school II peers. Thus neither the hypothesis that the reading or conceptual level of the whole numbers lessons is too high for school II students, nor that the school V teacher's integrating behavior somehow facilitated learning from PLATO, can be rejected. In the case of graphs, the school V teacher placed heavy emphasis on the topic in her classroom teaching (largely derived from PLATO-inspired worksheets) and prescribed essentially no time in PLATO graphing lessons. The 2.63-point PLATO class advantage here is almost certainly not directly caused by PLATO.

Examining the school effects for the other two grades, we see that in 13 of 16 instances in which the PLATO teacher reported spending as much as or more time on a topic than did the comparison teacher, PLATO effects were positive. The three exceptions all involve the low-achieving mixed-grade class in school II. In the eight instances, all in grades 5 and 6, in which the PLATO teacher spent less time on a topic than did the control teacher, PLATO effects were still positive in five, and it seems reasonable to attribute these positive outcomes to PLATO. The three negative PLATO effects in these instances all occurred in whole numbers.

6.4 Attitude Scale Results--Mathematics

The instrument developed to assess attitudes towards mathematics was designed to yield scales as well as individual item results. Three scales yielded sufficient reliability at pretest to figure in the analyses. These were (1) attitudes toward reading (α = .61, .55, .69 for grades 4, 5, 6); (2) attitudes toward mathematics (α = .76, .84, .84); and (3) locus of control (α = .35, .47, .55).

In this section, the results for the three scales are discussed for PLATO and control subjects at each grade. Items figuring in these scales and other baseline items that tapped nonacademic self-concept, general attitude toward school, attitudes toward PLATO, and perceptions of others' attitudes toward PLATO are discussed in the section following this one.

The construct of an attitude as a reliable unitary trait requires that a number of items, each seen as reflecting the attitude and specific variance for that item, covary in a population. Demonstrating change in the overall attitude requires that subjects be relatively consistent in changes at the item level if the construct is to retain meaning over time.

Measuring treatment effects on attitude(s) presents problems beyond those inherent in attitude scale construction. Thus, even if a larger percentage of subjects respond "mathematics is fun" and "mathematics is my favorite subject" at posttest than at pretest, a scale constructed from the items may not show statistically significant change, unless those becoming more positive on each item tend to be the same individuals. Further, the use of pretest attitude scores to predict posttest attitude scores will not increase the precision of detecting treatment effects unless a reasonably strong relationship holds between an individual's responses at pretest and those at posttest. Although expressed attitudes were quite reliable at pretest, the stability of attitudes among elementary school children is known not to be high. Thus the regression model used in the analyses seldom predicted as much as 40% of the posttest variance. Nevertheless, interpretable effects appeared in grades 4 and 5 in attitudes toward reading and mathematics. No significant attitude scale results were obtained in grade 6, and the less reliable locus of control scale did not yield significant results at any grade, although the results approached significance in grade 5.

Table 6.4.1 gives the estimated effects, *t* tests, squared multiple correlations, and standard errors for each of the three scales at each grade.

In grade 4, a highly significant PLATO effect on attitude toward 'thematics occurred. A significant PLATO-by-sex interaction was also found ($t = 2.56$), yielding a 1-point net increase for PLATO boys on the 12-point scale and a nearly 6-point increase for PLATO girls over control subjects. A smaller, but also significant, relative improvement for PLATO subjects in attitude toward reading was also found. Here, a significant PLATO-by-pretest interaction showed that greater improvement occurred among PLATO children whose attitudes toward reading had initially been more positive.

The attitude-toward-reading scale was developed to distinguish global attitudinal changes or possible halo effects across subject areas from specific changes in attitudes toward mathematics. That 4th-grade PLATO children showed a greater improvement in attitude toward mathematics suggests some differentiation among school subjects, but this result does not rule out the possibility that these largest PLATO attitudinal outcomes

TABLE 6.4.1

ATTITUDES

Regression Results
and Posttest Reliabilities

	Grade 4	Grade 5	Grade 6
Math	T = 3.48 *t* = 3.33 F = .39 R^2 = .380 SE = 4.74 P x Sex = 4.943 t = 2.56 n = 94 α = .77	T = 1.34 *t* = 1.80 F = 1.29 R^2 = .385 SE = 5.03 n = 198 α = .84	T = -.10 *t* = .134 F = .27 R^2 = .406 SE = 4.46 n = 161 α = .87
Reading	T = 1.21 *t* = 2.89 R^2 = .398 P x Pretest Interaction t = 2.44, α = .70	T = -.69 *t* = 2.22 R^2 = .287 SE = 2.12 α = .60	T = .34 *t* = .09 R^2 = .425 SE = 2.05 α = .69
Loc Control	T = .11 *t* = .31 R^2 = .199 SE = 1.69 α = .40	T = -.43 *t* = 1.93 R^2 = .238 SE = 1.51 α = .50	T = .48 *t* = 1.08 R^2 = .163 SE = 1.66 α = .37

were rather diffuse and were the result of a generally positive classroom atmosphere in the three PLATO grade-4 classes.

In grade 5, on the other hand, evidence of children's differentiation of reading from mathematics is clearer. A significant decrease in positive attitude toward reading ($\underline{t}$ = 2.22) was coupled with an increase ($\underline{t}$ = 1.80) in positive attitude toward mathematics that approaches significance.

The only locus of control result approaching significance ($\underline{t}$ = 1.93) also occurred in grade 5, with the PLATO children becoming more external in their attributing responsibility for academic success or failure. Since the locus of control items specifically contrast individual and teacher responsibility for learning and test performance, this isolated locus of control result, coupled with the negative trend in attitude toward reading in grade 5 PLATO classes, may be as much a result of PLATO and control teacher differences as of children's experience with the PLATO terminals. It is, of course, possible to argue that the mathematics attitudinal results could also be attributed to teacher differences, but grade-5 PLATO teachers did not report the degree of personal involvement in mathematics that was found among grade 4 or grade 6 PLATO teachers.

Thus, in grades 4 and 5, where the PLATO mathematics curriculum represented supplementary or enrichment material rather than review, attitudes toward mathematics became relatively more positive in PLATO classes over the school year. This result was accompanied by a smaller relative improvement in attitude toward reading in grade 4 and a significant relative decline in attitude toward reading in grade 5. The item-level attitude results of the following section make the appropriateness and meaning of these results and their interpretations clearer. They show that changes were more marked on certain items making up these scales than on others.

The attitudinal results of the demonstration year were less dramatic than those of the pilot year, but they offered a general confirmation of positive PLATO effects on attitudes toward mathematics. Three major differences in the events of the second year may partially account for the weaker demonstration-year results: (1) In grade 5 and 6, the PLATO and control groups were more evenly matched initially in the demonstration year than in the pilot year; (2) The curriculum of the demonstration year was more complete, systematic, and in a sense, dull, with fewer gaps in curriculum or system limitations that caused children to receive games rather than step-by-step instruction. These differences might encourage us to put more credence in the demonstration-year results, although we must again acknowledge that how much effects can be attributed to PLATO alone or to characteristics of PLATO teachers remains an open question. The remaining difference might lead to underestimating PLATO effects; and (3) In the pilot year, the attitude test was given first in the battery at both pre- and posttest, whereas it was given last in the demonstration year, at the suggestion of the developers. Although minimizing initial teacher effects on the pretest achievement scores, this new strategy created the possibility of greater teacher impact on pretest scores than had been the case in the pilot year, and also the likelihood that attitude toward mathematics in the demonstration year was influenced by reaction to the lengthy curriculum-referenced and standardized math tests previously administered. Though this would be expected to affect PLATO and control classes equally, it might also contaminate responses to questions about mathematics and to attenuate any positive reaction to mathematics instruction rather than to testing.

6.5 Outcomes: Reading 1975-76

In this section, results of standardized and curriculum-referenced achievement tests in a subset of kindergarten and grade-one classes will be presented. Attitudes, as assessed in PLATO first-grade classes, will also be discussed.

Kindergarten

At the NSF-CERL-ETS meeting of August, 1975, it was concluded by the panel that full-scale evaluation of the PLATO Elementary Reading Curriculum (PERC) in the 1975-76 school year would be premature. At this meeting the PERC director stated that the project was learning how to deliver reading material to young children via PLATO and not yet ready to claim the ability to "teach" reading.

Resources that had been devoted to seeking out control classes in kindergarten and first-grade were therefore reallocated to strengthening the mathematics evaluation design in grades 4, 5 and 6.

Some limited achievement testing was necessary if children's ability to function at the terminals was to be related to their initial characteristics and rates of learning and if a formative validation of on-line assessments of growth was to take place. The Metropolitan Readiness Test and the PLATO-specific Special Reading Test were thus administered to some of the entering kindergarten children and first-graders in early September, 1975.

When the time came to deliver instruction to classes of the four kindergarten teachers selected for special study, the teachers, who each taught a morning and an afternoon class, preferred beginning PLATO instruction in only one of their two classes. The arrangement would, they felt, allow a more gradual introduction of problems the new system might raise.

Two teachers agreed to begin PLATO in their morning classes (traditionally composed of less mature kindergarteners) and two agreed to begin with afternoon children. Thus a small within-teacher design, balanced for time of day, was achieved in the first term. Midyear standarized and curriculum-referenced tests and end-of-year standardized tests were administered and the scores subjected to regression analysis. The remaining four classes were introduced to PLATO after midyear testing in February.

After the PERC director's departure in March, significant changes were made in the curriculum; the Curriculum Management System was abandoned, teachers were asked to become much more centrally involved in diagnosis and prescription of lessons, and, in fact did, becoming far more familiar with lesson objectives, content and strategies than had been the case with the earlier, more "teacher-proof" lesson delivery system; and certain phonics lessons, which had been strongly criticized by some teachers, children, and members of the PERC curriculum development team were removed from their central place in the curriculum.

The midyear contrast benefiting from the "within-teacher design" is thus a moderately sensitive test of the effect of the first term reading curriculum. The year-end comparison serves essentially as a persistence check of the first-term curriculum contrast after three months of common treatment. As noted, that common treatment differed from either group's first-term experience.

Kindergarten Treatment Summary

As of February 5, the four kindergarten teachers involved in the teacher-as-own-control study had logged the highest average hours of student use of any kindergarten teachers, but the average time per student was still only one-fourth as great as that of most first-grade teachers. Table 6.5.1 gives data suggesting that the average "dosage" provided by the four teachers was quite low in the fall semester.

TABLE 6.5.1

Average Cumulative Hours of PLATO

Usage/Student 2/5/76

Teacher		AM	PM
PAK	No. of Students	18	19
	Average hrs./student	4.37	—
PEK	No. of students	15	17
	Average hrs./student	6.75	—
PIK	No. of students	21	17
	Average hrs./student	—	3.58
PFK	No. of students	10	18
	Average hrs./student	—	4.87

In the most active classroom, the average child had received only about 41 10-minute PLATO sessions between pre- and posttesting. Teacher interviews and classroom observations indicate that for the class's first two weeks, CERL staff were in the classrooms daily, orienting children to terminals and teaching them to sign on. Although teachers stated that most children soon became quite independent on the terminals, ETS observations suggest that a significant number of children continued to encounter difficulties with finding and changing discs, putting on the proper headphones, and coping with system or touch panel errors well into the winter. According to Yeager (1971) on-line records show that an average of seven minutes of the child's 15-minute session was devoted to disc-changing character set loading, or other noninstructional activities. When something went wrong, some children seemed to be willing to wait interminably for PLATO to "get better," rather than to summon help and so, perhaps, to proceed with minimum delay.

During the first semester there was little evidence of teacher attempts to integrate PLATO reading instruction with the on-going program of teaching. In some cases, teacher aides handled PLATO scheduling, and teachers did not know what lessons children were being exposed to during this period. Computer printouts detailing children's progress were sent to teachers periodically, and the need to help children who were stuck or to arbitrate arguments about turns kept teachers in touch with children's attitudes about the terminals. These were reported as highly positive in general. Most of these teachers felt that the lessons delivered on PLATO were reasonably compatible with the material they were presenting, but reported making little attempt to synchronize PLATO with their scope and sequence or vice-versa.

Kindergarten Results

Table 6.5.2 gives means and standard deviations of subscores and total of the Metropolitan Readiness pretest and Metropolitan Primer midyear test for the four PLATO and control kindergarten classes. Table 6.5.3 summarizes the subscores of the curriculum-referenced Special Reading Test.

The pretest means tend to support the supposition that morning classes would start generally below afternoon classes, but especially so in the case of PFK, whose AM (Control) class began almost a standard deviation below her PM (PLATO) children on Readiness total score. The exception was PIK, for whom the two classes started quite well matched, the AM (Control) exhibiting an edge in visual matching, and the PM (PLATO) class showing slightly more initial skill in recognizing letters of the alphabet.

TABLE 6.5.2

Metropolitan Achievement Test Results

Kindergarten Teacher-as-own-control PLATO Reading Evaluation

September 1975 - February 1976

Control AM, PLATO PM

	Pretest (Metropolitan Readiness)	PLATO		CONTROL		Midyear Test (Metropolitan Primer)	PLATO		CONTROL	
		N = 18		N = 10			N = 18		N = 10	
Teacher		$\overline{X}$	S	$\overline{X}$	S		$\overline{X}$	S	$\overline{X}$	S
PFK	Word Meaning	8.56	2.97	6.80	2.04	Beginning	8.06	3.16	8.50	2.42
	Listening	9.61	2.15	8.90	1.45	End	7.56	2.97	6.70	2.75
	Matching	6.56	3.09	5.00	2.58	Letters	8.28	5.09	7.50	2.42
	Alphabet	12.39	4.37	8.10	3.98	Alphabet	10.00	2.03	10.00	1.25
	Total	37.11	9.00	28.80	8.03	Word	7.50	5.85	5.90	4.86
						Total	41.39	16.92	38.60	9.72
		N = 17		N = 21			N = 17		N = 21	
PIK	Word Meaning	8.82	3.50	8.62	3.09	Beginning	8.41	3.00	8.33	2.39
	Listening	8.88	2.57	8.86	1.88	End	7.35	2.37	7.14	2.87
	Matching	5.41	3.24	7.24	2.21	Letters	8.94	4.44	6.90	3.94
	Alphabet	13.06	3.82	11.90	4.31	Alphabet	9.71	2.39	9.48	2.23
	Total	36.18	10.84	36.62	8.23	Word	8.24	4.84	6.00	4.02
						Total	42.65	14.33	37.86	11.81

TABLE 6.5.2 (CONT.)

Metropolitan Achievement Test Results

Kindergarten Teacher-as-own-control PLATO Reading Evaluation

September 1975 - February 1976

PLATO AM, CONTROL PM

		Pretest (Metropolitan Readiness)					Midyear Test (Metropolitan Primer)			
		PLATO N = 19		CONTROL N = 18			PLATO N = 19		CONTROL N = 18	
Teacher		$\overline{X}$	S	$\overline{X}$	S		$\overline{X}$	S	$\overline{X}$	S
PAK	Word Meaning	6.50	2.31	6.58	2.04	Beginning	6.94	3.08	8.21	2.57
	Listening	7.83	2.38	7.95	2.17	End	5.78	2.16	6.89	1.94
	Matching	4.56	2.26	5.00	3.25	Letters	5.61	2.40	8.32	4.24
	Alphabet	6.28	3.80	8.42	5.03	Alphabet	7.33	3.01	8.42	3.11
	Total	25.17	7.14	27.95	9.03	Word	5.00	2.03	6.95	4.42
						Total	30.67	10.21	38.79	13.12
		N = 15		N = 17			N = 15		N = 17	
PEK	Word Meaning	8.07	2.76	9.41	2.79	Beginning	7.33	2.61	8.94	1.91
	Listening	8.87	1.55	8.71	1.53	End	5.67	2.61	7.41	2.18
	Matching	5.67	2.90	6.41	2.79	Letters	5.13	3.56	8.00	4.03
	Alphabet	11.13	3.29	11.71	3.46	Alphabet	9.60	1.72	10.59	0.71
	Total	33.73	7.58	36.24	6.81	Word	4.93	3.92	5.59	3.22
						Total	32.67	11.60	40.53	9.10

TABLE 6.5.3

Means and Standard Deviations Special Reading Test Subscores

September 1975 and February 1976

PLATO AM

Teacher	PAK								PEK							
	PLATO n = 16				CONTROL n = 17				PLATO n = 16				CONTROL n = 20			
	Pre		Mid		Pre		Mid		Pre		Mid		Pre		Mid	
Subtest	x̄	s.d.	x̄	s.d.	x̄	s.d.	x̄	s.d.	x̄	s.d.	x̄	s.d.	x̄	s.d.	x̄	s.d.
Vowels	3	1.03	2.89	1.14	2.39	1.38	3.50	1.80	3.29	1.18	3.56	1.37	3.20	1.12	3.15	1.49
Consonants and Blends	4.65	1.23	5.11	1.63	5.56	2.22	6.94	2.82	4.41	1.57	5.13	2.50	5.05	1.72	6.25	2.57
Word Recognition	1.25	.97	1.87	1.32	1.88	2.25	2.81	2.30	1.71	1.49	1.81	1.24	1.35	0.85	2.05	1.24
Sentence Identification	0	0	.63	.93	.88	1.78	1.69	1.49	0.88	0.83	0.25	0.75	0.65	0.73	0.95	0.80
Sentence Interpretation	1.00	.24	.31	.58	.53	1.14	.81	1.67	0.0	0.0	0.38	0.60	0.20	0.40	0.10	0.30

PLATO PM

Teacher	PFK								PIK							
	PLATO n = 16				CONTROL n = 19				PLATO n = 15				CONTROL n = 15			
	Pre		Mid		Pre		Mid		Pre		Mid		Pre		Mid	
	x̄	s.d.	x̄	s.d.	x̄	s.d.	x̄	s.d.	x̄	s.d.	x̄	s.d.	x̄	s.d.	x̄	s.d.
Vowels	3.39	1.38	4.63	1.72	3.26	1.41	3.65	1.49	4.13	1.89	3.93	2.05	3.24	1.55	3.47	1.65
Consonants and Blends	6.06	3.01	7.21	2.46	4.53	1.87	5.40	2.03	6.47	2.53	8.33	2.68	5.18	2.36	6.12	2.81
Word Recognition	2.00	1.97	2.47	2.41	1.33	1.00	1.63	0.87	2.00	1.79	2.93	2.29	2.00	1.37	2.59	1.65
Sentence Identification	0.94	1.09	1.47	1.60	0.83	.76	0.89	0.91	1.27	1.39	2.13	1.41	0.82	0.78	1.29	0.96
Sentence Interpretation	0.31	0.68	0.68	1.42	0.17	.37	0.16	0.36	0.60	1.50	0.93	1.57	0.12	0.32	0.73	1.12

By February, the discrepancy between PLATO and control means had widened for the two morning PLATO teachers, with the PLATO children about two-thirds of a standard deviation below controls, as opposed to their initial one-third s.d. disadvantage. Among the afternoon PLATO classes PFK's class had lost most of its initial 1 standard deviation advantage, but PIK's had gained on its non-PLATO morning control group.

PLATO by pretest interactions. Figure 6.5.1 shows the patterns of change in the four sets of paired classes, revealing accelerated curves when mid-year Primer scores are fitted to alphabet by pretest scores; it suggests that PLATO had rather a different impact in PIK's classes than in the others. Figure 6.5.2 shows achievement in this teacher's class as a function of word meaning pretest scores, and depicts the disordinal interaction. CERL personnel had characterized PIK as the kindergarten teacher most involved with PLATO. On-line data, observations, and the postinterview supported this, although in her recollection, major involvement began only in February, after she was asked to start prescribing, and after these data were secured. In the two PLATO AM instances, the PLATO class started below its control and ended relatively even lower. IN PIK's case the control class began below the PLATO class and narrowed the gap considerably, a phenomenon that may have involved some regression to the mean. In PIK's classes, pretest means were nearly identical, and regression effects are clearly not indicated.

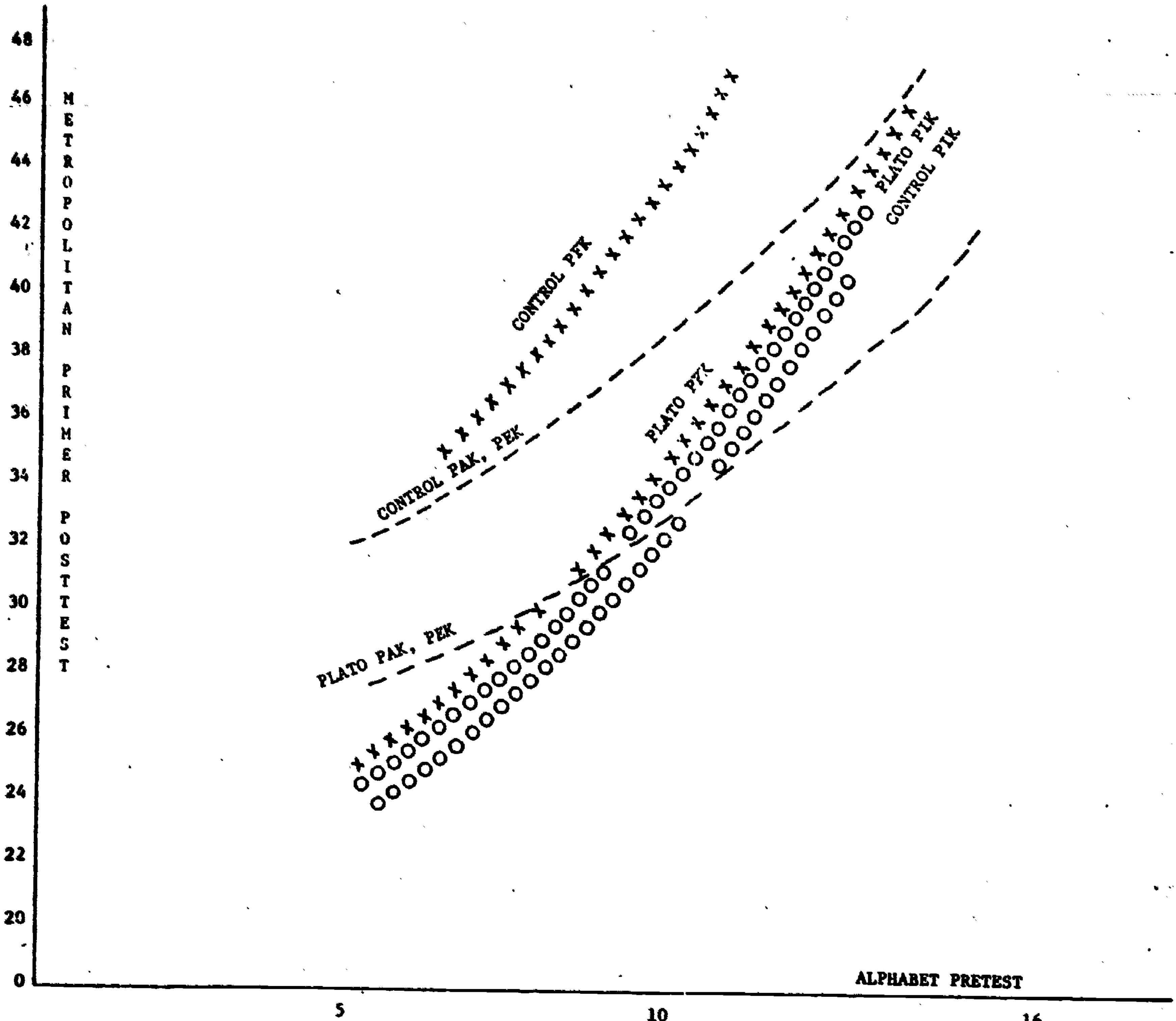


FIGURE 6.5.1: REGRESSION OF MID-YEAR KINDERGARTEN PRIMER SCORES ON ALPHABET METROPOLITAN READINESS SCORES

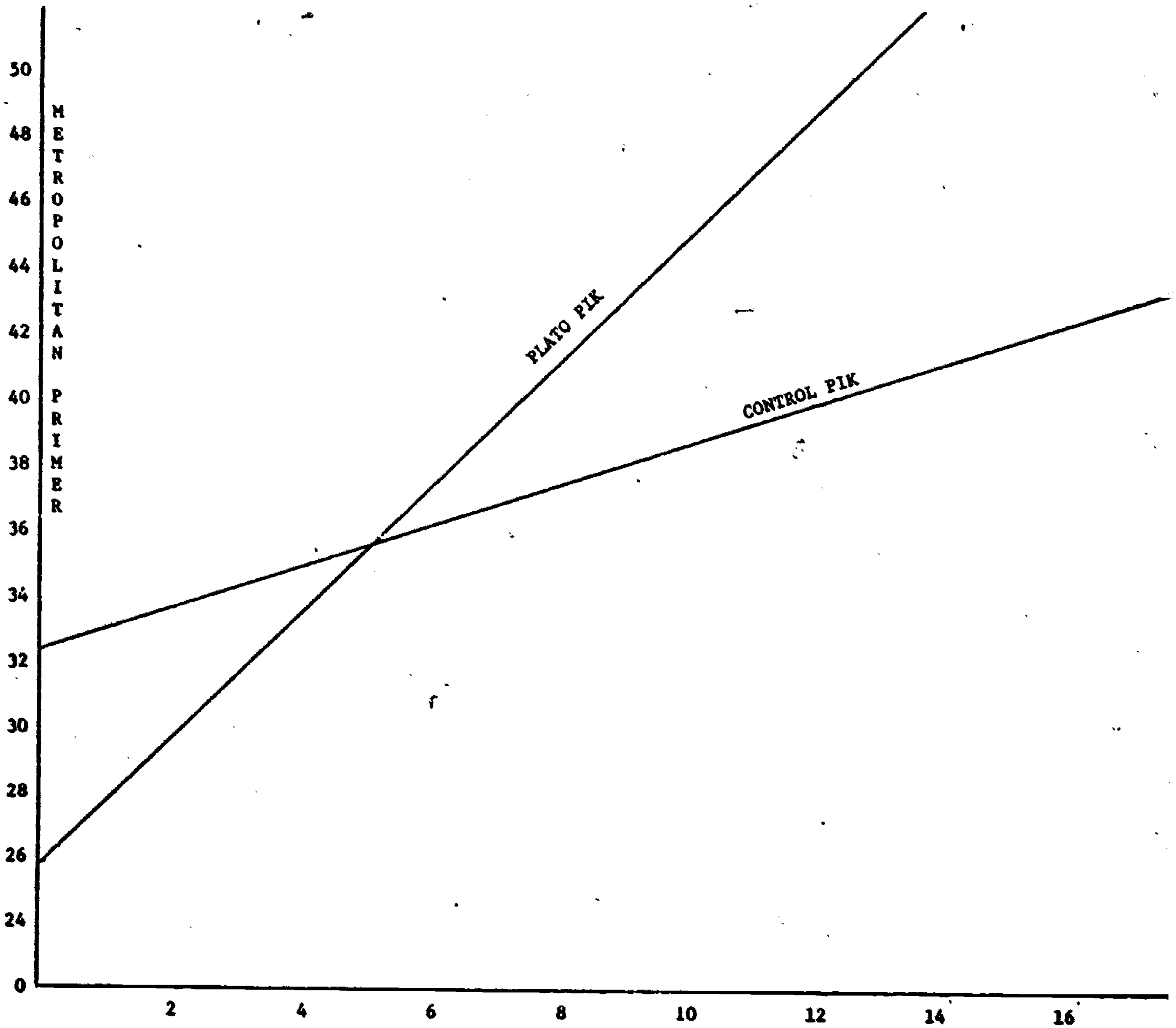


FIGURE 6.5.2: REGRESSION OF MID-YEAR PRIMER SCORES ON WORD MEANING METROPOLITAN READINESS SCORES: TEACHER PIK WORD MEANING PRETEST

Regression Results

Separate regressions were performed on posttest totals for PLATO AM and PM classes, employing presubtests, coded teacher effect, quadratic pretest terms, and interactions as covariates. The technique of stepping in certain variables, while determining the potential effects of those not yet in the regression, made it possible to decide on a minimal set of covariates to reduce error variance without unduly degrading degrees of freedom for the error estimate.

The combined analyses for main effects and interactions are presented in Table 6.5.4 For PLATO AM teachers, PAK and PEK are combined, since common regression estimates are appropriate. For PM teachers, PFK and PIK require unique regression estimates for the Metropolitan Primer dependent variable. They are appropriately combined for the Special Reading Test.

Examination of the results uncovered a significant interaction on the Primer involving PIK's classes, and on the SRT for both PM PLATO classes. A quadratic term, pre-alphabet squared, pre-word meaning and the Special Reading pretest displayed highest correlations with the posttest totals and were selected as covariates.

TABLE 6.5.4

1975-76 KINDERGARTEN MID-YEAR ACHIEVEMENT

REGRESSION ESTIMATES

	PLATO AM						PLATO PM			
	Teachers PAK and PEK				Teacher PFK		Teacher PIK		Teachers PFK and PIK	
	Metropolitan Primer		SRT*		Metropolitan Primer		Metropolitan Primer		SRT*	
	n				n		n		n	
	β	t	β	t	β	t	β	t	β	t
	R = .71		R = .78		R = .87		R = .89		R = .81	
PLATO	-4.66	-2.18	-1.94	-1.86	-8.73	-2.75	-15.14	-3.35	-5.49	-1.85
PRE SRT*	.79	2.69	.94	6.75	1.12	3.11			.72	4.39
PRE ALPHABET²	.07	4.87	.02	2.46	.11	5.77	.11	7.89	.02	2.[illegible]
PLATO x PRE WORD							1.90	4.05	.85	2.65
AVERAGE EFFECT (Pre Word at Mean)	-4.66		-1.94		-8.73		1.58		1.71	

*SRT Special Reading Test

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TABLE 6.5.5

SPRING 1976 KINDERGARTEN METROPOLITAN PRIMER
REGRESSION ESTIMATES

	PLATO AM		PLATO PM			
	Teachers PAK & PEK n = 62		Teacher PFK n = 25		Teacher PIK n = 33	
	R = .75		R = .91		R = .87	
	τ	t	τ	t	τ	t
PLATO	-3.31	-1.38	-5.23	-1.85	-11.64	-2.05
PRE SRT	.91	5.22	.88	2.83		
PRE ALPHABET					− 6.47	-2.83
PRE $ALPHABET^2$	.09	2.82	.12	7.48	.42	3.91
PLATO x PRE WORD					1.31	2.28
AVERAGE PLATO EFFECT (Pre Word at Mean)	-3.31		-5.23		0.04	

Table 6.5.5 gives the results of regression analyses with end-of-year Metropolitan Primer scores as the dependent variable, the curriculum-referenced pretest, the Metropolitan Readiness test, treatment conditions and interactions as independent variables. It should be kept in mind that the PLATO effect in this analysis represents the contrast between the effect of being exposed to PLATO in both semesters vs. the effect of such exposure in the second semester only. For the two teachers who began PLATO with their morning classes, the significant covariates were again the curriculum-referenced reading pretest and an accelerating function (quadratic) of the Readiness alphabet pretest. The PLATO effect was again negative, but attenuated, -3.31 points as opposed to the -4.66 points at midyear, and was no longer significant at the .05 level.

In the case of the two teachers who had initiated PLATO with their afternoon classes, expanding the treatment to morning classes in the second semester, it was again not appropriate to pool results. Teacher PFK exhibited a pattern similar to the morning teachers, although with a 5.23 point negative

PLATO effect, again attenuated from the significant negative effect in her classes at midyear, but still approaching significance ($T_{21} = -1.85$, $p < .10$).

In the case of teacher PIK, both linear and quadratic terms of the alphabet pretest contributed significantly to prediction of posttest scores, and the interaction of treatment with Metropolitan Readiness Word Knowledge pretest was again significant, with children one standard deviation below the pretest mean showing a negative PLATO effect of -4.36 points, PLATO children one standard deviation above the word knowledge pretest mean showing an advantage of 4.45 points, and full-year PLATO children at the mean showing essentially no difference from the group that had received PLATO only in the spring.

Thus the full-year kindergarten achievement results are in close agreement with the first semester outcomes, suggesting a more or less equivalent progress for the beginning and continuing groups of children during the second semester, when both were exposed to PLATO. This parallel growth under comparable treatments is evidence that the negative PLATO effect in the first semester was genuinely a result of the treatment difference, rather than of some unmeasured pre-existing difference among the children. The diminution of the magnitude of the negative effect, and the continuing interaction with pretest word knowledge in the class of teacher PIK gives support to the notion that the negative PLATO effect did not apply to children with sufficiently developed reading readiness. However, since the achievement gap did not close appreciably in the spring, it appears that the first semester's PLATO experience did not provide such development in readiness.

First Grade 1975-76

In the pilot year, a negative PLATO effect was found on the Metropolitan Primary instrument in grade 1. The apparent lack of sufficiently challenging lesson material for the more advanced first graders coupled with this result contributed to PERC's decision to recruit additional kindergarten teachers and to the evaluator's decision to focus attention on this younger group. The demonstration year's finding of an interaction between initial ability and positive achievement in kindergarten led us to recheck first-grade effects. Although the refocusing on kindergarten precluded either a strong design or thorough measurement, the success of the able kindergarten students suggested that grade-one students might find similar success in the revised demonstration year curriculum.

No grade-one control classes were tested in the demonstration year. However, five first-grade PLATO classes were tested primarily to provide formative data to PERC concerning the validity of on-line pupil assessment and to help assess the impact of increased emphasis on teacher lesson prescription. Three of these five classes were taught by teachers who had used PLATO in the pilot year; thus posttest scores, obtained at the end of April and in early May, could be compared across years. Unfortunately, pretesting occurred near the end of October during the pilot year, and at the beginning of September during the demonstration year, resulting in generally lower and noncomparable pretest scores for the demonstration year.

Table 6.5.6 gives the Metropolitan pre- and posttest scores for the five classes, with the corresponding scores for the three pilot-year classes taught by teachers PB1, PD1, and PG1.

TABLE 6.5.6

Pilot and Demonstration Year Grade 1 Test Means - Metropolitan Primer Pretest and Metropolitan Primary Posttest

TEACHER	PB1				PC1		PD1				PG1				PH1	
	1974-75		1975-76		1975-76		1974-75		1975-76		1974-75		1975-76		1975-76	
Primer	mean	s.d.	mean	s.d.	mean	s.d.	mean	s.d.	mean	s.d.	mean	s.d.	mean	s.d.	mean	s.d.
Listening	33.2	4.7	26.1	6.8	26.2	7.3	31.7	4.2	22.5	7.8	26.1	9.2	27.4	6.4	19.4	9.6
Reading	22.7	4.1	17.0	5.3	19.0	4.7	23.2	3.4	17.7	5.9	19.6	6.3	18.8	5.6	13.5	7.7
Primary																
Word Knowledge	29.5	5.9	28.6	7.1	23.0	8.3	27.8	6.5	24.8	7.7	28.7	7.7	29.0	6.9	24.7	9.2
Word Analysis	34.7	5.5	32.6	6.6	30.2	5.5	34.8	4.9	29.2	8.7	30.8	9.7	32.8	7.4	29.9	9.4
Reading	32.9	8.4	27.2	12.2	23.9	11.4	25.4	11.4	22.4	11.3	25.3	12.5	28.3	11.7	25.5	13.2

Of the three cross-year comparisons, only those for teacher PG1 represent a demonstration-year posttest improvement. However, the fact that her demonstration-year class attained pretest means at the beginning of September comparable to those of the pilot-year class in the third week of October, suggests that her 1975-76 group was considerably more able than her pilot-year group, and does not offer evidence that the reading curriculum was more effective for first graders in the demonstration year.

Other than in the case of this teacher, demonstration-year posttest scores are generally lower than pilot-year grade 1 scores.

Although pretest scores are also low for those demonstration-year classes, the fact that they were obtained earlier in the year prevents the inference that demonstration-year first graders were initially lower on readiness than pilot-year first graders. If we are prepared to assume that the two groups of children were generally comparable, there is no evidence of improvement in effectiveness of the PLATO elementary reading curriculum for first graders in its second year of implementation. If, on the other hand, we argue that demonstration-year PLATO children's pretest scores are lower than could be explained by the testing time differential, we might conclude that PLATO no longer had a negative effect in grade 1, but that its positive effect was not sufficient to bring scores up to the pilot-year control class averages of 29.1, 33.1, and 27.6 on the posttests.

The PLATO Elementary Demonstration

Educational Outcome Evaluation

Final Report

VOLUME II

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and

Judith A. Morgan

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National Science Foundation

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VOLUME II

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VOLUME II

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Chapter 7

Item Level Results

7.1 Comprehensive Test of Basic Skills

The CTBS Arithmetic Test, Level 2, Form R, consists of a 48-item computation section, covering basic operations on whole numbers, decimals, and fractions, a 30-item concepts subtest, covering representation of fractions, units, place value, vocabulary, notation and estimation, and a 20-item applications subtest consisting of "word problems" including questions asking for the appropriate method of solving a problem, rather than for the numerical answer.

Mathematics developers rated items on the test as to their degree of coverage by the strands, and these ratings are summarized in Table 7.1.1. The computation items were rated from 0 to 2 "+'s" by whole numbers and fractions authors. Concepts and applications ratings are given for each group (W, F and G) separately. At each grade level, responses of children with both pre- and post-scores were analyzed to determine item difficulty for PLATO and control subjects before and after exposure to the elementary mathematics curriculum, Tables 7.1.2 to 7.1.12 give item difficulties for the six groups on the three tests.

Of particular interest to assessing the impact of PLATO are those items on which PLATO pupils showed considerably more or less progress than did comparison pupils. It must be recalled that changes in item difficulty reflect differing teacher emphases as well as the effect of the computer lessons, and that items which were extremely easy at pretest preclude large differences in positive growth because of ceiling effects. Nevertheless, the comparison of item data is quite instructive.

The computation subtest is presented in a spiral structure, with three 16-item cycles, of four items each in addition, subtraction, multiplication and division. The first cycle of questions deals with 2- and 3-digit addition and subtraction of whole numbers, and multiplication and division by single-digit numbers. The second cycle includes column addition and subtraction of 4-digit

TABLE 7.1.1

CTBS COMPUTATION ITEM CONTENT AND COVERAGE
(++ = EMPHASIZED)
(+ = COVERED)

ITEM			CONTENT	PLATO COVERAGE RATING
1	Addition	2	2 Digit Numbers No Renaming	+
2	Addition	2	2 Digit Numbers With Renaming	+
3	Addition	1	2 Digit Numbers With Renaming	+ +
4	Addition	3	3 Digit Numbers With Renaming	
5	Subtraction	2	3 Digit Numbers No Renaming	+
6	Subtraction	2	3 Digit Numbers No Renaming	+
7	Subtraction	2	2 Digit Numbers With Renaming	+
8	Subtraction	2	3 Digit Numbers With Renaming	+
9	Multiplication		1 Digit By 3 Digit Number	+
10	Multiplication		1 Digit By 3 Digit (Multiple of 100)	+
11	Multiplication		1 Digit By 2 Digit Number	+ +
12	Multiplication		1 Digit By 2 Digit With Carrying	+ +
13	Division		2 Digit By 1 Digit Number	+
14	Division		2 Digit By 1 Digit Number	+
15	Division		2 Digit By 1 Digit Number	+
16	Division		3 Digit By 1 Digit Number	+
17	Addition	4	4 Digit Numbers	
18	Addition	4	2 Place Decimals (Dollars and Cents)	
19	Addition	2	1 Place Decimals	+
20	Addition	4	2 Place Decimals With Multiple Carrying	
21	Subtraction		3 Digit From 4 Digit Number	
22	Subtraction	2	4 Digit Numbers	
23	Subtraction	2	3 Digit (Dollars and Cents)	+
24	Subtraction		3 Digit From 4 Digit Decimal With Renaming	

TABLE 7.1.1 (CONT.)

25	Multiplication	1 Digit By 3 Digit	+
26	Multiplication	1 Digit By 4 Digit	-
27	Multiplication	Whole Number By 2 Place Decimal	+
28	Multiplication	2 Digit Numbers	+
29	Division	3 Digit By 1 Digit	+
30	Division	4 Digit By 1 Digit	
31	Division	4 Digit Decimal By 1 Digit	
32	Division	3 Digit By 1 Digit	+
33	Addition	Fractions Like Denominators	+ +
34	Addition	Fractions Unlike Denominators	+ +
35	Addition	Whole Number and Mixed Number	+ +
36	Addition	Two Mixed Numbers Unlike Denominators	+ +
37	Subtraction	Two 1 Place Decimals	+
38	Subtraction	Identical Fractions (a - a = o)	+ +
39	Subtraction	Two Fractions Like Denominators	+ +
40	Subtraction	Whole Number From Mixed Number	+ +
41	Multiplication	2 Digit Number By 4 Digit Decimal (Dollars and Cents)	
42	Multiplication	2 Fractions	+
43	Multiplication	Whole Number and Fraction	+ +
44	Multiplication	2 Fractions	+
45	Division	2 Decimals (Dollars and Cents)	+
46	Division	3 Digit By 1 Digit With Remainder	+
47	Division	Identical Fractions (a ÷ a = 1)	
48	Division	Whole Number Divided By Fraction	+

TABLE 7.1.1 (CONT.)

CTBS CONCEPTS ITEM CONTENT AND COVERAGE
(W = WHOLE NUMBERS STRAND)
(F = FRACTIONS STRAND)
(G = GRAPHS STRAND)

ITEM	CONTENT	COVERAGE W	F	G
1	Word to Numeral Representation	+		
2	Longest Distance (Feet and Inches)			
3	Open Sentence: Subtraction			+
4	Pictorial Representation Of Fractions		+	
5	Units: Inches to Miles			
6	Value of Coins			
7	Pictorial Representation of Fractions		+	
8	Percent			
9	Place Value			
10	Calendar			
11	Open Sentence: Subtraction			+
12	Number Series			+
13	Open Sentence Multiplication			+
14	Transitivity - Word Problem			
15	Estimation and Measurement		+	
16	Place Value			
17	Place Value			
18	Size of Fractions		+	
19	Place Value (One's Place)	+		
20	Missing Information - Average			
21	Place Value (Hundreds)			
22	Vocabulary (Diameter)			
23	Vocabulary (Quotient)			
24	Number Series			+
25	Vocabulary (Square Feet)			

TABLE 7.1.1 (CONT.)

		W	F	G
26	Open Sentence Multiplication			+
27	Time			
28	Estimation		+	
29	Comparing Fraction and Percent			
30	Vocabulary (Diagonal)			

CTBS APPLICATIONS (WORD PROBLEMS)

		W	F	G
1	Hours To Minutes			
2	Multiplication	+		
3	Division	+		
4	Money Addition and Subtraction	+		
5	Division (Which Operation?)	+		
6	Multiplication	+		
7	Cost / Month to Cost / Year	+		
8	Division and Multiplication			
9	Multiplication	+		
10	Multiplication (Which Operation?)	+		
11	Fractions and Division		+	
12	Temperature (Negative Numbers)			+
13	Percent			
14	Yards to Feet			
15	Division of Whole Number by Fraction			
16	Multiplication and Division			
17	Sum and Difference			
18	Multiplication Fraction (Which Operation)		+	

TABLE 7.1.1 (CONT.)

		W	F	G
19	Average			
20	Rate And Distance	+		

numbers including decimals, and more difficult multiplication and division problems. The final cycle involves fractions, multiplication and division of decimals, and mixed numbers.

Examining the results in grade 4, Table 7.1.2, we can see PLATO students are enjoying a relative pre-post gain of 20* or more percentage points more than control children's on items 13, 24, 28, 30-33, 37, 39-41, 46, and 47. Of these, items 13, 30-32, and 46 involve division by a single-digit number, 24 and 37 require subtraction of decimals and 28 and 41 involve multiplication of 2-digit numbers. The remaining four high-growth items involve fractions and mixed numbers. PLATO students grew more than control students on 23 of the remaining 35 items, and on all but one of the more difficult items from item 24 on. The exception is item 36, involving the addition of mixed numbers with unlike denominators, passed by 19.6% of PLATO and 17.5% of control students at pretest, but by 39.2% and 47.4% respectively at posttest. It appears that the significant positive effects of PLATO in grade 4 computation total score were concentrated on the more difficult whole number operations, fractions, and decimals. This effect may therefore be classed as acceleration, a tutorial effect, rather than only the consolidation of basic whole number operations that might be expected from drill and practice at this grade level.

In grade five, the overall PLATO effect on CTBS computation total scores, as reported in Section 6.2, was positive, but not significant. In schools II and III, PLATO 5th graders gained less than their non-PLATO counterparts, while in the remaining schools, children in PLATO classes appeared to benefit from the

*The 20% figure was selected for convenience of description. With 50 subjects in a group and maximum item variance, it represents two standard deviations.

TABLE 7.1.2

CTBS COMPUTATION

GRADE 4

PERCENT CORRECT AT PRE- AND POSTTEST

	PLATO n=51		CONTROL n=57	
ITEM	PRE	POST	PRE	POST
1	96	100	89	98
2	94	98	75	98
3	90	90	86	89
4	73	78	67	79
5	84	90	84	96
6	80	90	86	84
7	69	88	61	81
8	78	86	70	84
9	69	92	53	88
10	53	88	49	82
11	49	92	46	81
12	55	92	49	79
13	47	96	61	86
14	59	94	65	89
15	45	96	56	88
16	14	75	21	70
17	53	69	44	58
18	73	82	61	74
19	57	80	51	61
20	33	73	42	67
21	33	80	33	70
22	27	57	18	39
23	49	78	47	81

TABLE 7.1.2 (CONT.)

	PLATO n=51		CONTROL n=57	
ITEM	PRE	POST	PRE	POST
24	20	63	19	37
25	29	78	19	61
26	27	71	19	51
27	16	67	14	47
28	12	71	18	51
29	25	73	18	63
30	20	69	21	49
31	14	73	16	53
32	8	55	14	28
33	18	59	25	35
34	4	20	9	21
35	25	61	16	44
36	20	39	18	47
37	14	55	12	26
38	31	76	28	54
39	20	63	16	32
40	27	59	21	33
41	6	45	9	25
42	10	27	14	21
43	16	43	16	30
44	14	51	12	33
45	18	37	16	21
46	10	43	23	19
47	12	49	18	25
48	14	25	12	12

treatment. Examination of item statistics for all fifth graders, Table 7.1.3, reveals a pattern similar to that observed for fourth grade, but shifted. That is, PLATO groups appear to be at a slight disadvantage in growth in the first part of the test, showing greater growth on only 13 of the first 33 items. Most differences are small, but five of the above show at least 7* points in favor of the control group, and the PLATO group shows this much advantage on three items. Beginning with the more difficult fractions and decimals items at the end of the test, the situation reverses. The PLATO group outperforms the non-PLATO group on 11 of the last 15 items, showing a relative gain of seven points or more on seven of these. The exceptions, items 39-41, are among the easier items of this set, dealing with subtraction with like denominators and multiplication involving a whole number and dollars and cents. In all but three of the cases in which control children grew more than PLATO children, they began from a lower pretest baseline. PLATO students outgained control students, although starting from an equal or higher pretest score on eight items. Of the 233 5th graders in the analysis, one-third were from school III, in which the apparent effect of PLATO was negative. The PLATO teacher, PF, in school III had placed low emphasis on whole-numbers skills in his teaching and had prescribed little sequential whole-numbers strand work for his class (although many of the games they chose dealt with whole numbers), stating that most of his children already knew the material. Although teacher PF expressed preference for teaching social studies rather than mathematics and felt PLATO forced him to expand his "contract system" of individual instruction, he was quite positive about PLATO. In the previous year, school III had "streamed" its 5th graders, and teacher PF taught a very able class. It is possible that this experience affected his assessment of 5th graders computational ability. In any event, Table 7.1.4 gives

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*One standard deviation when $p = .5$ and $n_1 = 109$, $n_2 = 124$.

TABLE 7.1.3

CTBS COMPUTATION

ALL GRADE 5

PERCENT CORRECT AT PRE- AND POSTTEST

	PLATO n=109		CONTROL n=124	
ITEM	PRE	POST	PRE	POST
1	98	98	99	100
2	96	96	96	95
3	97	96	93	94
4	76	85	78	86
5	95	95	95	97
6	96	96	94	96
7	84	89	83	81
8	83	90	86	89
9	90	86	86	87
10	87	90	74	88
11	[illegible]	93	87	97
12	84	95	78	90
13	89	95	85	93
14	92	95	90	94
15	88	96	82	90
16	61	82	53	83
17	75	86	61	77
18	90	88	84	89
19	63	81	67	84
20	71	77	69	79
21	77	83	77	81
22	61	77	58	72
23	83	90	85	90

TABLE 7.1.3 (CONT.)

	PLATO n=109		CONTROL n=124	
ITEM	PRE	POST	PRE	POST
24	60	76	61	73
25	69	82	65	85
26	62	85	67	79
27	51	73	50	73
28	50	80	52	77
29	62	83	60	82
30	58	78	67	78
31	61	79	64	86
32	50	74	46	77
33	40	65	35	62
34	12	47	9	35
35	58	77	70	81
36	25	64	31	59
37	35	62	40	60
38	59	86	63	81
39	50	72	42	75
40	59	75	60	77
41	40	61	34	63
42	21	44	28	34
43	30	48	30	46
44	39	71	41	68
45	26	59	35	54
46	32	54	27	43
47	39	72	30	63
48	19	23	22	27

TABLE 7.1.4

SCHOOL III

CTBS COMPUTATION

GRADE 5

PERCENT CORRECT AT PRE- AND POSTTEST

	PLATO n=28		CONTROL n=50	
ITEM	PRE	POST	PRE	POST
1	96	100	100	100
2	93	93	96	98
3	96	89	98	98
4	86	82	80	88
5	96	89	98	98
6	96	86	96	98
7	89	79	86	90
8	93	82	88	100
9	93	86	94	94
10	93	79	74	94
11	100	82	88	100
12	82	93	82	100
13	93	89	80	100
14	93	82	90	100
15	79	96	86	98
16	64	71	54	92
17	86	82	66	82
18	93	82	90	98
19	71	82	68	88
20	82	68	70	88
21	93	75	74	88
22	64	71	72	86
23	79	82	84	94

TABLE 7.1.4 (CONT.)

	PLATO n=28		CONTROL n=50	
ITEM	PRE	POST	PRE	POST
24	54	64	62	86
25	71	71	70	86
26	50	71	70	94
27	57	68	52	76
28	57	79	56	86
29	50	68	56	86
30	43	75	62	82
31	46	64	62	92
32	39	64	48	88
33	36	54	28	74
34	7	36	10	60
35	46	75	68	84
36	18	50	32	80
37	29	57	42	66
38	46	86	60	86
39	36	61	32	78
40	50	79	60	84
41	39	54	34	76
42	21	50	30	42
43	11	32	26	58
44	46	64	42	70
45	18	61	34	52
46	36	54	20	54
47	29	66	28	74
48	11	14	18	30

results of the computation test in school III. It is evident that the PLATO class in this school was atypical in level of performance in computation, although not in pattern, actually declining in percentage passing 14 of the first 20 items from pre- to posttesting while improving, although generally not as much as the school III comparison classes on the later, more complex items. The only items on which this PLATO class showed appreciably more growth than did the non-PLATO classes were 30, 35, 38, 42, and 45, involving fractions, division, and decimals. This decline in basic computation performance among a sizeable group of treatment subjects was sufficient to decrease the average treatment effect in computation to below significance.

Table 7.1.5 shows the item results for the remaining fifth-grade pupils, excluding school III, and reveals a pattern quite similar to that observed in grade 4: small positive differential gains on the early items and large gains in favor of PLATO children on later problems (particularly 24, 26, 34, 36, 43, and 46). The major contract between these grade-5 results and those in grade 4 is in absolute, rather than differential, gain: in grade 4 both PLATO and control subjects show large gains on the simple multiplication items 9-16 while grade 5 children begin nearer ceiling on these items. The results do not appear to be artifacts of differential speed of working, since comparable percentages of children attempted the final items in both groups at pretest (70% and 74%) and at posttest (91% and 93%).

This school III finding suggests that the achievement impact of individual teachers' curriculum emphases both in regular teaching and in prescriptions of computer lessons may be large and further weakens the case for pooling PLATO classes indiscriminately.

Not only was the PLATO treatment an "add on" to different individual teachers' coverage of topics, but the PLATO treatment itself varied from classroom to classroom. When, as in the case of teacher PF, information is available which

TABLE 7.1.5
CTBS COMPUTATION
GRADE 5 EXCLUDING SCHOOL III

PERCENT CORRECT AT PRE- AND POSTTEST

	PLATO n=81		CONTROL n=74	
ITEM	PRE	POST	PRE	POST
1	99	98	99	100
2	98	98	96	93
3	98	99	89	92
4	73	86	77	85
5	95	98	93	96
6	96	100	9[illegible]	95
7	83	93	81	76
8	79	93	85	81
9	89	86	81	82
10	85	94	74	84
11	89	96	86	95
12	85	95	76	82
13	88	98	89	88
14	91	99	89	91
15	91	96	80	85
16	60	85	53	77
17	72	88	58	74
18	89	90	80	82
19	60	80	66	81
20	67	80	68	73
21	72	86	78	76
22	60	79	49	63
23	84	93	65	86

TABLE 7.1.5 (CONT.)

	PLATO n=81		CONTROL n=74	
ITEM	PRE	POST	PRE	POST
24	62	80	61	65
25	68	85	61	84
26	67	90	65	69
27	49	75	49	70
28	48	80	50	72
29	67	88	62	80
30	63	79	70	76
31	67	84	65	82
32	53	78	45	69
33	42	69	41	54
34	14	51	8	18
35	62	78	72	78
36	27	69	30	45
37	37	64	38	57
38	63	86	65	77
39	56	75	49	73
40	62	74	61	72
41	41	64	34	54
42	21	42	27	28
43	37	53	32	38
44	37	73	41	66
45	28	58	35	55
46	31	54	32	35
47	42	73	31	55
48	22	26	24	26

appears to aid in the interpretation of differing treatment effects in different schools, it is appropriate to make use of it. However, this information is not complete, and the possibility than other apparent positive or negative PLATO effects are due in varying degrees to unknown differences in teacher emphasis or effectiveness cannot be ruled out under the circumstances of a small, self-selected sample.

In the applications and Test C discussions we will see that in areas which the school III teacher emphasized word problems and graphs, the teacher-computer team achieved a positive effect. However, to definitely apportion the cause between teacher and PLATO is not possible with the information at our disposal.

Turning to the grade-6 computation item difficulties, to be found in Table 7.1.6, we see that PLATO and control children are quite comparable in gains in the first half of the instrument. Although ceiling effects make large differential gains impossible to demonstrate, PLATO children show a small consistent advantage on easy multiplication items 10-12, perhaps reflecting the result of remediation on material simpler than is normally presented in grade 6. PLATO classes also show a slight positive effect on addition of decimals 18-20, and a relatively smaller gain than the controls on more difficult multiplication items 25-38. This negative effect appears in spite of the higher percentage of PLATO children passing each of the four items at posttest, since the PLATO group scored well above controls at pretest. The PLATO curriculum does not emphasize more complex applications of the multiplication algorithm, but rather concentrates on basic understanding of the meaning of multiplication. The outcome is consistent with the suggestion that grade 6 teachers spent relatively little class time on remediation of basic facts, allowing PLATO to demonstrate a remedial effect on the small number of students who still needed help in this area.

TABLE 7.1.6
CTBS COMPUTATION
ITEM DIFFICULTIES
GRADE 6

PERCENT CORRECT AT PRE- AND POSTTEST

	PLATO n=91		CONTROL n=95	
ITEM	PRE	POST	PRE	POST
1	99	97	97	100
2	95	95	96	97
3	91	100	94	94
4	84	87	77	83
5	92	99	90	97
6	93	98	96	100
7	81	89	74	84
8	84	95	80	92
9	84	93	83	92
10	76	97	72	85
11	87	99	91	100
12	86	97	89	93
13	84	96	84	98
14	88	97	84	95
15	92	98	86	97
16	74	89	68	79
17	77	85	69	77
18	82	95	80	90
19	71	87	75	81
20	69	82	67	78
21	78	87	77	75
22	68	69	50	66
23	78	82	81	86

TABLE 7.1.6 (CONT.)

	PLATO n=91		CONTROL n=95	
ITEM	PRE	POST	PRE	POST
24	63	73	51	65
25	86	87	70	84
26	80	86	64	77
27	75	74	56	67
28	67	82	54	77
29	70	90	64	83
30	65	77	69	71
31	67	87	63	73
32	57	77	52	69
33	53	71	32	53
34	36	56	18	39
35	71	82	69	75
36	53	73	38	45
37	56	69	42	66
38	77	82	63	73
39	58	79	52	60
40	64	78	60	72
41	56	67	47	65
42	40	45	33	41
43	42	55	25	38
44	44	74	52	63
45	52	70	40	44
46	47	43	23	31
47	45	71	36	67
48	23	42	23	25

As was the case in grades 4 and 5, larger gains in favor of the PLATO group occurred later in the instrument, on items 30-32, 36, 39, 44, 45 and 48, involving more difficult division of whole numbers and manipulations of fractions. The patterns of change in item difficulties are somewhat distorted in grade 6 because of higher initial performance of PLATO students on a number of these later items. (In addition to items 25-28, PLATO pupils started well ahead on fraction items 22, 33, 36, 38, 43, and division item 46.)

The general pattern that emerges from this detailed examination of PLATO vs. control differences on individual computation items is consistent with our knowledge of the teachers' curricula at the three grade levels and of the PLATO curriculum. The computer lessons appear to have supplemented teachers' efforts in grade 4 in the teaching of basic whole number operations, and in grades 5 and 6 in more complex whole number and fractions operations. In grade 6 some evidence was detected of basic whole number remediation, probably independent of teacher coverage, and strong indications of acceleration in fractions in grade 4 were evident. The dependence of the treatment outcome on teacher emphasis was most evident in grade 5, where a focus on more advanced topics to the exclusion of basic skills in one classroom contributed to a decline in computational ability, in spite of the use of certain PLATO whole numbers games as well as material from the fractions and graphs strands.

The Concepts subtests of the CTBS contained relatively few items directly reflecting objectives of the PLATO curricula in whole numbers and fractions, and none receiving the "emphasized" rating by the developers. Several items in open sentence or series format (3, 11, 12, 13, 24, and 26) relate to graphs strand lessons. However, little time was spent on these lessons by PLATO students. Most of the concepts items deal with topics not stressed in the PLATO curriculum: place value, money, percentage, and vocabulary. That PLATO students did not show a significant average advantage over control students in growth on the concepts total score thus serves to support the contention that significant PLATO effects on other subtests can be attributed, at least partly, to the children's PLATO experience. In spite of the evidence for teacher effects we have seen in section 5.2 and in the item-level computation results, it does not appear that self-selected PLATO teachers were generally more effective in teaching all mathematics topics. The pattern of gains on individual items of the concepts instrument reveals a tendency for PLATO students to show more gain on certain items covered in the PLATO curriculum, less gain on other items presumably addressed by PLATO, and differing patterns on items not related to PLATO.

In grade 4, PLATO students began with an advantage on 25 of the 30 concepts items and showed 10 or more points more growth than did control children on 5 of these items. Of these 5, items 1 and 11 represented topics stressed in the PLATO curriculum, while 9, 14 and 30, dealing with place value, comparison of number size, and vocabulary, were less clearly related to PLATO lessons. Control children attained greater growth on items 6, 7, 10, and 16, of which only item 7, a rather unusual representation of a fraction was rated by the developers as being covered in the PLATO curriculum. None of the differential percentage gains on concepts items in grade 4 were large, both groups showing 10-20% improvement from pre- to posttest on most items. PLATO children showed no growth on items 2 and 6, dealing with length in feet and inches and with money, and control children declined on item 1, word-to-numeral translation, and showed no change on item 14, a transitivity problem. These mixed results on items not emphasized by the PLATO curriculum may indeed reflect differences in teacher emphasis of topics not covered by PLATO, but generally suggest that there was little systematic difference in effectiveness of PLATO and non-PLATO teachers on such topics.

TABLE 7.1.7

CTBS CONCEPTS

GRADE 4

PERCENT CORRECT AT PRE- AND POSTTEST

	PLATO n=51		CONTROL n=56	
ITEM	PRE	POST	PRE	POST
1	78	86	82	73
2	76	75	63	66
3	55	71	48	61
4	25	49	23	41
5	45	71	36	61
6	82	82	75	89
7	59	71	46	68
8	78	88	64	79
9	55	84	59	66
10	76	78	59	75
11	43	73	41	61
12	65	82	55	70
13	55	84	52	80
14	67	80	70	70
15	65	82	57	71
16	53	61	46	73
17	63	80	46	64
18	35	57	36	59
19	61	75	45	57
20	55	75	41	64
21	39	61	30	46
22	16	47	14	48
23	8	33	11	36

TABLE 7.1.7 (CONT.)

	PLATO n=51		CONTROL n=56	
ITEM	PRE	POST	PRE	POST
24	39	65	21	48
25	31	41	20	32
26	25	67	16	52
27	33	65	23	50
28	31	47	25	45
29	25	55	14	38
30	33	69	27	50

In grade 5, PLATO students began with a small initial disadvantage on the concepts items, finding only 12 of the 30 items easier than did the control 5th graders. Generally, changes in item difficulty were quite similar for both groups, although PLATO students did show notably greater growth on items 13, 16, 26, and 27, two of which deal with open sentences relating to graph strand lessons, one dealing with number comparison, and the final one with time. Control children excelled on item 8, comparing percentages. There is no evidence in this grade of a PLATO effect on such items as 1, 4, 7, 12, 18, and 28, which more directly cover PLATO-delivered whole numbers and fractions concepts.

Among 6th graders, PLATO students began with an advantage on about half of the concepts items, but in the case of certain items--11, 20, 21, and 30--this initial advantage was large. PLATO 6th graders exhibited considerably more growth on four items--7, 18, 22, and 29, whereas controls showed large relative gains on six items--3, 11, 13, 26, 27, and 30. Examining the content of these items reveals that the six items on which control children excelled consisted of all four algebraic open sentence items, which related to graph strand lessons, an item about time, and one item assessing knowledge of the term "diagonal." Three of the four items which PLATO children appeared to learn more effectively deal with fractions, but the remaining item, 22, deals with the PLATO-irrelevant term, "diameter." This pattern of results suggests that 6th-grade control teachers were able to teach open-sentence concepts quite effectively without the assistance of PLATO, although the results of curriculum-referenced Test C, discussed in the following section, reveal that other concepts covered by graph-strand lessons, signed numbers and plotting points, were more effectively learned by PLATO 6th graders. The fractions advantage apparent in the computation results is also visible in 6th-grade concepts results.

TABLE 7.1.8

CTBS CONCEPTS

GRADE 5

PERCENT CORRECT AT PRE- AND POSTTEST

	PLATO n=106		CONTROL n=121	
ITEM	PRE	POST	PRE	POST
1	81	88	79	88
2	85	89	77	88
3	60	69	64	65
4	28	54	29	49
5	64	78	65	79
6	90	89	91	93
7	58	75	55	80
8	91	87	83	93
9	75	80	65	78
10	81	89	83	88
11	75	81	72	74
12	76	90	82	90
13	79	96	89	92
14	76	86	81	87
15	75	89	75	80
16	72	92	79	81
17	80	88	77	85
18	47	73	49	80
19	63	75	74	80
20	63	78	71	85
21	54	64	49	60
22	38	62	36	55
23	30	44	26	39

TABLE 7.1.8 (CONT.)

	PLATO n=106		CONTROL n=121	
ITEM	PRE	POST	PRE	POST
24	52	65	54	69
25	37	45	45	51
26	46	83	61	70
27	52	75	57	63
28	58	66	50	65
29	41	58	38	55
30	57	75	62	69

TABLE 7.1.9

CTBS CONCEPTS

GRADE 6

PERCENT CORRECT AT PRE- AND POSTTEST

	PLATO n=41		CONTROL n=71	
ITEM	PRE	POST	PRE	POST
1	85	88	79	77
2	71	78	73	80
3	63	56	61	71
4	24	44	28	39
5	63	73	66	73
6	93	93	85	93
7	49	78	49	54
8	83	76	77	81
9	73	76	80	74
10	80	83	82	90
11	73	80	52	71
12	73	85	75	80
13	88	85	75	87
14	83	85	70	73
15	73	83	59	67
16	63	78	70	83
17	73	73	75	86
18	49	78	37	41
19	61	63	68	70
20	76	78	58	69
21	61	54	41	53
22	29	54	30	37
23	37	54	25	31

TABLE 7.1.9 (CONT.)

	PLATO n=41		CONTROL n=71	
ITEM	PRE	POST	PRE	POST
24	54	66	41	60
25	46	56	48	43
26	59	63	54	73
27	61	66	48	73
28	41	63	44	60
29	37	66	37	34
30	76	73	48	70

Again, the Concepts test item results suggest that PLATO teachers were not uniformly more effective than control teachers on items not covered by PLATO, not even on some items directly relevant to the PLATO curriculum, thus making less plausible the hypothesis that the positive results attained on tests more directly reflecting the PLATO curriculum might be due only to teacher differences.

The CTBS applications subtest consists of 20 "word problems" covering basic whole numbers operations, fractions applications (3 items), conversion, and combinations of operations. The PLATO whole numbers lessons, "real-life word problems," and "ant war" offered practice in certain word-problem forms. Authors indicated those CTBS application items which fit the forms covered by these lessons (Table 7.1.10), but rated no item on this subtest as "emphasized."

PLATO 4th graders scored as high as or higher than control 4th graders at pretest on all but one applications items, and showed more growth than control children on items 2, 4, 13, 15, and 18, while control children gained substantially more on items 5, 8, and 20. The item with largest differential gain for PLATO children was number 18, a problem testing knowledge of the operation corresponding to the phrase, "1/2 of it," while the largest differential gains for control 4th graders occurred on two items not directly covered by the PLATO curriculum; item 8, a combined division and multiplication item, and item 17, a sum and difference intuitive simultaneous equation problem. However, PLATO students also showed large relative gains on items 13 and 15, not specifically emphasized by PLATO, while control children exhibited at least slightly more growth than did PLATO students on five of the items identified as emphasized in the PLATO curriculum. Thus there is little evidence that fourth-grade PLATO students improved in their ability to apply mathematical concepts to verbally presented problems as a result of their PLATO experience.

TABLE 7.1.10
CTBS APPLICATIONS
GRADE 4

PERCENT CORRECT AT PRE- AND POSTTEST

	PLATO n=51		CONTROL n=53	
ITEM	PRE	POST	PRE	POST
1	65	75	47	51
2	73	90	62	68
3	59	80	47	72
4	57	67	57	55
5	53	63	43	64
6	53	67	45	66
7	41	69	38	60
8	69	73	55	74
9	49	78	45	68
10	51	76	47	66
11	41	51	34	47
12	39	47	38	45
13	43	65	43	51
14	33	51	19	45
15	31	55	28	42
16	31	53	28	51
17	29	35	25	45
18	20	51	15	30
19	18	43	17	34
20	25	47	21	45

In grade 5, a significant PLATO effect was obtained on the applications test. However, examination of item results again suggests that this effect was not concentrated on those items specifically emphasized in the PLATO curriculum. PLATO 5th graders gained more than controls on 17 of the 20 items. School III did not appear different from other schools on this test, as it had on the computation test. School III PLATO 5th graders exhibited considerable growth in applications relative to their comparison classes, as did other PLATO 5th graders. PLATO children showed greatest relative gain on item 17, not directly covered in the curriculum. Large gains were also registered on items 4, 7, 14, and 16, of which only the first two were linked to PLATO lessons. Control children showed their greatest relative gain on item 20, covered by PLATO, and slightly greater relative growth on items 1, 2, and 15, the former two items specifically addressed by PLATO. Thus it appears that any impact of the PLATO curriculum on word problems was generalized, and not the direct impact of drill in specific formats. Since PLATO's primary means of communication to the student is through written messages, such a general effect on ability to understand English formulations of mathematical statements might be more to be expected than effects specific to particular problem formats. However, that this effect is limited to grade 5 does not strongly support the developer's suggestion that PLATO might have strong impact on reading skills.

The grade 6 applications item difficulties bear out this lack of PLATO-specific effect. PLATO students showed greatest relative gains on items 6, 8, 10, 15, and 17, of which only 6 and 10 had been identified as emphasized in PLATO lessons, while control 6th graders gained more on items 1, 4, 7, and 18, all of which were so identified.

This examination of relative gains on CTBS items by PLATO and non-PLATO students has led us to conclude that PLATO effects on this standardized test

TABLE 7.1.11

CTBS APPLICATIONS

GRADE 5

PERCENT CORRECT AT PRE- AND POSTTEST

	PLATO n=105		CONTROL n=122	
ITEM	PRE	POST	PRE	POST
1	66	63	57	59
2	79	88	78	89
3	69	83	76	83
4	70	77	75	66
5	59	70	61	67
6	61	74	68	75
7	51	75	60	68
8	70	83	64	69
9	70	79	73	76
10	58	80	58	75
11	50	70	45	61
12	42	54	43	45
13	62	77	66	72
14	48	67	45	51
15	61	68	50	66
16	54	75	52	59
17	34	51	37	32
18	31	48	34	41
19	26	38	34	43
20	47	52	40	61

TABLE 7.1.12

CTBS APPLICATIONS

GRADE 6

PERCENT CORRECT AT PRE- AND POSTTEST

	PLATO n=38		CONTROL n=70	
ITEM	PRE	POST	PRE	POST
1	50	55	48	63
2	63	79	68	77
3	74	68	68	80
4	79	74	61	79
5	50	66	46	57
6	53	82	62	70
7	76	68	59	67
8	61	76	66	69
9	58	79	62	74
10	50	76	59	71
11	50	58	32	43
12	45	42	38	41
13	55	61	59	63
14	47	50	38	39
15	45	58	42	41
16	55	68	42	57
17	26	39	25	23
18	39	39	17	41
19	47	42	30	34
20	50	55	37	37

were particularly due to advantages in learning more complex whole numbers operations and fractions and decimals concepts. Some evidence was adduced of a remedial effect on simpler whole numbers operations for lower ability sixth graders. A significant effect on word problems in grade 5 appeared to be due to a generalized effect on translating English into numerical formats, rather than to drill on specific problem types.

The CTBS item level results generally support the interpretation that the impact of the PLATO mathematics lessons was considerable, particularly at the higher levels of the elementary curriculum. The PLATO curriculum may thus be contrasted with those drill-and-practice curricula that aim principally at building facility with number facts and specific problem formats.

7.2 Curriculum-Referenced Tests

For each of the three curriculum-referenced mathematics instruments, the percentage of PLATO and control subjects passing each item at pretest and posttest was computed. Only children who had scores for both instruments were included in the sample. For the whole numbers instrument, results for grades 4, 5, and 6 are given in Tables 7.2.1 to 7.2.3.

Whole numbers. In grade 4, PLATO subjects showed significant gains in total score over their non-PLATO peers. Examination of Table 7.2.1 reveals that these gains were not uniform across all whole numbers topics, but appeared in the more difficult items which are not normally emphasized in the grade 4 curriculum.

Thus, the large impact of the PLATO whole numbers curriculum at this level may be attributed to enrichment of understanding and acceleration, more than to the enhanced mastery of elementary operations skills that might be expected to characterize a drill-and-practice emphasis.

Specifically, control children may be seen to have progressed slightly more than PLATO pupils on the first two items, involving simple addition and multiplication, while on items 3 and 4, involving division of a five-digit number by a two-digit number, and translating a six-digit number from words to numerals, the PLATO advantage is dramatic: both items being failed by essentially all PLATO and control children at pretest, and passed by about 50% of PLATO subjects and 10% or fewer of control subjects at posttest. An equally striking PLATO effect is apparent for item 22, testing the understanding of multiplication as the result of building up from doubling.

Large PLATO effects are in evidence for a number of the remaining items: 7, 8, 11, 12, 13, 16, 17, 19, 20, and 21. Most of these items deal with alternative representations of numbers (e.g., making 16 from the numbers 4, 3, and 1) and writing and solving number sentences for verbally or pictorially presented situations. Item 20 requires the child to give a graphic representation of a meaning of dividing 21 by 3.

Other items do not reflect large differential PLATO gains. For all but items 1 and 5 (i.e., 9 x _ = 9), results for fourth graders are that a higher proportion of PLATO 4th-grade children pass the item at posttest than do control children. However, this does not lead to large differential gain in the balance of the items because PLATO children had begun with a considerable initial advantage. This "head start" is particularly apparent in items 1, 2, 6, 9, 10, 14, and 15. Since these fourth graders had not been exposed to PLATO itself prior to testing, and did not appear markedly superior to the control children on the earlier CTBS pretest, this initial advantage in some elementary problems and in such concepts as the variety of possible names for a number (6), the number line (9), inequalities (10), and graphic representations of multiplications (14 and 15) may represent the outcome

TABLE 7.2.1

PERCENT PASSING ITEMS ON CURRICULUM-REFERENCED TEST A:

WHOLE NUMBERS

GRADE 4

	PLATO n=48		CONTROL n=51	
ITEM	PRE	POST	PRE	POST
1	83	71	65	75
2	73	90	55	84
3	0	48	0	4
4	4	10	0	10
5	75	92	73	92
6	38	67	24	53
7	31	79	31	49
8	15	40	2	[illegible]
9	56	65	39	59
10	77	83	63	78
11	33	81	29	53
12	33	60	31	37
13	21	65	20	43
14	21	48	6	24
15	35	60	18	55
16	38	81	31	55
17	19	79	16	51
18	33	65	22	51
19	25	69	12	35
20	50	73	51	57
21	21	60	18	25
22	2	42	4	6
23	0	4	0	2

of differing emphasis in instruction during the first month of school, prior to the curriculum-referenced test administration and the initiation of PLATO. Two of the fourth-grade PLATO teachers had previous experience with the curriculum and devoted time early in the year to orienting children to some of the new kinds of problems they would encounter in early PLATO whole numbers lessons--such as alternative names for today's date, number line lessons, and arrays. Thus while PLATO appears to have further enhanced these skills, not all additional learning on these introductory topics can be attributed to the computer-delivered lessons. While it is not possible to attribute all PLATO grade-4 effects to the machine alone, the developers intended that the teacher and computer would work together, and the whole numbers pretest and posttest item results suggest that to some degree, this occurred, with the result of increased understanding of basic operations for children exposed to the PLATO-teacher combinations.

Turning to the grade-5 whole numbers item results, a group for whom the PLATO effect on total score was not significantly positive, we find little evidence of a systematic pretest advantage for PLATO students. While PLATO pupils enjoyed a 13% pretest margin on item 14, a 10% edge on item 6, and 9% on item 8, control children began ahead on items 1, 5, and 21.

PLATO 5th graders made high gains relative to control children only on items 2, 21, and 22, whereas control children made substantially more growth on items 10, 14, and 18.

Although the large PLATO effects on the visual and word problem item 21 and the meaning of multiplication item 22 are consistent with grade 4 results, the meaning of division item 10 (If you have 87¢, what is the greatest number of dimes you could have?) does not show the PLATO advantage seen in grade 4. The fact that one grade-5 PLATO teacher did not emphasize whole numbers in his instruction or in

TABLE 7.2.2

PERCENT PASSING ITEMS ON CURRICULUM-REFERENCED TEST A:

WHOLE NUMBERS

GRADE 5

	PLATO n=104		CONTROL n=119	
ITEM	PRE	POST	PRE	POST
1	78	79	87	75
2	80	95	82	87
3	16	56	11	53
4	27	36	31	46
5	83	94	92	97
6	67	80	57	68
7	54	72	55	71
8	22	31	13	26
9	67	77	64	71
10	82	85	74	87
11	70	87	64	82
12	61	65	55	65
13	49	63	49	64
14	43	45	30	44
15	46	52	48	55
16	69	88	62	85
17	63	86	60	82
18	53	62	52	71
19	52	69	50	63
20	57	67	63	71
21	46	66	55	60
22	15	34	12	24
23	2	14	3	14

PLATO strand assignments, coupled with the evidence that most control children mastered most of these whole numbers concepts by the end of grade 5 without recourse to PLATO, results in little new information from this pattern of item difficulties.

In grade 6, however, the whole numbers total PLATO effect was more positive, although still not reaching significance. Here there is again evidence of initial PLATO advantage, particularly on items 3, 6, 7, 8, 9, 13, and 14, partly due to the inclusion in the PLATO group of some children with previous PLATO exposure, with noticeably greater PLATO growth on items 1, 18, 21, and 22, and relative control gains on items 9, 12, and 13.

These whole numbers items are not markedly easier for control children at the end of sixth grade than at the end of grade 5. Although PLATO children did better than controls at posttest on all but items 4, 5, 12, and 23, relative growth of PLATO over control children occurred in only the few items noted, even though the last two items on this test were specifically covered in the PLATO curriculum.

Fractions. The 20-item curriculum-referenced fractions test again showed some evidence of an initial advantage for PLATO 4th graders, as did the whole numbers instrument. This pretest lead is evident in items 1, 5, 6, 10, and 18. Control 4th graders found only item 4 ("Write a mixed number name for $\frac{8}{3}$ ") initially notably easier. However, at posttest, 60% of PLATO children successfully responded to this item, as compared to 22% of control children. Most items were extremely difficult for both groups at pretest, and remained so for control children at posttest. Control children evidenced more growth on items 5, designed to assess understanding of a fraction of a turn as generalized

TABLE 7.2.3

PERCENT PASSING ITEMS ON CURRICULUM-REFERENCED TEST A: WHOLE NUMBERS

GRADE 6

	PLATO n=83		CONTROL n=90	
ITEM	PRE	POST	PRE	POST
1	82	88	82	80
2	86	96	80	89
3	42	67	27	54
4	42	53	43	56
5	92	96	96	97
6	73	80	56	64
7	63	86	48	69
8	36	52	23	39
9	78	76	58	67
10	76	87	78	84
11	61	93	57	84
12	64	67	57	72
13	63	67	44	63
14	48	61	36	53
15	55	71	41	63
16	71	95	67	84
17	67	87	59	80
18	54	73	59	66
19	64	72	57	69
20	57	76	50	57
21	51	64	42	63
22	22	49	11	29
23	5	13	6	19

TABLE 7.2.4

PERCENT PASSING ITEMS ON CURRICULUM-REFERENCED TEST B:

FRACTIONS

GRADE 4

	PLATO n=45		CONTROL n=50	
ITEM	PRE	POST	PRE	POST
1	40	64	28	46
2	40	64	38	58
3	38	62	36	46
4	4	60	16	22
5	38	60	16	56
6	18	44	10	24
7	2	67	6	24
8	13	29	8	26
9	11	58	14	20
10	29	47	12	20
11	20	60	18	36
12	9	38	6	14
13	0	49	4	14
14	0	22	0	2
15	4	22	6	10
16	2	27	6	8
17	11	49	6	26
18	13	44	4	38
19	7	22	6	8
20	0	11	0	0
21	0	18	2	0
22	2	38	0	0
23	2	40	0	2

TABLE 7.2.4 (CONT.)

	PLATO n=45		CONTROL n=50	
ITEM	PRE	POST	PRE	POST
24	3	47	2	0
25	0	36	0	0
26	2	44	0	0
27	0	42	0	0
28	0	36	0	0

from the "programming" PLATO lessons Skywriter and Spiderweb, item 8, involving subtraction on the number line, and item 18, requiring multiplication of fractions. In each of these cases, the final proportion of PLATO subjects passing the item exceeded that of control children, but the change did not maintain the initial PLATO advantage. On the remaining 25 items, however, PLATO 4th graders outstripped their control counterparts, most dramatically on items covering mixed numbers (4, 9, 11), equivalent fractions (7, 13, 16), and decimals (22-28). These last items remained essentially impossible for control 4th graders at the year's end, but were passed by about 40% of PLATO subjects. While no item was mastered by more than two-thirds of either 4th-grade group at posttest, 17 of the 28 items were passed at posttest by at least 40% of PLATO children as compared to four items found this easy at posttest by controls. Seven items were passed at posttest by at least 60% of PLATO children, while no item yielded to this large a percentage of control children.

Thus the impact of the PLATO fractions curriculum, and of 4th-grade PLATO teachers' extra emphasis on fractions, partly inspired, according to their reports, by the PLATC on- and off-line materials, was large and positive. Most of the material, particularly the mixed number and decimal portions, represented acceleration for 4th graders. The positive PLATO results for traditional introductory representation of fractions with pict.res (1, 2, 3), and by estimation on the number line (6, 10) and equivalent fractions (7, 13), suggest that PLATO also supplemented teachers' efforts on these items for which the occurrence of growth among control children suggests that the specific topics were also covered in control classes.

In grade 5, the groups were initially quite comparable, with the

TABLE 7.2.5

PERCENT PASSING ITEMS ON CURRICULUM-REFERENCED TEST B:

FRACTIONS

GRADE 5

	PLATO n=103		CONTROL n=116	
ITEM	PRE	POST	PRE	POST
1	40	71	38	52
2	42	66	48	68
3	40	61	39	43
4	17	66	18	52
5	60	62	40	67
6	28	50	28	37
7	17	71	17	47
8	24	49	17	28
9	28	63	22	46
10	34	50	28	40
11	36	75	34	79
12	19	29	23	25
13	20	52	19	41
14	7	38	1	28
15	17	35	10	25
16	12	43	8	22
17	22	44	20	34
18	39	70	47	73
19	12	44	4	22
20	0	17	0	26
21	6	20	5	25
22	5	45	3	21
23	8	48	7	28

TABLE 7.2.5 (CONT.)

	PLATO n=103		CONTROL n=116	
ITEM	PRE	POST	PRE	POST
24	5	37	7	9
25	2	58	2	31
26	4	59	4	30
27	2	48	1	28
28	3	57	1	32

PLATO group enjoying a large advantage only on item 5. However, with the exception of this item, and items 11, 20, and 21 on addition and multiplication of mixed numbers, PLATO students again showed more growth than controls on most fraction items. Again, large relative gains were observed on equivalent fractions items 7 and 16 and on the decimals items. Interestingly, among 5th graders the representation items 1 and 3 ("Fill in 1/5 of the circles," "color 2/3 of the pie") also showed a considerable relative learning advantage for PLATO. It may be that this introductory material was considered too easy by most 5th-grade teachers, even though only about 40% of 5th graders correctly responded to these items at pretest.

In grade 6, PLATO students again registered large gains on the representation items at the beginning of the test as well as on equivalent fractions and decimals items. The same interpretation of this progress on the elementary, as well as on the more difficult items that was suggested for grade 5 also seems reasonable for the 6th graders.

In summary, PLATO achievement effects on the curriculum-referenced fractions tests were positive, large and clear-cut at all grade levels. PLATO effects were particularly pronounced on the items dealing with equivalent fractions and decimals, and in the upper grades for the "remedial" concept of pictorial representation of fractions.

<u>Graphs</u>. Curriculum-referenced Test C is a 20-item instrument covering concepts of signed numbers, graphing, and examples of linear equations.

While this strand was used least in PLATO classes (about 14% of total time), much of the material is not traditionally emphasized in the intermediate mathematics curriculum, and represented acceleration or enrichment for all three grades. The PLATO graphing strand lessons ranged from games such as "Battleship," aimed at

TABLE 7.2.6

PERCENT PASSING ITEMS ON CURRICULUM-REFERENCED TEST B:

FRACTIONS

GRADE 6

	PLATO n=61		CONTROL n=69	
ITEM	PRE	POST	PRE	POST
1	30	68	19	37
2	62	75	35	47
3	38	59	19	29
4	34	71	17	44
5	46	66	45	49
6	33	56	13	44
7	31	74	14	40
8	36	40	12	26
9	31	67	14	24
10	33	47	16	24
11	44	69	36	46
12	21	49	16	13
13	20	47	13	31
14	13	37	4	27
15	25	40	9	18
16	13	48	4	10
17	31	53	9	22
18	54	76	51	67
19	15	39	4	22
20	10	26	0	24
21	10	34	0	24
22	15	54	3	22
23	20	38	9	24

TABLE 7.2.6 (CONT.)

	PLATO n=61		CONTROL n=69	
ITEM	PRE	POST	PRE	POST
24	14	45	12	13
25	11	59	0	30
26	18	60	7	33
27	11	56	0	23
28	15	54	9	30

giving practice in plotting points in two dimensions, with the convention that the first element of an ordered pair represents the x-axis, through the more didactic "Postman Stories," providing concrete examples of addition and subtraction of positive and negative integers, to "Guess My Rule," a difficult trial-and-error introduction to linear graphing. (Many of these lessons had been initially developed in the Madison mathematics project, and were transferred to PLATO with little revision. In the case of "Guess My Rule," it was the evaluators' impression that much of the suspense and excitement that characterized the original use of this inductive technique was lost in the translation process. Such games as "Battleship," and "Torpedo," however, seemed compelling to children and adults alike.)

In grade 4, children were exposed to a very small dose of PLATO graphing lessons. One teacher devoted considerable time to teaching the material in class, using approaches and worksheets developed in her previous year's experience with the PLATO material. but the PLATO effect on total score for this instrument was not significant in grade 4. However, the patterns of item difficulties suggest that, whether due to the efforts of PLATO or teachers, certain topics were learned more or less effectively in demonstration classrooms.

At pretest, PLATO 4th graders began at a distinct advantage on open sentence items 2 and 4, involving parentheses, and items 15 and 16 requiring that a number be found to complete an equation or pattern. Control children were considerably higher at pretest on items 1, 7, 8, 11, and 12 requiring supplying missing numbers in subtraction problems, negative numbers, and providing ordered pairs to locate points on a two-dimensional graph. PLATO 4th-grade students exhibited substantially more growth than controls on items 6, 7, 8, 11, 12, and 20 with the advantage on the point-labeling

TABLE 7.2.7

PERCENT PASSING ITEMS ON CURRICULUM-REFERENCED TEST C:

GRAPHS

GRADE 4

ITEM	PLATO n=46 PRE	PLATO n=46 POST	CONTROL n=53 PRE	CONTROL n=53 POST
1	63	80	74	68
2	70	87	49	87
3	50	96	55	92
4	72	93	58	83
5	26	37	23	45
6	15	28	17	17
7	4	26	25	28
8	2	28	17	25
9	2	13	8	19
10	9	4	6	13
11	9	63	23	40
12	2	35	19	34
13	0	13	9	23
14	4	15	4	11
15	70	76	58	72
16	46	59	30	45
17	4	15	9	25
18	4	15	4	23
19	0	4	0	0
20	7	15	8	6

item 11 being the most striking. Control children showed greater percentage gains on items 2, 4, 5, 10 and 15 - 18, the last set involving functions and graphing. PLATO 4th graders thus seem to have made more progress than controls in adding and subtracting signed numbers and in labelling points on a graph, but to have lost this advantage on concepts deriving from the "guess my rule" sequence of lessons.

In grades 5 and 6, the PLATO effect on the total score of this test was significantly positive. Examining the item difficulties at these grades, it appears that not only signed numbers and labelling points, but the linear function material represented strong areas of growth for PLATO children, with large PLATO effects for items 5, 7, 8, 11, 13, 14, 16, 18 and in grade 5 only, 12, 17 and 20, with only items 3 and 15 in grade 5 being passed at posttest by fewer PLATO than control pupils. Although the lack of comparable impact on these more difficult concepts for younger children may be simply due to lack of exposure to the lessons, several teachers judged the "guess my rule," "identity" and "linear graphing" sequences as being markedly more difficult than the remaining PLATO material, and it is possible that the difference in exposure in grade 4 was partly due to teachers' judgments and prescriptions concerning the appropriateness of the material.

Thus, while PLATO classes learned more about signed numbers and labelling points than did controls at all grades, superior learning of the concept of linear functions was apparent only in grades 5 and 6.

TABLE 7.2.8

PERCENT PASSING ITEMS ON CURRICULUM-REFERENCED TEST C:

GRAPHS

GRADE 5

	PLATO n=102		CONTROL n=112	
ITEM	PRE	POST	PRE	POST
1	75	76	57	73
2	84	90	79	82
3	84	93	85	95
4	82	96	87	95
5	32	52	38	37
6	26	46	16	30
7	21	51	16	33
8	15	40	12	23
9	10	25	9	21
10	7	18	6	10
11	22	49	18	19
12	13	43	8	10
13	14	36	7	12
14	9	26	8	9
15	72	85	76	91
16	52	78	63	76
17	10	35	20	15
18	10	40	15	14
19	1	7	0	1
20	6	29	6	9

TABLE 7.2.9

PERCENT PASSING ITEMS ON CURRICULUM-REFERENCED TEST C:

GRAPHS

GRADE 6

	PLATO n=84		CONTROL n=86	
ITEM	PRE	POST	PRE	POST
1	71	83	60	73
2	79	83	77	80
3	90	95	86	87
4	83	96	83	91
5	48	61	43	53
6	30	62	12	28
7	33	61	19	24
8	27	54	15	24
9	14	31	6	10
10	13	30	3	13
11	21	48	10	34
12	21	26	1	21
13	10	37	3	10
14	10	27	5	13
15	80	93	81	91
16	61	86	62	81
17	27	43	2	22
18	25	50	3	20
19	1	11	1	6
20	33	48	9	19

7.3 Attitudes toward Mathematics and PLATO

In this section, we examine results for representative individual items of the demonstration year attitude instrument. Responses to all attitude items appear in Volume II, Appendices.

In order to provide a sense of how school-related attitudes, other than those toward math, were affected during the year by the PLATO program, ten items were included in the questionnaire that focused on attitudes toward nonmathematical topics. Of the ten items, six were oriented toward reading, and the remaining four toward singing, drawing, sports, and school in general. It was hoped that this would facilitate judgments about the extent to which attitude changes were specifically math-related rather than globally school-related.

Baseline item results. For the six reading items, the pretest data revealed no striking differences between PLATO and control groups. The fourth-grade ratings varied more than other grades', but in no consistent direction. At each grade level (4, 5, and 6) the number of items on which the PLATO children displayed a more positive attitude was equalled by the number of items on which the control children displayed a more positive attitude.

In the end-of-year data, there were some differences that appeared worth noting. In all of the items at the 4th grade level, the PLATO group had a more positive attitude toward reading than the control group had. This, however, was less a result of an improvement in the PLATO group's attitude from pre- to posttest than of an increase in negative attitudes of the control group. In the fifth grade, quite a different pattern appeared. In all six items, the control group displayed a more positive reading attitude than the PLATO group's. This appeared to be the result of a slight drop in the attitude ratings for the PLATO group from pre to post and a slight rise in the ratings of the control group.

At the sixth-grade level, there was little difference between PLATO and control or from pre to post. On four of six items, PLATO children gave more positive responses than did control children at the posttest, and on one of these the difference was fairly large (ten percentage points).

Following are two representative items, with the percentage of children who responded "Yes" to them.

		% Responding "Yes"								
		4			5			6		
		Pre	Post	Diff.	Pre	Post	Diff.	Pre	Post	Diff.
I am very proud of the way I read.	P	74	76	+2	66	61	-5	58	62	+4
	C	65	52	-7	69	76	+7	57	55	-2
Reading is fun.	P	72	88	+16	71	68	-3	66	61	-5
	C	80	60	-20	71	75	+4	61	66	+5

With regard to the four other nonmath-related items, the pretest data showed that the 4th-grade PLATO groups displayed more positive initial attitudes than did their controls. In the fifth grade, controls gave higher ratings to two items, and the PLATO group gave them to two. In 6th grade, the PLATO group was more positive on 3 of the items.

At the posttest, it appeared there was little systematic change from pre to post, except in the item "I like school," which dropped from pre to post in all groups. For the other 3 items, most of the differences between pre and post were 2 or 3 percentage points. In 4th and 6th grades, all four items indicated more positive attitudes for the PLATO groups than the control. In 5th grade, 3 of the 4 items were more positive for the PLATO group. Hence there was a slight shift upward for the PLATO group on the whole, relative to the controls. Following are the summary data for two of the items:

		PERCENT "YES"								
		4			5			6		
		Pre	Post	Diff.	Pre	Post	Diff.	Pre	Post	Diff.
I like school.	P	77	58	-19	52	48	-4	56	49	-7
	C	67	54	-13	55	52	-3	49	48	-1
		PERCENT "NO"								
Drawing pictures is hard for me.	P	82	82	0	69	67	-2	68	66	-2
	C	67	65	-2	73	62	-11	58	55	-3

These results suggest that children were generally capable of differentiating attitude toward school from attitudes toward school subjects; they also demonstrate that 4th graders, beginning their intermediate schooling, tended to be initially more positive than were older children. The rather striking difference in 4th graders' attitude changes toward reading and school contrasts, however, with the generally small changes observed in other grades for these baseline items.

Mathematics Items

In the pretest data for the twelve general attitude items, there were some evident trends. In fourth grade, in 11 out of 12 items the PLATO group, as with baseline items, displayed more positive attitudes than did the controls. In contrast, the 6th-grade PLATO group, in 8 of 12 items, showed less positive attitudes than the control group's. For the 5th grade, PLATO children had higher ratings in three items and controls in six items; the percentage was the same in three items.

Hence it appeared that, at the pretest, the control groups had a more positive attitude toward math in 5th and 6th grades than did the PLATO group; in 4th grade, the opposite was true.

In the posttest results, the fourth-grade PLATO children showed an advantage over the control group on all 13 items. In 10 of these items, the PLATO group's ratings either rose a few percentage points (seven items) or remained the same (three items) from pre to post; the control group's ratings dropped several points in every case. In two items, both the PLATO and control groups dropped. Thus the mathematics attitude change, while significant, paralleled the change in attitude toward reading. However, the baseline item results for attitude toward school argue against dismissing this outcome as a halo effect.

In the fifth grade, 11 of the 12 items showed an advantage for the PLATO children at the posttest. In 9 of these items the ratings increased several percentage points from pre to post for the PLATO group, while decreasing several points for the controls. These results contrast with 5th-grade reading attitude changes, which were in the opposite direction.

At the sixth-grade level, there was an increase in the number of items in which the PLATO group showed more positive attitudes than the control did, from three items in the pretest to six items in the posttest. In two items, the PLATO and control groups were the same, and in four, the controls were more positive.

Hence it appears that the PLATO groups at all three grades evidenced some gain in their attitude toward math relative to the control groups. The gain was most striking in 5th grade, where the PLATO group was initially more negative than the control. It was also quite clear in 4th grade and negligible in 6th grade. Following are the data from three representative items:

		% Responding "Yes"								
		4			5			6		
		Pre	Post	Diff.	Pre	Post	Diff.	Pre	Post	Diff.
Math is fun	P	59	67	+8	44	51	+7	54	54	0
	C	49	42	-7	62	46	-16	61	58	-3
I am good at math	P	70	74	+4	48	61	+13	44	47	+3
	C	44	37	-7	48	47	-1	50	47	-3
Math is my favorite subject	P	33	41	+8	20	38	+18	33	33	0
	C	37	29	-8	31	28	-3	44	40	-4

In addition to items about math in general, three items were included which related to three specific topics covered by PLATO: decimals, fractions, and graphs. Interestingly, attitudes toward learning about decimals and fractions were markedly higher for the PLATO group than for the controls at the posttest, while the pretest showed no clear difference between PLATO and control groups. In all grades for these two topics, the attitudes for the PLATO group rose from pre to post while the controls' attitudes declined in half the cases. With graphs, on the other hand, the PLATO and control groups were about the same in 4th and 5th grades, at the pretest, and attitudes decreased from pre to post for the PLATO group in all three grades; the controls, however, remained constant or declined very slightly. In 6th grade, the attitudes toward graphs were higher for the PLATO group than for the control groups at both the pre and posttest, but there was a seven percentage-point decline among PLATO children.

The negative finding for graphs attitudes may have been partly a result of the graphs strand's being little used in some of these classes or partly a result of its being relatively more difficult than the other strands. At any rate, it is clear that PLATO had a large positive effect on attitudes toward learning about decimals and, in grade 4, about fractions.

		% Responding "Yes"								
		4			5			6		
		Pre	Post	Diff.	Pre	Post	Diff.	Pre	Post	Diff.
I like learning about decimals	P	33	54	+21	20	56	+36	30	53	+23
	C	19	15	-4	22	32	+10	37	31	-6
I like learning about fractions	P	46	70	+24	51	65	+14	53	63	+10
	C	60	56	-4	48	58	+10	44	57	+13
I like learning about graphs	P	54	48	-6	48	43	-5	49	42	-7
	C	51	48	-3	44	44	0	28	30	+2

PLATO Items

Overall attitudes toward PLATO were quite positive. Representative items relating to general PLATO attitudes were these:

	% Responding "Yes"		
	Grade 4	Grade 5	Grade 6
PLATO is fun	83	90	70
I learn math more easily on PLATO	67	71	49
PLATO helps me like math better	64	79	57

In each of the six items relating to general attitudes toward PLATO, including the three above, the 5th grade had the highest percentage of positive responses. In four of the six items, the 6th-grade response was considerably less positive than the 4th or 5th grade's. This was a pattern that was repeated in a number of PLATO-related items.

One question of interest was the extent to which children regarded PLATO positively because they saw it as entertaining, as opposed to educationally valuable. In the 1974-75 questionnaire data, in response to the open-ended question, "What do you like most about PLATO?", the vast majority of children had answered "playing games," and a few teachers that year speculated that it was fascination with the games that had kept the children interested in

PLATO. Also, there was a criticism that some children seemed to be able to get through lessons without really learning what the lessons were supposed to be teaching. Hence the following items were added to shed some light on this question.

	% Responding "Yes"		
	Grade 4	Grade 5	Grade 6
I like playing games on PLATO	94	94	83
PLATO is fun but I don't learn much math from it	30	26	32
You can often get through a PLATO lesson without really knowing what is going on	38	32	48
If you don't know how to do a problem on PLATO, you can just type in anything and get through	7	17	16

Here again the same pattern of highest positiveness in the 5th grade and greatest negativity in the 6th grade is evident, except in the last item. It does appear that a substantial minority in all grades felt that they didn't learn a lot of math from PLATO and that they could often get through lessons, although not always individual problems, without understanding them. This, of course, does not negate the fact that a majority of children agreed with the statement that "PLATO helps me like math better" and "I learn math more easily on PLATO," but it may support the view that PLATO's facilitation of math learning lay partly in getting the children involved in the game aspects of the curriculum.

It appears largely untrue, at least in this final year of the program, that children felt they were able to type responses randomly to get through lessons when they didn't understand them.

Another comment that had been made by several teachers during the pilot year was that some children had found some lessons boring, and also that initial enthusiasm had tended to wane except when new games or a new strand was put in the system. Hence the following items were included.

	% Responding "Yes"		
	Grade 4	Grade 5	Grade 6
PLATO is often very boring	22	14	40
PLATO is fun at first but after a while it gets boring	28	32	52

There was clearly a high response to both these items in 6th grade and a not insignificant response to the second item in 4th and 5th grades. The 6th graders, of course, found the lessons much easier than did the younger children--which may have accounted for their very high agreement. The response at all grades to the second item is less easily explainable and may indicate a novelty effect.

Two negative feelings other than boredom, reported by teachers in the pilot year, were frustration when the terminals did not work properly and the feeling at times that PLATO was cheating when it defeated children at games. The following items were included to elicit such feelings:

	% Responding "Yes"		
	Grade 4	Grade 5	Grade 6
There are a lot of times when PLATO doesn't work	60	57	64
I get mad when PLATO doesn't work	59	60	64
PLATO cheats in games	30	28	32

A majority of children did feel that PLATO often wasn't functioning properly, and a majority were frustrated when it wasn't working. A sizeable minority did perceive PLATO as cheating at times. In all three items, the 6th graders were again slightly more negative.

Along quite different lines, some studies have suggested that an individual's perceptions of how other important groups regard an innovation often are related to his or her own attitudes toward it. Hence the following items were included:

	% Responding "Yes"		
	Grade 4	Grade 5	Grade 6
My friends think PLATO is fun	67	76	75
My teacher thinks PLATO helps me learn	67	79	66
My parents think PLATO helps me learn	63	69	57
My friends think PLATO doesn't teach you anything	20	6	18
My teacher thinks PLATO is a waste of time	9	3	8
My parents think PLATO is a waste of time	11	2	5

It is interesting to compare the first item with the item "PLATO is fun," to which 83% of the 4th graders, 90% of the 5th graders, and 70% of the 6th graders agreed. A higher percentage of 4th and 5th graders judged PLATO to be fun than perceived their friends as judging PLATO to be fun; the opposite was true at 6th grade. It is also interesting that one-fifth of the 4th and 6th graders agreed that their friends thought PLATO didn't teach anything.

It was also reported in the pilot year that some children were confused by some of the lesson content or instructions. The following items were directed at this question:

	Grade 4	Grade 5	Grade 6
I get frustrated because PLATO can't answer my questions	36	38	43

Here again the 6th graders were not less negative, a response which is surprising, since one would expect the older children to have less difficulty than the younger. A sizable percentage at all grade levels did have some difficulty in this area.

A final questionnaire item was related to the question of how important the visual aspects of the system were to the children.

	% Responding "Yes"		
	Grade 4	Grade 5	Grade 6
The pictures on PLATO help me learn more than the words	44	43	32

Here, as might be expected, the younger children placed the highest emphasis on the pictures, and the oldest the least. Clearly, for all grades, the visual effects were considered quite important.

PLATO and Other Instructional Modes

A number of items were included which compared various aspects of PLATO instruction with various aspects of traditional instruction or other learning modes.

In order to see how PLATO affected and compared with children's preferred settings for learning, five items were included which began with the stem, "I like working on math with," and ended with one of the following: "other kids," "my teacher," " a textbook," " alone," and "with PLATO." In 4th and 6th grades, the PLATO groups initially were more positive to working alone or with a textbook than were the controls and less positive to working with the teacher or children in both the pre- and posttests. However, in 5th grade, this was somewhat reversed, with PLATO children showing greater valence for working with other children and less for working alone in both the pre- and posttest. The other two items, relating to teacher and textbook, showed no clear difference in 5th grade.

		% Responding "Yes"								
		Grade 4			Grade 5			Grade 6		
		Pre	Post	Diff.	Pre	Post	Diff.	Pre	Post	Diff.
I like working on math with other kids	P	72	56	-16	70	71	+ 1	70	71	+ 1
	C	73	69	- 4	60	62	+ 2	76	75	- 1
I like working on math with my teacher	P	59	44	-15	40	36	- 4	34	36	+ 2
	C	64	48	-16	39	41	+ 2	48	40	- 8
I like working on math with a textbook	P	46	35	-11	44	34	-10	62	47	-15
	C	46	19	-27	42	39	- 3	55	33	-22
I like working on math alone	P	56	59	+ 3	51	38	-13	47	45	- 2
	C	48	31	-17	54	47	- 7	43	43	0
I like working on math with PLATO (posttest only)	P		67			91			72	

At the 4th-grade level, there was a systematic decline excep for "alone" in ratings by both PLATO and control groups over the year. Since attitudes toward math improved for the PLATO groups over the year, it may be that the decline here for the PLATO group was due to a displacement of interest in other modes of learning to working with PLATO. In 5th grade, there was not a systematic decline for PLATO and control groups, but in three of four items, there was a drop from pre to post for the PLATO group but an increase or smaller drop for the control. Here again, since general attitudes toward math had risen for the 5th-grade PLATO group and since the response to working with PLATO was very high (91%), one might argue that interest in other modes had been displaced, somewhat, by PLATO. For the 6th grade, there was relatively little change pre to post. Unlike 4th and 5th grade, where PLATO had the highest ratings of all options, the rating for PLATO was about the same as for working "with other kids" among 6th graders.

A second set of items compared the teacher and PLATO directly with regard to math instruction. These items were included only in the PLATO group posttest.

		Grade 4	Grade 5	Grade 6
I like math better with PLATO than with my teacher	% 'Yes'	36	60	32
	% 'No'	34	26	37
I learn more math from PLATO than from my teacher	% 'Yes'	20	22	20
	% 'No'	50	47	64

Although the previous set of items had indicated that more children, at all grade levels, responded positively to working on math with PLATO than with their teacher, here only about a third of the 4th and 6th graders agreed that they actually liked math better with PLATO than with their teacher. About a third were unsure (they circled the "?" option), and a third chose "no." The fifth grade, as in other items, was much more positive; a majority felt they liked math better with PLATO. Even in 5th grade, however, almost half of the children felt they did not actually learn more math from PLATO than from their teacher. It should be noted, though, that this second question may have been ambiguous in that, according to the math coverage questionnaire and the time-on-system data, children in most classes actually spent more time learning math from their teachers than from PLATO. So the different pattern of responses to the second question may have been influenced by the amount of time spent in the different contexts.

A third set of items relating to teacher/PLATO comparisons is composed of several pairs of items which contrasted particular aspects of teacher- or PLATO-based instruction. One such pair was the following:

		% Responding "Yes"								
		Grade 4			Grade 5			Grade 6		
		Pre	Post	Diff.	Pre	Post	Diff.	Pre	Post	Diff.
Teachers sometimes make me feel bad when I make a mistake	P	35	28	- 7	41	32	- 9	37	41	+ 4
	C	48	48	0	43	48	+ 5	52	46	- 6
PLATO sometimes makes me feel bad when I make a mistake (PLATO post only)			16			13			12	

The purpose of these items was to explore the hypothesis that children feel less threat to their self-esteem from negative feedback from CAI than from negative feedback from their teacher. For the first item the control groups at each grade, in both the pre and post, responded "yes" more frequently than the PLATO groups. This may be an indication that the PLATO teachers tended to be more flexible or permissive in teaching style than the controls, as the difference appears in the pre as well as the post. In the comparison PLATO item, children clearly did indicate that they less often felt bad when they made a mistake on PLATO than with their teacher.

Another hypothesis was that the PLATO curriculum might be seen by the child as confusingly unintegrated, as the lessons were often quite different in format and approach as well as in content. Hence the following two items were included in the posttest:

		% Responding "Yes"		
		Grade 4	Grade 5	Grade 6
It's hard to see how my teacher's math lessons fit together	P	7	24	20
	C	29	21	19
It's hard to see how PLATO math lessons fit together	P	34	36	34

It appears that more children in PLATO classes did perceive PLATO as being unintegrated than they did their teacher's lessons.

A third pair of items was designed to see if children had problems understanding directions while on PLATO.

		% Responding "Yes"								
		Grade 4			Grade 5			Grade 6		
		Pre	Post	Diff.	Pre	Post	Diff.	Pre	Post	Diff.
I usually understand directions to math problems the teacher gives me	P	87	76	-11	71	74	+ 3	65	65	0
	C	67	60	- 7	65	66	+ 1	67	62	- 5
When PLATO gives me math problems to do, I usually understand the directions	P		80			79			78	

In 4th and 5th grades, the PLATO children more frequently agreed that they understood teachers' directions than did control children, in both the pre- and posttest. This may indicate that the PLATO teachers tended to communicate more clearly than the control teachers in these grades. The children in PLATO classes also slightly more frequently judged that they understood PLATO's directions than their teacher's directions at the posttest. It is interesting that understanding was equally high at all grade levels.

In conclusion, some observations are suggested by the data as to the relative influence of PLATO and the classroom teacher. There seems some evidence that the PLATO teachers offered math instruction of a higher quality than control teachers', as indicated by the items on integration of lessons, clarity of directions, and effect of negative feedback. On the other hand, fewer PLATO children than control children indicated at the pretest that they liked to work on math with the teacher. This may have reflected less dependence on the teacher in the PLATO classes.

PLATO was rated higher than the PLATO teacher on the posttest items on clarity of directions and effect of negative feedback, but did not do as well in the lesson integration item. For the 4th and 6th grades, a third of the children preferred to learn math with PLATO rather than the teacher; 60% of the 5th grade indicated this preference, probably reflecting the fact that the 5th grade was the targeted grade in design of the curriculum. A substantially smaller (20-22% of all grades) percentage of children felt that they actually learned more math from PLATO than from their teacher.

Other Attitudes Possibly Affected by PLATO

In addition to the general math attitude items and the reading and other school-related items, there were several categories in the questionnaire that were designed to focus on various attitudes hypothesized to be affected by PLATO's presence in the classroom.

Competition/cooperation. The two items below showed no consistent differences between PLATO and control groups or pre and post.

		% Responding "Yes"								
		Grade 4			Grade 5			Grade 6		
		Pre	Post	Diff.	Pre	Post	Diff.	Pre	Post	Diff.
I like to show people how to play games	P	64	53	-11	51	56	+ 5	56	57	+ 1
	C	67	55	-12	66	56	-10	54	46	- 8
I like to beat other kids at games	P	60	52	- 8	49	53	+ 4	46	52	+ 6
	C	56	58	+ 2	53	49	- 4	46	46	0

<u>Degree of autonomy and locus of control</u>. A number of teachers at the end of the 1974-75 year had noted that they felt PLATO had increased children's sense of independence. Several items were consequently included that focused on the child's feelings about various aspects of autonomy.

		% Responding "Yes"								
		Grade 4			Grade 5			Grade 6		
		Pre	Post	Diff.	Pre	Post	Diff.	Pre	Post	Diff.
I like teachers to let me decide for myself what I'm going to do in school	P	74	52	-22	86	82	- 4	71	70	- 1
	C	81	73	- 8	68	68	0	71	61	-10
I can learn at my own speed in this class	P	61	65	+ 4	68	69	+ 1	57	74	+17
	C	67	50	-17	56	56	0	58	51	- 7
		% Responding 'No'								
I often disagree with what the teacher says	P	72	59	-13	60	36	-24	57	49	- 8
	C	60	40	-20	54	47	- 7	49	44	- 5

In the first item, there seems to be no clear pattern, except that the 5th-grade PLATO children responded much more positively to this item than did the 5th-grade controls, at both pre- and posttest. This may be partly a result of one of the 5th-grade classes being highly individualized in structure. A high percentage of all children responded "yes" to this item, and in almost all cases there was a decline from pre to post.

In the second item, the PLATO group seemed to increase significantly in their positive ratings relative to the controls, especially in 4th and 6th grades. PLATO or the behavior of PLATO teachers seemed to have an effect on the children's sense of autonomy, at least with regard to pacing. Again the 5th-grade PLATO group was much higher than the control at the pretest, and remained higher at the posttest. Hence it appears that the PLATO children, at all grades, did perceive that they had more self-control in pacing than did the controls. How much of this was due to differences among teachers and how much to the PLATO experience cannot be determined.

With regard to the third item, more PLATO children than control children disagreed with the item on the pretest, at all grade levels. This may indicate a higher initial positive attitude as to the PLATO teachers' credibility. Also, as might be expected, the percentage of disagreements declined from 4th to 6th grade, suggesting a more critical attitude toward the teacher as grade level increased. At all grades, for both PLATO and control groups, the percentage of "no" responses declined over the year, indicating that children were more likely to disagree with their teachers at the end of the year. At the 4th- and 6th-grade posttest, PLATO children were less critical of their teachers than the control groups were; at 5th grade the opposite was true..

It was hypothesized that PLATO might affect whether the children perceived the locus of control to be internal or external, and four items were added which pertained to this issue: two pairs of similarly worded items indicating that success in school depends on either the teacher or the child.

		Grade 4			Grade 5			Grade 6		
		Pre	Post	Diff.	Pre	Post	Diff.	Pre	Post	Diff.
% Responding "Yes"										
The amount that I learn in school depends mostly on me	P	61	50	-11	71	77	+ 6	65	78	+13
	C	51	42	- 9	68	68	0	63	73	+10
If I do badly on a test it's because I didn't work hard enough	P	73	65	- 8	71	68	- 3	72	75	+ 3
	C	51	50	- 1	72	81	+ 9	73	69	- 4
% Responding 'No'										
The amount that I learn depends mostly on my teacher	P	44	28	-16	52	35	-17	32	50	+18
	C	33	29	- 4	46	35	-11	39	53	+14
If I do badly on a test it's because the teacher didn't teach me well	P	80	84	+ 4	82	73	- 9	80	77	- 3
	C	60	72	+12	79	80	+ 1	70	69	- 1

About 70-80% of the children at all grades, with the exception of the 4th-grade control group, felt that when they did not do well on a test it was because they hadn't worked hard enough, not because the teacher hadn't taught them well. PLATO 4th and 5th graders at posttest moved more in the external direction on this item pair than did their respective controls, but the pattern was mixed for the 6th grade. For the items on the amount learned in school, the PLATO 4th graders' tendency to assign an internal locus of control declined relatively from pre to post, while the 6th graders' increased over the year. The 5th grade was inconsistent in changes from pre to post. The difference between PLATO and control groups at the posttest on these two items was very small in five out of six comparisons. Thus there was no evidence of a PLATO effect in this area.

<u>Friendliness, happiness</u>. Two items were included relating to possible changes in children's sense of friendliness and happiness in the classes.

		Grade 4 Pre	Grade 4 Post	Grade 4 Diff.	Grade 5 Pre	Grade 5 Post	Grade 5 Diff.	Grade 6 Pre	Grade 6 Post	Grade 6 Diff.
Kids in this class are very friendly	P	74	49	-25	63	60	- 3	45	63	+18
	C	60	48	-12	62	64	+ 2	55	37	-18
I am happy most of the time in this class	P	85	74	-11	81	73	- 8	80	69	-11
	C	79	74	- 5	78	69	- 9	60	67	+ 7

(% Responding "Yes")

In most cases (5 out of 6) the PLATO children responded more positively in the pretest, indicating that PLATO children initially felt more positive about their class and other children than did the controls. All of the PLATO groups, except for the 6th-grade group on the first item, responded less positively on the posttest than the pretest. With the exception of the 6th-grade group on the first item, the PLATO and control groups were quite close in rating at the posttest.

Technology. The two final items focused on children's feelings about computers and TV, as two dimensions of technology that might affect or be affected by the experience with PLATO.

% Responding "Yes"

		Grade 4 Pre	Grade 4 Post	Grade 4 Diff.	Grade 5 Pre	Grade 5 Post	Grade 5 Diff.	Grade 6 Pre	Grade 6 Post	Grade 6 Diff.
I would like to work with computers when I grow up	P	52	30	-22	57	41	-16	49	38	-11
	C	45	27	-18	44	28	-16	26	28	+ 2
Watching TV is one of my favorite things to do	P	67	54	-13	51	40	-11	49	43	- 6
	C	56	44	-12	62	46	-16	60	45	-15

Most pre-post comparisons indicated a substantial decrease for both PLATO and control groups in both items. The item on computers showed the PLATO group had a more overall positive attitude toward computers both at the pre and post, but that the PLATO group dropped as much as or more than the controls at all three grades, from pre to post. Hence the anticipation of PLATO may have caused the PLATO group's attitudes toward computers to be higher at the beginning of the year, but the experience of PLATO did not result in that attitude remaining high. Nevertheless, as of the posttest, the PLATO groups still did evidence a somewhat more positive attitude toward computers than the control groups did. There was no notable difference between PLATO and controls in attitudes toward TV.

Individual attitude items thus reveal patterns of considerable absolute change and change relative to the control group, but also show considerable differentiation and specificity. Thus, for example, PLATO fourth graders decline in percentage endorsing "I like school," increase slightly in reporting "I am good at math," but increase strikingly in reported liking for fractions and decimals (and not for graphs). These item-level results suggest that the global attitude scales reported in Chapter 6, although showing some significant positive PLATO effects, masked the variety of a complex and quite differentiated set of particular attitude outcomes resulting from PLATO experiences in the various classrooms, outcomes which on the balance, appear more positive and more clearly relatable to PLATO than did the more global attitude results.

7.4 Attitudes toward Reading

In the demonstration year, the reading attitude instrument was administered only to PLATO grade-one classes, there being no control classes that year in grade one. The attitude instrument had been used at the Kindergarten level in 1974-75, but its demands were found inappropriate for children that age, and its administration was therefore confined to first graders.

Although no control groups were used in 1975-76, four first-grade classes had participated as controls in the 1974-75 year. Both the control and PLATO groups of 1974-75 provide interesting contrasts with the final year and are, therefore, reported in the following summary of results.

The reading attitude instrument is shown in the Appendix. Briefly, it consisted of a number of items in the format, "When you _______, how do you feel?" The response options consisted of "Happy," "OK," "Sad," enclosed in a square, triangle, and circle, respectively, so that children who were unable to read could use the shapes to locate their response. To avoid confusion, the options were always presented in the same order; thus we accepted the possibility of position bias in response, but this bias was equally applied to all items.

Several items were included to assess the children's degree of understanding of the questions and the amount of response bias to be expected in the responses. These items also served as a general baseline against which to compare attitudes toward reading and PLATO and changes in them.

		Percent Responding		
		Happy	OK	Sad
When you draw a pretty picture [how do you feel?]	Pre	68.9	21.4	7.8
	Post	69.9	23.3	5.8

6.6.1

When you drop an ice cream cone	Pre	16.5	11.7	67.0
	Post	8.7	7.8	83.5
When you don't have enough time to finish a game	Pre	23.3	22.3	52.4
	Post	10.7	18.5	69.9

The two negative situations show considerable decrease in the percentage of children marking "Happy" from pre- to posttest and suggest that, by posttest, about 90% of the children understood the task. Accordingly, it seems likely that changes in responses to the similar items are partly due to increased understanding of the items:

		Percent Responding		
		Happy	OK	Sad
When you don't have enough time to finish your reading	Pre	44.7	21.4	34.0
	Post	30.1	31.1	38.8

In addition to this pre-to-post effect, attributable to increased understanding of the task, there was also a general shift in the direction of greater use of the "OK" response option at the end of the year. Of 19 pre-post comparisons, 14 showed an increase in the percentage of "OK" responses. Two of the general baseline items exemplify this effect:

		Percent Responding		
		Happy	OK	Sad
When you go to school	Pre	49.5	21.4	28.2
	Post	45.6	39.8	14.6
When you can spell a word	Pre	67.0	22.3	9.7
	Post	46.6	45.6	6.8

This general tendency had also been found in the 1974-75 PLATO and control group data (18 of 19 and 15 of 19 items, respectively, had shown an increase in the percentage of "OK" responses from pre to post). This shift could be an indication that the children's attitudes had changed, that they understood the item format better and so perceived their true attitudes more adequately, or that they simply chose to be less open at year end.

These general changes in the nature of the children's responses contribute to the difficulty of interpreting pre-post differences. There are also fluctuations in pre-post commitments that are hard to interpret and which probably only reflect the instability of children's attitudes at this age. Because of these factors, it was decided early in the development of the instrument to use sets of similarly worded items where possible, so as to provide simple comparisons that might facilitate interpretation of the children's responses.

Two sets of items directly contrasted attitudes toward reading, PLATO, and numbers. The last subject was chosen to provide a baseline of attitudes toward another school subject which presumably would not have been affected by PLATO.

	Percent Responding "Happy"								
	1975-76			1974-75					
	PLATO			PLATO			Control		
	Pre	Post	Diff.	Pre	Post	Diff.	Pre	Post	Diff.
When it is time to work on numbers	44	43	-1	44	38	- 6	43	43	0
When it is time to work on reading	48	47	-1	59	44	-15	38	50	+12
When it is time to work on PLATO		72			60				
When the teacher helps you learn about numbers	50	48	-2	77*	55	-22	62*	61	- 1
When the teacher helps you learn to read	73	68	-5	73	65	- 8	68	67	- 1
When PLATO helps you learn to read		76			60				

*Note: This item was the next-to-last item on the 1974-75 pretest, and there was a tendency for children to rate the last few items more positively; so the high percentage may be a result of the item placement.

Attitudes toward numbers remained about the same from pre- to posttests and across groups, with the exception of one item in the 1974-75 PLATO group which indicated a sharp drop. This may, however, have been an anomaly also resulting from the placement of the item at the very end of the questionnaire.

Attitudes toward reading were generally somewhat more positive than toward math and also did not seem to change significantly from pre to post. Hence, it would appear that the use of PLATO did not result in a more positive attitude toward reading, either absolutely or in comparison with the control classes, despite the fact that children seemed to have quite positive feelings about PLATO. The items relating to PLATO elicited more positive responses than any of the comparison items did in 1975-76. In 1974-75, however, children responded more positively to "when the teacher helps you learn to read" than "when PLATO helps you learn to read."

As another indication of how children felt about PLATO, the following set of items was included in the 1975-76 instrument.

	Percent Responding "Happy"		
	Pre	Post	Difference
When you read a story in a book	66	55	-11
When you read a story with other children	48	45	- 3
When you read a story by yourself	56	61	+ 4
When you read a story with the teacher	52	59	+ 7
When you read a story on PLATO	--	69	--

PLATO was the most positively regarded medium and setting for reading as of the end of the year. The least interest was displayed in reading "with other children." This parallels the finding, in the "student interaction at terminal" checklist, that the primary-grade children seemed to have a higher level of interaction with adults than with peers.

The following items give an idea of children's feelings about PLATO relative to other positive experiences.

	Percent Responding "Happy" at Posttest		
	1975-76	1974-75	
	PLATO	PLATO	Control
When you get a toy for a present	92	88	87
When you get a book for a present	59	48	64
When you take home something you made at school	73	75	72
When you take a book home	57	50	51
When it is time to work on PLATO	72	60	--

In both 1974-75 and 1975-76, the PLATO experience fell far below the experience of receiving a toy for a present, in terms of eliciting positive feelings. However, PLATO was regarded more positively than the experiences of receiving a book as a present or taking a book home. In 1975-76, PLATO was regarded about as positively as the experiences of taking home "something you made at school," while in 1974-75 it was rated less positively.

The following items similarly give a sense of how children felt about negative experiences with PLATO relative to other negative experiences.

	Percent Responding "Sad" at Posttest		
	1975-76	1974-75	
	PLATO	PLATO	Control
When you drop an ice cream cone	84	82	82
When you don't have enough time to finish a game	70	69	71
When you don't have enough time to finish your reading	39	40	46.
When you don't get a turn on PLATO	68	--	--
When PLATO doesn't work	67	--	--

Not receiving a turn on PLATO was regarded as negatively as PLATO's not working. Both were rated about the same as not having enough time to finish a game. Both were seen as much more negative experiences than not having time to finish a reading activity.

In conclusion, children seemed to have positive feelings toward PLATO, regarding it more positively than other modes of learning reading. Attitudes toward PLATO seemed higher in 1975-76 than in 1974-75. In comparison with the 1974-75 control groups, the PLATO classes in 1974-75 and 1975-76 did not show more positive attitudes toward reading itself. In general there seemed to be no significant differences between attitudes in the PLATO classes and in the control groups. This finding suggests that the positive attitude toward PLATO evidenced by most children did not carry over into their attitudes toward reading or other school experiences.

VOLUME II

Item Level Results

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Pilot Year Analyses

APPENDIX B
Demonstration Year Means and Standard Deviations

APPENDIX C
Instruments

APPENDIX A

Pilot Year Analyses

PRELIMINARY ANALYSIS

PLATO ELEMENTARY

MATHEMATICS ACHIEVEMENT

1974-75

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The PLATO mathematics curriculum is divided into whole numbers, fractions, and graph strands. Lesson material in all three strands concentrates more on understanding concepts than on drilling alogorithms, but the approaches vary considerably among the strands.

The whole numbers lessons, which have evolved from work began in earlier versions of PLATO, represent a rather loose collection of attractive games and exercises aimed at repres_ntations of number operations. Much of the development in the previous year involved filling gaps and increasing the focus on alogorithms. The whole numbers strand employs a great deal of extrinsic motivation in the form of animated displays not essential to the logic of its lessons.

The fractions curriculum is a carefully sequenced, step-by-step structure of lessons carrying a child from understanding of the meaning of fractions through the idea of equivalent fractions to addition and subtraction of mixed numbers with like and unlike denominators. While extensive graphic displays and animations are used in the meanings section in such lessons as "pizza" and "make a monster," the treatment becomes progressively more didactic as children progress through the strand. Drill is provided with attractive games, e.g., darts, torpedo, and fractions basketball. The principal distinguishing characteristic of the sequence is the existence of rather strict mastery criteria, such that the pupil is not exposed to more complex levels until earlier components have been thoroughly mastered.

The graphs strand draws heavily on previous material developed by Robert Davis and his colleagues in the Madison Project. Covering addition and subtraction of signed numbers, plotting points in two dimensions, and interpreting equations for linear graphs, the material is discovery oriented, making heavy use of trial and error approaches with guided checking of the results against desired results. Motivation tends to be intrinsic, with knowledge of having found a solution emphasized as a reward. The curriculum sometimes requires large jumps in understanding on the part of the child, particularly in the "guess my rule" sequence.

In the pilot year, the graphs material was the only strand that was essentially complete and integrated with the router in time for the beginning of the school year.

Since a logical sequence would have been whole numbers first, followed by either fractions or graphs, the lessons were not introduced optimally. A severe memory shortage persisted until February, making it impossible for graphs lessons to be delivered in appropriate sequences, or delivered at all to many students, who spent much time in mathematics related games. In November, the whole numbers strand lessons replaced graph lessons as the major curriculum for all pupils, with the lesson designers manually changing the list of available lessons each week, because memory limitations made it impossible for the router to do this automatically. Thus, children who still needed review on some whole numbers concepts were unable to receive it, and others were held back.

Many whole numbers lessons depended on the availability of touch panels, and because of late arrival of these devices, a rather cumbersome touch panel simulation was progammmed. In March, additional memory and the availability of sufficient touch panels made it possible for the fractions curriculum to run more nearly as intended. Because of the late start and slower than expected pace of children through this material, many children did not complete the strand by the end of the school year. Lesson development piloting, and revision was continuing in both fractions and whole numbers throughout this period.

Thus, the pilot year's results should be interpreted with the understanding that only the fractions material had a fair trial, and that coming at the end of the year, the lessons were still fresh in PLATO student's minds at the time of the posttest.

Two other issues must be considered in interpreting these pilot results. First, while all children were exposed to similar lesson material, it is not appropriate to think of this procedure as constituting a comparable treatment across grade levels. The regular curriculum at grades 4, 5 and 6 focusses on different subject matter. The whole number strand shows substantial overlap with the main tasks facing fourth graders, constitutes review for 5th grade, and would be considered remedial for 6th graders who need further work in the area. Fractions are introduced in grade 4, but form the core of the 5th grade curriculum and are reviewed in grade 6. Graphs are not usually introduced until grade 5, and do not normally form the topic of serious work before grade 6.

ROLE OF PLATO

Grade	Whole #s	Fractions	Graphs
4	Supplementary	Enrichment	Enrichment
5	Review	Supplementary	Enrichment
6	Remedial	Review	Supplementary

Thus, if we wish to evaluate PLATO in a supplementary mode, the appropriate comparisons are along the main diagonal of this table. Below this diagonal, the possibility for a PLATO effect depends on the existence of substantial numbers of children who have not yet mastered the material by traditional means, and above this diagonal, any PLATO effect represents an acceleration partly due to the fact that comparison classes are not given comparable exposure to similar material in the regular course of instruction.

Given the high entering level of PLATO children in last years demonstration, little information is available concerning the review or remedial cells of this table. Clearly, it is a more stringent requirement to ask that PLATO show a significant effect in the supplementary mode than as enrichment.

The following analyses clearly demonstrate positive PLATO effects in the enrichment cells, but show a supplementary effect only in the case of fractions.

The second issue encouraging caution in interpreting these results emerges from the characteristics of PLATO and comparison classes. While in grade 4, PLATO and comparison children seem roughly comparable, and in grade 6, comparison children begin at slightly higher levels, the grade 5 comparison classes available last year were considerably below PLATO classes in entering achievement. While covariance analysis can adjust for initial differences in means of randomly sampled classes from a single population, it cannot correct for the different and unknown expected growth rates in samples from two different populations. Since the one case of a clear supplementary effect occurs in grade 5, any firm conclusion must await the results of the current year's demonstration, in which comparison classes have been quite successfully matched to PLATO classes. However, the fact that the fraction material showed a small but positive effect even in grade 6 suggests that its effect in grade 5 may not be entirely a result of lack of comparability of comparison classes.

PLATO ELEMENTARY
MATHEMATICS
CURRICULUM REFERENCED TESTS 1974-75
Means-Whole Numbers

		PLATO		CONTROL	
		Pre	Post	Pre	Post
Grade 4	Boys	13.87	18.57	12.11	19.07
	Girls	12.54	17.23	11.00	17.76
Grade 5	Boys	17.41	21.22	13.44	17.22
	Girls	15.72	19.66	14.33	18.30
Grade 6	Boys	19.30	21.77	19.43	21.28
	Girls	19.07	21.77	21.53	23.50

ANALYSIS OF COVARIANCE - COVARIATES ACCOUNT FOR 59.8% VARIANCE

Source	df	Mean Square	F	Prob. of Larger F
Grade	2	40.89	4.204	.016
Treatment	1	.04	.004	.952
Sex	1	3.48	.353	.598
Error	433	9.727		
G x T	2	53.27	5.57	.004
G x S	2	3.38	.353	.703
T x S	1	7.56	.790	.375
Error	428	9.57		
G x T x S	2	2.42	.25	.778
Error	426	9.60		

COVARIANCE - ADJUSTED MEANS

		PLATO	CONTROL
Total		9.805	10.095
	Boys	9.836	9.381
	Girls	9.775	10.253
Grade 4		9.724	11.579
	Boys	9.748	11.791
	Girls	9.700	11.367
Grade 5		10.078	9.176
	Boys	10.190	8.875
	Girls	9.966	9.478
Grade 6		9.613	9.531
	Boys	9.568	9.149
	Girls	9.658	9.9133

Inspection of pretest means reveals that in grades 4 and 5, control means ranged from 1-5 to 4 points below those of PLATO children. By the end of the year, this gap had been closed in grade 4, but not in grade 5. Analysis of covariance shows the grade effect and a grade by treatment interactions to be highly significant, but does not reveal a significant treatment effect. Inspection of the above table, which gives posttest means adjusted for pretest differences, reveals that the source of the interaction is indeed a negative PLATO effect in grade 4, contrasted with a smaller positive PLATO effect in grade 5.

MEANS - FRACTIONS

		PLATO		CONTROL	
Grade 4		Pre	Post	Pre	Post
	Boys	2.23	8.27	3.08	4.64
	Girls	1.62	8.54	1.53	2.95
Grade 5					
	Boys	5.30	11.06	2.41	5.31
	Girls	5.02	9.69	3.32	6.11
Grade 6					
	Boys	8.50	12.25	10.05	12.05
	Girls	7.73	10.65	10.86	12.98

ANALYSIS OF COVARIANCE - COVARIATES ACCOUNT FOR 49% of VARIANCE

Source	df	Mean Square	F	Prob. of Larger F
Grade Level	2	31.90	3.00	.051
Treatment	1	507.73	47.67	.000
Sex	1	14.70	1.38	.24
Error	425	10.65		
G x T	2	118.94	11.71	.000
G x S	2	4.99	0.49	.613
T x S	1	8.53	0.84	.36
Error	420	10.16		
G x T x S	2	7.95	0.78	.46
Error	418	10.17		

COVARIANCE - ADJUSTED MEANS - FRACTIONS

		PLATO	CONTROL
Total		5.64	2.85
	Boys	5.76	2.84
	Girls	5.51	2.85
Grade 4		6.85	1.86
	Boys	6.38	1.90
	Girls	7.32	1.81
Grade 5		5.84	3.19
	Boys	6.29	3.30
	Girls	5.39	3.07
Grade 6		4.22	3.50
	Boys	4.62	3.33
	Girls	3.81	3.68

Investigation of the pretest means suggests neither grade 4 nor grade grade 5 children began the year with any significant understanding of fractions as measured by this instrument. As was the case with the whole numbers test, grade 5 control children were behind their PLATO counterparts at the beginning while at grade 6, control children possessed an initial advantage. At all grade levels, PLATO subjects gained more than comparison groups, the difference being most marked in grade 4, smaller in grade 5, and negligible in grade 6.

Analysis of covariance confirms the significance of these effects, resulting in a highly significant PLATO effect ($F_{1,425} = 47.67$), and a significant grade by treatment interaction ($F_{1,420} = 11.71$). Inspection of covariance adjusted means in Table 6 reveals an orderly pattern of positive PLATO effects, decreasing in magnitude with increasing grade level.

MEANS - GRAPHS

		PLATO		CONTROL	
Grade 4		Pre	Post	Pre	Post
	Boys	6.05	12.10	4.57	6.78
	Girls	5.00	10.75	4.00	6.22
Grade 5					
	Boys	10.4	11.98	5.33	6.30
	Girls	9.32	10.28	4.93	5.46
Grade 6					
	Boys	12.14	12.98	8.79	11.16
	Girls	10.40	11.56	8.97	12.63

ANALYSIS OF COVARIANCE - COVARIATE ACCOUNT FOR 45% of VARIANCE

Source	df	Mean Square	F	Prob. of Larger F
Grade Level	2	152.26	15.20	.000
Treatment	1	15.24	1.52	.218
Sex	1	0.384	.04	.845
Error	412	10.01		
G x T	2	194.87	21.58	.000
G x S	2	22.11	2.45	.088
T x S	1	15.81	1.75	.186
Error	407	9.03		
G x T x S	2	1.57	.17	.84
Error		9.07		

COVARIANCE - ADJUSTED MEANS

Total		3.89	2.75
	Boys	4.08	2.61
	Girls	3.70	2.89
Grade 4		6.58	2.85
	Boys	6.71	2.87
	Girls	6.45	2.84
Grade 5		2.62	1.35
	Boys	3.14	1.57
	Girls	2.09	1.13
Grade 6		2.47	4.05
	Boys	2.39	3.39
	Girls	2.55	4.71

In the case of the graph strand, some 5th and 6th grade subjects had worked with the material in the previous year, and had spent up to a week in graphs lessons at the time the pretest was given.

Thus, the pretest advantage enjoyed by PLATO subjects is to some extent an effect of PLATO, and the analysis will remove this early effect as well as differences on pretest due to other sources.

Again analysis of covariance shows a grade by treatment interaction, with 4th grade PLATO subjects gaining most, 5th graders showing a slight advantage, but 6th grade PLATO children not gaining as much as comparison classes. The grade by sex interaction term approaches significance, with 5th grade boys gaining more than 5th grade girls, and a reverse situation occurring in grade 6. Given the unknown degree to which pretest is confounded with treatment, and the information from other instruments on differential comparability of control and PLATO classes across grades the most reasonable interpretation would seem to be that PLATO demonstrated a large effect in grade 4, a very small effect in grade 6, on the basis of comparable posttest means, and an unknown but probably intermediate effect in grade 5 on graphs material.

SUMMARY

The differing pattern of results for the three strands should be interpreted cautiously because of pecularities of the pilot year's implementation sequence and because of differential appropriateness of the material to the three grade levels.

The year began with all PLATO children being exposed to graphs for two months, followed by four months of whole numbers lessons. Both strands were plagued by system malfunctions and memory shortages that prevented them from delivering all intended material in the intended sequence. The fractions strand, beginning in March, had the advantage of a smoothly functioning system and of being fresh in PLATO student's minds at test time.

If we consider graphs to be enrichment in grade 4 and part of the curriculum in grade 6, the fact that with a less than ideal implementation, grade 4 pupils did better than controls, who had not been exposed to the material by their teachers, while grade six pupils did not learn more than controls, who were studying some of the same material with their teachers makes sense. In grade 4, whole numbers is the main topic, with some introduction to fractions. Under the difficult circumstances of the first half of the year, PLATO 4th graders may have been at a disadvantage in the material to which control teachers were devoting major amounts of time and energy. In 5th grade, the curriculum puts much more emphasis on fractions, and 5th grade pupils who still needed work on whole numbers concepts may have had more opportunity to obtain this from PLATO than was the case in the control classes.

In the case of fractions, 5th graders were exposed to the material intensively in both PLATO and control classes, and PLATO was functioning as intended. While the results may be inflated by the large differences in entering ability of PLATO and control 5th graders, the pattern of large effect in grade 4, smaller effect in grade 5, and smaller but still positive effect in grade 6 suggests that PLATO, when operating reliably, can not only teach enrichment material but can materially supplement a teacher's efforts.

In the coming year, better matched comparison groups and a more smoothly functioning system capable of delivering to the student lessons from any strand at the appropriate point in the year will enable us to determine the degree to which the whole numbers and graphs strands can show an impact comparable to that of the fractions material.

Pilot Year Mathematics Attitude Results

Spencer S. Swinton

February 1976

Pilot Year Mathematics Attitude Results

A thirty-four item attitude test was administered by ETS personnel at the beginning and end of the school year to PLATO mathematics and control classes, with PLATO pupils receiving additional PLATO-related items on the posttest. The child circled the response, "yes," "?," or "no," to a series of statements describing feelings about mathematics, reading, school and nonacademic activities. By asking about parallel attitudes toward other subjects, it was possible to differentiate attitudes toward mathematics from general change in acquiescence or social desirability. For example, the statement, "Reading is fun," elicited similar pretest responses among 4th grade PLATO (72.3% yes) and control (72.1% yes) children. While PLATO children declined nine percentage points on the posttest, control children gained 15 points in agreement. By contrast, in the case of the statement, "mathematics is fun," control 4th graders began with slightly more positive attitudes (54.4% vs. 42.6%) but declined to 49.3% "yes." While the PLATO children increased to 55.1% "yes." In grade 5, control children began with less positive attitudes toward reading, which again improved slightly, while PLATO children exhibited a three percentage point decrement over the year. As was the case in grade 4, however, the experimental children "came from behind" in attitude toward mathematics, moving from 49.5% to 63.1% "yes" to this statement at the same time that control children were declining from 64.1% to 60.0% agreement. In grade 6, control childrens' attitudes toward both of these reading and mathematic items became less favorable from pretest to posttest, while PLATO pupils remained almost constant in reading and show an improvement similar to those for 5th graders in mathematics.

While convincing children that mathematics is fun is no mean achievement, changing their self-evaluation of themselves as mathematics students is perhaps more important, given the increasing body of research on the relationship of academic self-concept to achievement.

The responses to item 16, "I am good at math," are encouraging in this regard. At all three grades, fewer than one half (40.4-44.3%) of PLATO subjects agreed with this statement at the beginning of the year, while more than half (51.6-59.9%) circled "yes," at year's end. The smallest gain, in grade 6, was 9.2 percentage points. In contrast, control 4th and 6th graders gained 1.3 and 2.1 points respectively, from a slightly less positive starting level, while 5th grade control children declined from 62.0% to 48.9% "yes" over the same period.

In response to the statement, "math is my favorite subject," PLATO children increased in positive responses at all three grade levels, while control children declined. The most positive posttest response, 36.9% among PLATO 5th graders, was not so large, however, as to suggest that children were strongly influenced by a social desirability set, or were uniformly motivated by a desire to make PLATO "look good." Acquiescence also does not seem to have been a major source of error variance, given the responses to item 2, "reading is the hardest thing I have to do, which ranged from 0.8 to 7.8% "yes."

PLATO students tended to disagree more with negative statements about mathematics after their exposure to PLATO, as well as to agree with positive statements. For example, in response to statement 26, "mathematics is often boring," 4th grade pupils dropped from 53.2%, pretest agreement to 28.6% posttest agreement, while control children declined only 3.4%. In grades 5 and 6, PLATO children showed 3.5 to 5.1% decreases in agreement with the statement, while control students showed increases of slightly more than 8%.

The rather low pretest agreement with this item among 5th graders is consistent with other evidence that the 5th grade sample of children in the pilot year of the study were relatively less sophisticated and able than were 4th and 6th graders. This rather dismal reading of the impact of sophistication on attitudes may reflect increased willingness to state unpleasant truths as much as actual changes in attitudes, however. While posttest percentages of agreement with this item show a regular decrease with grade level of positive attitudes, consistent with the large body of research indicating that children became more negative with increasing age, the most "bored" PLATO children, (grade 6) indicate less boredom than the least disaffected control children (grade 4).

There is some evidence that children differentiate among the strands. In response to item 24. "I like learning about fractions," PLATO students gained from 9.1 to 30.4 percentage points, while control children declined in level of agreement in grades 4 and 5, and increased by only 3.4 points in grade 6. In contrast, item 25, "I like learning about graphs," showed no change for either PLATO or control children in grade 4, similar 5 point gains for PLATO and control children in grade 5, and greater gains for control children in grade 6. This difference may reflect the unsatisfactory conditions of system performance at the beginning of the year, when the graph strand was implemented, rather than reflecting on the curriculum itself. In the current year with a reliable system and an attempt to introduce the student to a module of a strand only when he or she is ready for it, it should be possible to obtain more interpretable data regarding preferences among parts of the curriculum.

Moving from the level of individual items to combinations of items assessing clusters of related attitudes, total scores were formed to obtain the following scales: attitude toward reading, 7 items, attitudes toward mathematics, 10 items, and attitudes toward PLATO, 7 items. Scale means suggest that the reading and mathematics scales do pick up differential ractions among PLATO and control subjects:

1974-75 ATTITUDE MEANS

	READING $\alpha = .67$		MATH $\alpha = .80$		PLATO $\alpha = .85$
	PLATO	CONTROL	PLATO	CONTROL	
PRE	3.72	3.25	1.85	1.87	-
POST	4.23	3.33	3.43	0.98	4.17

The Introduction of Innovative Instructional Systems: Implementation and Program Evaluation

I. The Practitioner: Selection, Training, and Program Evaluation

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The persistent and hydra-headed attempts in the past to improve elementary instruction may be roughly divided into two unequal parts. The smaller number of innovations aimed at broadly conceived teacher development, as attempting to change teachers and their instructional ways by enriching their understanding of subject matter, improving their diagnostic and managerial skills, or increasing the repertoire of their interactions with students. The affective education movement, the Academic Year Institutes, and the open education advisory services are examples of such efforts. By far the greater number of moves toward reform were those that sought to bypass the teacher, seeking instead to affect students through the mediation of curricular materials or activities. Thus the curriculum reform movement engaged the issue of teacher development only to the extent that productive implementation of new materials was seen to depend on some concomitant training of the teacher. Of course, neither approach ever came to pass in pure form, but a careful scrutiny of goal statements and patterns of resource distribution reveals the developers' leanings. The failure of materials intended to be "teacher-proof" is a tale so often repeated as to require no retelling here. There is no plethora of successful teacher development efforts to point to, except to note that this effort never received the same attention and largesse of resources as did the area of curriculum development.

The PLATO Elementary Program

The undertaking we shall talk about here is one we have been observing and evaluating for close on to two years. It had the development of curricular materials, in this case programs delivered over an interactive computer system, as its main objective. The developers, however, professed a view of the teacher's role as critical to the effective use of these programs. Under optimal conditions the materials would be integrated with ongoing curriculum, modified by the classroom context, even shaped by the needs, goals, and style of the teacher. This project thus sought to combine educative functions for students and teachers, albeit with far more articulated plans for the instruction of students, with teacher education largely serving program implementation.

As the PLATO project is an effort unique in scope and character, a brief description of its main features is offered to frame our subsequent observations. The PLATO elementary reading and mathematics demonstrations represent ambitious attempts at sequential and concurrent hardware, software, curriculum, and implementation development of tutorial computer assisted instruction in elementary schools. Since 1960, the engineering and systems development of the PLATO system and TUTOR teaching language has been under way at the Computer-Based Education Research Laboratory of the University of Illinois, with much in-house experience acquired over the years in authoring university-level lessons and sophisticated simulations and games. While some elementary mathematics units had already been developed for earlier versions of PLATO, it was only in 1972, with the awarding of funds from the National Science Foundation, that development of PLATO in lesson sequences covering significant portions of the beginning reading and 4th to 6th-grade elementary mathematics curriculum was undertaken. The PLATO system, with nearly 1,000 terminals connected to a CDC Cyber 70 computer in Urbana, is able to make a substantial library of lessons available to any user on call, constrained only by the system's extended core storage capacity. The PLATO terminal is a device with a typewriter-like keyboard, a "plasma" screen, internal character memory, impressive graphic and slow animation capability, rear projection of color microfiche images, computer-controlled random access to disc-stored audio messages, and the ability to sense the portion of the display touched by the student. Although development and improvement continues on hardware and system features, the system is now sufficiently stable to permit the orderly introduction of the still-developing curriculum into the elementary school classroom.

The many unique features of the project should not mask the fact that the development and implementation issues emerging from the evaluation have relevance beyond the specific medium of instruction in use, the means chosen to carry them out, and the actual course of implementation. A good understanding of the developers' conceptions and intentions can prove enlightening about innovative curricular programs across a range of conditions.

We should like to describe the issues of teacher selection, orientation, and early support in some detail. These are common concerns in most implementations of curricular change. They can, however, be handled or solved in a variety of ways, depending on the implementer's convictions, goals, skills, and situational constraints. The strategies deployed by the PLATO project will serve to illustrate some of the assumptions and consequences of these tactics, which shall be examined here.

While we will be sharing some tentative observations about the first phase of the project, the question persists of how an effort of this scope and complexity may be appropriately assessed. The meaningful questions to ask, processes to observe, methodologies and tools to use, audiences to address, remain open issues. Our impressions and the assessments we will make are based on varied informal sources of information--they were culled from documents, telephone conversations, formal meetings, and even encounters at the coffee urn. Our formal systematic data collection was done via five avenues: an in-depth interview of teachers, classroom observations, system data, teacher logs, and norm-and content-referenced attitude and achievement tests.

The teacher interview, semi-structured and open-ended in format, sought to gain access to the teachers' pedagogic constructs, especially those related to math or reading. We also solicited the teachers' perceptions of their own classrooms, the teaching role, children as learners, and related matters that were judged relevant to the utilization of a new teaching aid. The teachers were also probed for their expectations of and predispositions toward the new resource.

The interview had been originally designed by the Early Education Group at ETS for a study of teachers working in open-education settings. This instrument was revised with the needs of the present evaluation in mind, with the addition of PLATO-related questions, as well as extensive probes of the teacher's conceptions of math and reading. Only a small portion of the interview data will be reported here; i.e., information primarily dealing with the teachers' entry into the program and their perception of early orientation efforts.

The rationale and the development of the means for classroom observations will be described in detail in the next section of this paper, thus setting the context for the investigation of mode of PLATO use and nature of classroom integration.

The log, although not kept by all teachers, and irregularly by those who did keep it, yielded valuable information, from the teachers' perspective, on life with a neonate innovation. The data yielded by the logs will not be attributed to their specific source.[1]

Selection of Participants.

One of the early decisions program developers need to make is to identify and select those who will try out the innovation. The users of curricular materials are school districts, i.e., superintendents, principals, teachers, pupils, and parents. While the teachers and pupils are most directly affected by new programs, administrators and parents are recipients of important secondary benefits or losses, and at times have significant input into decisions of acceptance or rejection.

After initial negotiations with more distant urban and rural school systems, the directors of the elementary PLATO projects took a consequential step when they approached the two school districts adjacent to the University where the program was being developed. Several advantages accrued to this choice. The districts had a long histroy of University connections;

1. We will not report on test data in this paper.

they had often served as testing ground for a number of previous and ongoing projects. The schools were accustomed to, or at least familiar with, the disruptions and intrusions that accompany pilot projects. Ready access to the schools made information flow between the user and project staff with greater frequency, richness, and shorter turn-around time.

School personnel were not unaware of the benefits, direct and derived, that cooperation with the University and some of its renowned educators could bestow. In addition to the direct benefits of "free" access to an expensive and locally high-status resource, there were the less tangible rewards of stature by association and, on occasion, the availability of educational and material resources that were only tangentially related to project needs. On balance, however, it appears that the association at this stage benefits PLATO staff more than the schools. A tacit recognition of the debt incurred is sometimes made manifest in project decisions about distribution of resources. As an example, even in classes where the terminals are judged to be used only marginally, PLATO staff have not made unilateral decisions to remove the resource if the teacher wants it and has invested energy in incorporating it into the classroom.

The convenience of trying out ideas, methods, and materials in one's own backyard may, however, be offset by other consequences of this strategy. The easy and frequent access to the implementer may foster dependency on the part of the user, who then does not invest the requisite effort in acquiring facility with the resource, thus giving the evaluator a false impression of the cost involved in assimilating it into the classroom. The implementor on the other hand, is not pressed to articulate and develop, in publicly accessible and exportable forms, the skills and knowledge necessary for the effective use of the resource, making ultimate dissemination on a broad scale less probable. It should be pointed out that extensive documentation of the lessons themselves has occurred, particularly in the case of elementary reading. Equally extensive orientation, training, and support material are, however, not yet in evidence.

Thus, the major drawback, from the evaluators' perspective, of implementing close to home is that it is difficult, if not irresponsible, to generalize to less hot-house-like conditions, when the program must stand alone without the facilitating presence of its own developers. For research and inquiry, when wider dissemination is not a consideration, this can be a viable, even preferred choice. For a program slated for broad dissemination, it may still be appropriate to conduct field trials on familiar ground. Only when a field demonstration is intended to simulate the probable conditions of future implementations would such a strategy be questionable.

The choice of schools within a district has equally important effects. Schools may be chosen with a population of students and teachers that could unduly facilitate or hinder the acceptance of a program. The student body may closely resemble or diverge widely from the target population of the program. The PLATO projects did not per se select schools as sites for introducing the program, but it must be acknowledged that the strategy of teacher selection did increase the likelihood of certain schools, rather than others, becoming pilot sites.

The selection of classrooms to house PLATO terminals was done indirectly, via the selection of teachers. A district-wide notice went out ostensibly to all teachers (some principals were more thorough in transmitting information to their staff than others) informing them of the program, and soliciting volunteers for field trials. Relying on volunteers to make room in the class for programs in their early developmental phase is a common approach, reflecting assumptions, some of them quite unexamined, about the teaching role, forces motivating teachers, the organization of schools, and more.

The basic assumption underlying the volunteer strategy is the importance of teacher commitment to the program. The developer wants the teacher to be on the program's side, investing it with positive expectations or at least protecting it by suspended judgment. The implementor also wants the teacher to be willing to commit the effort that introducing the program requires, an effort which is often nontrivial, involving understanding the developers' intentions, learning new instructional techniques, rethinking previously held constructs, and putting up with the frustrations that inevitably accompany the shakedown phases of any innovation. How to maximize the likelihood of these conditions for implementation? The inference seems reasonable that if a teacher comes forward, offering to give the program a home in her classroom, she is well motivated to explore its potential, and is likely to share the program's approach and goals.

On the face of it, an eminently plausible assumption. But in an extended interview, when probing teachers' reasons for volunteering to participate in the PLATO project, we found a remarkably catholic set of motives, not all of which related to an interest in trying computer-aided instruction in the classroom. A sizeable number of the teachers could be classified as "high innovators," i.e., teachers who have a history of participating in a variety of new projects. But there were a few teachers who had no affinity with the subject matter that was to be computer-aided and hoped to be relieved by the computer of responsibility for teaching it. Others hoped that the computer would prove helpful to particular children with whom the teacher felt ineffective. The teachers with the more intrinsic reasons for participating divided among those who felt in need of help with their teaching of reading or math, and those who were interested in learning about new approaches to instruction, seeing the program as an opportunity for professional growth. There were teachers who volunteered for idiosyncratic reasons; one joined the program because it ensured her stay in the same school till retirement, others wanted to enlarge their community of interest in computers with a friend or spouse. House (1974) has suggested that the prospect of career advancement is a major motivating force of entrepreneurs and early users of innovations. Among the PLATO elementary teachers, given the flat career ladder of elementary schools, this was a negligible factor, applicable mainly to the rare male teacher - incidentally putting into relief the fact that perceived differential opportunities for the sexes persist in these institutions.

House, Ernest R., Politics of Education Innovation. California: McCutchan, 1974.

The strategy of selection by volunteerism, then, did not entirely serve its intended purpose -- it did not assure the most receptive conditions for the program in its first time out of the laboratory. An alternative strategy, that of scanning the district for teachers with a special interest in the new instructional aid might have led to recruiting teachers with ore relevant motivation. Thus, the appropriateness of a strategy is context-dependent, with the implementor needing both the foresight and a relatively clear understanding of priorities to make a reasoned decision.

Yet another consequence of relying on volunteer practitioners was the foreclosure of independent choice of the pilot schools. Most of the "high-innovator" teachers were from two schools that have traditionally been hosts for programs emanating from the University. Although both schools had a cross section of SES represented in the student body, the children of University faculty, and indeed of PLATO staff, were a conspicuous presence. The schools were also receptive to innovation, tolerant of the attendant disruptions, flexible regarding instructional styles, and not focused on a single mode of assessment, viewing achievement test results as but one, and not necessarily the most important, indicator of children's progress.

The program subsequently fanned out to other schools in the district, but only now, in its third year, is the math program significantly present in two schools that are largely composed of low-SES children, even though potential benefits to this population were identified early as a project goal.

Orientation of Participants.

The recruitment strategy gains significance when the question of teacher preparation is confronted. The developers need to define the role that they expect the teachers to play, they must consider the qualities of the teachers already recruited, assess their working environment, its supports and constraints, and take account of the implementation's own resources to bring about a favorable confluence of givens and aims, despite the invariably limited means for teacher orientation.

It is a rare implementor who approaches this task with the requisite humility and wisdom. It is a rare implementor, too, who gives the task its full due. Few responsible programs nowadays neglect it entirely, remembering the history of the golden age of curriculum development projects of the 50's, when materials and teacher's guides were often regarded as sufficient for curriculum improvement, and the teacher's sensitive role was grudgingly acknowledged only when the expected improvement failed to materialize.

Views of the teacher's proper contribution to program implementation vary widely among developers, and interact significantly with the pedagogic notions underlying the materials. Programs with narrowly defined and circumscribed use tend to provide teachers with a "script," expecting only a faithful rendering of the prescribed behaviors. Preparation for implementing such programs falls under the rubric of "training" rather th "education." Programs with greater flexibility of use entail some teacher familiarity with program purposes, which presumably overlap with the teacher's own curricular concerns. Thus the developer, in his interactions with teachers, needs to take some account of their perceptions and conceptions and, if necessary, shape these to benefit the implementation. This process may be a short move away from training or a long one, depending on the complexity of the requisite understandings, the teacher's entry state, and the weight given to the teachers' role. In the case of richly and broadly conceived programs, where a high level of teacher input is posited, developers are wont to select teachers with the desired qualities, rather than face the uncertain prospect of educating.

The two elementary projects differed somewhat in their views of and plans for teacher preparation. The math group was staffed at the start of the Contract by a small core of former teachers with extensive experience in developing and implementing an innovative mode of math instruction. They came to the PLATO project with tested convictions about the teaching of mathematics, ready to explore the computer as a vehicle for the expression of their precepts.

The math staff had originally anticipated extensive summer workshops for teachers, which would deal not only with the logistics and pragmatics of incorporating computer terminals into a classroom, but substantive questions in mathematics as well. These elaborate plans were not realized. The request for additional funding for teacher training was only partially successful, and the available project funds were not reallocated to cover the training effort. Also, teachers were reluctant to give up summer weeks, especially without acceptable reimbursement.

Training for the math group evolved into a varied set of interactions between PLATO staff and teachers. A two day meeting was held in the summer, along with varied levels of self-scheduled working at the terminal by individual teachers. Throughout the year, after school meetings were held with all the volunteer teachers. In addition, staff members were available to spend time at the terminal with individual teachers, who used this opportunity in diverse ways. All went through some of the available lessons, and learned how to access the student data kept by the system. A few explored some of the system's capabilities. Math staff also spent considerable time in classrooms, with children and teachers, helping smooth the transition, observing the interaction of programs and children, troubleshooting for the frequent hardware and software problems during the first months.

The reading group represented a more diverse set of backgrounds and interests. They shared some teaching experience, but not with a focus on beginning readers. The group's approach to the reading process was analytical, leading to the identification of a set of skills that were assumed to be prerequisite components of the ability to read. The programs were aimed at the development of these skills. Although the reading group expressed intentions of forging these relatively discrete skills into an integrated model of the reading process as a result of working with children on PLATO, during the first wave of teacher orientation there was no perceived need to imbue teachers with a particular view of the process of learning to read.

The reading and math staff also differed in their relation to the computer. The same members of the reading group programmed lessons as well as the course-specific control system -- in the math group the router programming and curriculum design functions tended to be separated. The reading group on the whole had more interest in using the medium to its full potential, and conversely, in living within the limitations imposed by it.

The mode of teacher orientation was related to these predispositions. A substantial amount of programming was invested by the reading staff in the preparation of on-line training materials, which were intended to familiarize teachers with the relevant workings and capacities of the system, as data collector and storer, diagnostic aide, as well as tutor. In addition, teachers were encouraged to go through the available lessons in the student mode.

The programmed materials proved to be drastically underused. The reading group, much like the math group, found face-to-face interaction with teachers and students the most effective and probably indispensable mode of orientation. As the majority of the core reading staff worked almost exclusively on programming, two experienced persons were engaged for the important task of classroom liaison. With the exception of one member of the reading team, a significant part of teacher and child orientation was carried out by new staff, who themselves h d to be oriented to the program's rationale and intent.

The overall picture of teacher orientation for both projects summarizes to an uneven effort. Training varied from teacher to teacher, as a result of the staff's desire to respond to individual needs and interests, and the consequences of the hazards of "early chaos."

The quality and direction of the effort was consistent with the developer's priorities, which centered on curriculum design. Neither group undertook broadly conceived teacher development, even though each asserted the interrelationship between the use of programmed materials and teaching modes. The resolution attempted by the math program was aimed at attracting exemplary teachers, the reading program, also working with volunteers, sought to create programs that did not require extensive teacher involvement.

Judgements on the effectiveness of teacher orientation and the relationship between that process and the eventual deployment of the innovation are forbiddingly risky to make. A possible way to assess training procedures is to scan the intersecting areas between training foci and the intended audiences' concerns. Taking a first step in that direction, we distilled from the interviews the teachers' expectations regarding mode of PLATO use, and the anticipated benefits and apprehensions associated with the prospect of utilizing such a resource. We ordered the range of expectations into a tentative framework that may be used to place an individual teacher's expectations, or actual modes of use, as well as to summarize groups of teachers along the same dimensions. This framework is presented in Table I.

TABLE I.

Modes of PLATO Use, Anticipated/Actual

A. POSITIVE EXPECTATIONS/USES

1. Instructional/subject-matter focus

Intent in Use	Pattern of Use: Tutorial/Expository		Drill and Practice/Review	
	Supplantive	Supplemental	Supplantive	Supplemental
Instructional (CAI)				
Record Keeping/ Retrieval (CMI)				
Enrichment				
New Teaching Mode				

2. Diagnostic - additional context for learning about students:

   1. for its own sake
   2. to lead to more effective PLATO utilization
   3. to lead to better use of other resources
   4. more effective communication with parents

3. Instructional - additional focus

   1. motivation
   2. acquisition of good work habits, increased attentiveness
   3. computer literacy
   4. medium for encouraging cooperation/helping among children
   5. sense of accomplishment resulting from controlling complex system

4. Classroom management

   1. reward
   2. control
   3. isolation
   4. behavior shaping

B. NEGATIVE EXPECTATIONS/USES

   1. Distortion of child's conception of the nature of math or reading
   2. Fear of PLATO takeover
   3. Discipline problems
   4. Disruption of class routine
   5. Increased competitiveness
   6. Physical strain
   7. PLATO encouraging autistic trends

The framework incorporates the whole range of expectations encountered among this group of teachers, most unfamiliar with computer-aided instruction, as well as impact anticipated by the developers and evaluators. Educationally trivial or unrealistic expectations were not screened out of the list.

The two-dimensional category related to instructional use with subject matter focus distinguishes between supplantive and supplemental use. Neither program as yet accepts supplantive responsibility, where instruction of a segment of the curriculum is entrusted to the computer programs. Supplemental use, where students interact with the programs in addition to their regular classroom instruction can subsume a wide range of expectations, and may be broken down further if the responses warrant it. Both modes can be envisioned as serving either tutorial, explicative use, where new concepts or methods are introduced, or drill and practice, aimed at reinforcing concepts previously introduced to the student.

Although the teachers differed in the degree to which they articulated suppositions, on the whole their ideas about the nature of the resource they elected to try were vague and undifferentiated. A great diversity of expectations emerged among the teachers, which may be related to the early lack of firm information about the capabilities of the system and the characteristics of the programs. The implications for training are that if PLATO is the inkblot that it appeared to be to teachers, orientation will need to be broad indeed if it is to speak to all the concerns of all those concerned.

Section II

Degree of Implementation and Classroom Observation

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Disillusioned by the questionable ecological validity of laboratory research in learning, and by the lack of even replicability of traditional field educational research, in which tests and questionnaires separate the investigator from the behavior under study, forming a wall of paper impermeable to any but the strongest signal, a growing band of researchers is returning to the classroom to watch the behavior of interest itself. It is fashionable to speak of the need for a phase of natural history before any further theory construction.

Evaluators are not immune to this trend: Cronbach, Stake and others have emphasized a reportorial function for evaluation, and even those who demur at restricting evaluation to a descriptive role acknowledge the importance of process, as well as product (Guba, 1975).

While this recognition of the importance of getting close to the phenomena is commendable, it is often accompanied by the hope that insight will automatically emerge from studying complete behavioral records. It won't. Simply counting unintegrated behaviors without considering their contexts or arbitrarily imposing one's own context as a way of limiting the range of behaviors considered important ignores a central issue in the study of behavior: the problem of determining the functional units of behavior in contexts as experienced by the organism. We do not claim to here contribute to resolving that issue; we merely insist that it not be swept under the rug in discussions of observational techniques for evaluation.

Surely the script and stage directions for a play constitute as complete a record of surface behavior as any practicable observation technique

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Guba, E. G. Problems in Utilizing the Results of Evaluation. Journal of Research and Development in Education, 1975, 8(3), 42-54.

could be expected to produce. Yet actors spend far more time in trying to get into their role, exploring the character's motivation and dynamics, than in simply reproducing lines and gestures. The number of interpretations available of Iago's "behavior record" gives the lie to the new critics' hope that internal evidence is sufficient to determine explanation. In spite of this difficulty, to study of the staging of any project requires attending the performances.

Having set the stage for the confrontation of PLATO system, children and teachers, we take our seats and await curtain time, somewhat apprehensive at the prospect of following the action of a play in the naturalistic genre in which characters seldom explain their actions.

Before this metaphor collapses under its own weight, let me point out that it represents an attempt to evoke some of the limitations and frustrations inherent in naturalistic observation as a technique for gathering evaluation data. Observational methods can chronicle and rate pervasive[1] patterns of overt behavior, but cannot get beyond the behavior and into heads, where presumably the activity of major interest is taking place. For this reason, we will attempt in later reports to coordinate information gained from observation with that provided by other data sources.

The results are not yet in, let alone coordinated, and despite the increasing pressures on evaluators to emulate the reigning drama critics by filing a judgment on opening night, we plan to continue to examine the dimensions on which judgments ought to be made and to pursue new sources of relevant information as the play continues to run. Rather, we'll try to

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[1]As Medley pointed out, to the extent that rare, "peak" experiences are determinants of outcome, they are unlikely to be captured by intermittent classroom observations.

sketch the evolution of one of the observation instruments being employed to observe the effects of PLATO on the life of some twenty elementary classrooms, the conditions and hypotheses under which it has been developed and used, and one illustrative result concerning implementation.

We assume we are preaching to the converted on the issue of the importance of assessing degree and mode of implementation. A reasonable consensus exists on the impossibility of interpreting outcomes in ignorance of how or even whether "treatments" were, in fact, applied. A case can be made that the study of varieties and impacts of approaches to confronting and integrating a potentially valuable but possibly demanding new resource is most germane to policy.

We see it as our responsibility to go beyond the function of a CAI consumers' report, providing information relevant to an administrator facing a decision to purchase or reject the system in its present form. We must attempt also to identify the issues and important determiners of mode of use in the hope that when someday the developers of "WITTGENSTEIN I" appear with an even more sophisticated technology, they will not be faced with reinventing the wheel in their attempts to implement their system to test its effectiveness in school situations.

While it would be consistent with some traditions in evaluation to lay out our a priori analysis of all questions important for the evaluation, a theory relating mode of implementation to outcome, and to proceed to show how an evaluation instrument was logically derived from these considerations, the actual process has been considerably less antiseptic. Bumping up against the phenomena being evaluated continues to modify our assessment of what should be looked at and how.

The observational approach employed in this evaluation was developed. during and in response to the less-than-optimal early implementation, with initial observations taking place during the first pilot testing of the systems in three classrooms one year ago. The first observations were the third author's attempts to characterize the teachers' classroom organizations and styles, which were later coupled with detailed narratives of individual children's behavior at the terminal. As these preliminary field reports arrived at ETS, they were studied and discussed in an attempt to identify dimensions of variation and possibly significant indicators of mode and effectiveness of use. Additional questions and areas of focus were suggested by the observers and the Princeton staff and an iterative process of instrument development began. While it was clear that design of a specific instrument, tailored to the features of the PLATO system was essential for the recording of individual child interaction with the system, it had been hoped that an existing instrument for observation of the classroom as a whole would prove appropriate to the task of characterizing those variations in teacher approach that might affect mode of implementation, outcome, and acceptance. None of the instruments catalogued in Mirrors for Behavior seemed to capture enough of the richness evident in the narrative reports that were being collected, but the problem of reducing such material to manageable summaries required that a coding scheme be applied, either to the narratives themselves, at one remove from the phenomena under observation, or by the observers. Thus was born yet another observation checklist, designed to supplement, but not to replace observers' running accounts. The early hope that a real-time checklist could be designed which would obviate the need for most of the narrative, leave room for recording unanticipated events, and yet retain the contextual information necessary to assess the significance of a given behavior, proved optimistic.

The current truce, worked out with the lively input of the two field observers (the third and fourth authors), involves a post-observation checklist designed to save some writing in the narrative, to provide opportunity for judgments of frequency of commonly-seen behaviors, and for more global judgments of pervasive classroom style, but is not based on the assumption that the narrative can or should wither away.

The development of the instrument for observing individual children (appendix A) at the terminal was a relatively straightforward process of creating a form to record behaviors that were characteristically noted in narratives. This interaction is seen as a process to be observed for overt indications of the child's attitudes, comfort and ease of use, pace, interest, task orientation, and understanding. To some extent, these represent evaluative dimensions in themselves, as well as being causally linked to amount of learning likely to be taking place.

In the case of the observation of the classroom setting, the situation is less straightforward. Of the countless perspectives from which the transactions and activities of life in classrooms can be viewed, few consistent relationships among identifiable teaching styles or acts and pupil outcomes have emerged. Rosenshine and Furst (1973) point out that although earlier reviewers of classroom observation methodology and findings wrote

> "in the hope that observational instruments would be used in correlational and experimental studies where the criterion was student gain, and that such studies would involve a cycle of probing and refinement which would improve both instruction and student growth. Unfortunately this research has not been done to any great extent. Instead, as has been demonstrated, the

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Rosenshine, B., and Furst, N. The Use of Direct Observation to Study Teaching. In R.M.W. Travers (Ed.) Second Handbook of Research on Teaching. Chicago: Rand McNally, 1973. Pp. 122-183.

> major use of observational instruments has been to describe teaching and train teachers in skills of undocumentated value. Such activities are necessary but not sufficient". (p. 162)

We might question even the necessity of the latter of these two activities, but it seems to remain the case, as it was noted by Medley and Mitzel a dozen years ago, that we don't yet know how to tell effective teaching by looking at it.

This assessment of the situation led us to an eclectic approach, with piloting of a number of existing instruments due to D. Solomon, Soar and Ragosta, Brown, and Trismen, Wilder, Nalin, Weinberg and Hardy. Previous experience in the analysis of a low-inference category instrument had led one member of the team to agree with Rosenshine and Furst that higher-inference sign, rating and global judgment techniques of data recording offered the current best hope of adequate adaptation of the data recording process to the context of behavior. Our position is that at this stage of knowledge we should build on the observational skills that intelligent human beings must possess to survive, (Heyns and Lippitt, 1954) rather than attempt to constrain them to simulate mechanisms with the limitations that go with the reliability of clockwork.

The process of trying, modifying or rejecting items from all of the above sources and even a few of our own, with much discussion and patient pointing out of gaps, hard cases and impossible distinctions by the on-site half of the team, led to a 155-item checklist reproduced in Appendix B.

Heyns, R. W., and Lippit, R. Systematic Observational Techniques. In G. Lindzey (Ed.) Handbook of Social Psychology. Cambridge, Mass.: Addison-Wesley, 1954. Pp. 370-404.

Built into the checklist, besides notations of certain physical characteristics of the classroom, materials and curriculum approaches are several sets of items designed to provide measures of constructs derived from previous research, constructs related in specific hypotheses with which we approached the evaluation of these implementation efforts. Among these are the constructs of Teacher Behavioral Control, Teacher Cognitive Controll or Input, Breadth vs. Narrowness of Focus, Degree of Pupil Cooperation, and Teacher Involvement with PLATO.

A major hypothesis relating these constructs arose from the modes of implementation actually adopted. While a terminal room capable of handling a whole class of children at a time was for a while contemplated at one high-innovating school with a large number of PLATO classes, the option was rejected in favor of placing 1,2, or 3 terminals in each reading classroom, and 4 in most mathematics classrooms. The consequence of this placement strategy is that if all children in a class are to have their 15 minute or half-hour turn on PLATO each day, some children must be using the terminals at almost all times. Thus we hypothesized that irrespective of the relationship of the curriculum to the teachers' goals, teachers high in attention to behavioral control, particularly those who were accustomed to working with the whole class in a single group much of the day, would find PLATO intrusive and demanding without extensive in-service training in new modes of classroom organization. Since the training provided was focused on the mechanisms of system and lesson operation, with classroom organization aspects being left to the ingenuity of individual teachers, the hypothesis leads to the specific predictions that teachers high on the control dimension are likely to be low on PLATO acceptance, while those more in tune with open, individualized, or even only "reading group" techniques would tend to be able to integrate PLATO terminals more easily into the congeries of resources they were already managing.

A second hypothesis dealt with teacher's level of cognitive input, as distinguished from behavioral control. It was felt that nearly orthogonal to the dimension of strict or loose classroom behavioral management should lie a dimension of activism or even instrusiveness with respect to the children's learning. It was argued that the teacher high on this dimension would be likely to evaluate PLATO lessons carefully, and accept or reject the system in terms of its perceived educational value for individual children. The delays that led to the sequence: graphing, whole numbers and then fractions in mathematics, and the fact that many first graders among the PLATO demonstration classes enter knowing how to read, was expected to lead such teachers to be critical of PLATO, if not to reject it for certain children.

Finally, because of the clear link of lesson materials to behavioral objectives corresponding to an analytic view of reading, and the much more free-floating goals of many mathematics lessons, it was hypothesized that reading teachers having a "narrow focus" in instruction would react more positively to the reading curriculum, while those mathematics teachers with a narrow focus (differently defined) in their instruction would react less positively than would their counterparts with a broader conception of children and curriculum.

Preliminary examination of the results of the first two rounds of classroom observations (n = 38) completed in the fall of 1974, suggests that some constructs fare better than others, and that while one hypothesis cannot be rejected, the others cannot yet be tested. Validation of these scales was carried out on the 57 observations of rounds 2,3, and 4, and alphas and interscale correlations were found to remain quite stable.

Tables 1 - 5 give the items making up the control, input, narrow focus, and PLATO scales, item-scale correlations, and coefficient alpha measures of consistency of the scales formed of the sums of the standardized items of the validation set.

Insert Tables 1 - 5 about here

As is apparent from their reliabilities the scales varied in the degree to which they hang together, with PLATO involvement being the least well-measured construct. Nevertheless, the reliabilities are acceptable if the scales are indeed measuring different things.

most of them are not.

In particular, Scale 1, Teacher control, and Scale 2, teacher input, intercorrelate as high as their reliabilities permit, indicating that we have not succeeded in retrieving independent measures of the two behavioral patterns, or possibly that in this sample at least, they are not in fact independent. The "narrow focus" scales relate to teacher input and consequently inter-relate more strongly than one would prefer, although less strongly to behavioral control.

The correlation between the narrow focus scales in math and reading is of course spuriously inflated by the fact that they share items. Thus until the scales have been refined into more nearly individual entities, or, as is more probable, the separate construct of teacher "input" is abandoned and combined with teacher control, we have no evidence that we are dealing with more than one dimension. While the fact that teacher control relate slightly negatively ($p<.15$) to the PLATO involvement scale tends to support one of our original hypotheses, the possibility that this pattern of judgments reflects a bipolar evaluative dimension contrasting high PLATO valuers with "bad guys" cannot be discounted at this stage. To the extent that data from the teacher interviews and system records of actual usage confirm this preliminary finding, and to the extent that the application of analytic methods reveal a more differentiated structure in these and later observations, the hypothesis that we are chasing a halo effect will be infirmed. The narratives and observers' summaries suggest that observers do not attach any particular "halo" to PLATO use. If more thorough analyses support substantive findings in this area, their importance will be in the realm of refining the tautology that "traditional teachers" resist innovation. Few of the volunteer teachers in this sample could be characterized as "traditional" in any simple sense of the word. The specific beliefs and behaviors that go with a teachers' acceptance of the heavy demands inherent in making her classroom a proving ground for a new technology need to be understood if we are to hope to separate the potential of the play from the idiosyncracies of the actors in any particular production. Classroom observation, coordinated with interview and test data, shows promise in helping us in the task of clarifying and ultimately assessing this potential.

CLASSROOM OBSERVATION

SUMMARY OF INTER-RATER RELIABILITY IN EIGHT SETS OF PAIRED OBSERVATIONS

Checklist Items

Item	No. Pairs	Positive Agreements*	Disagreements	Negative Agreements**
1	8	8		0
12	8	4		4
13	8	4		4
14	8	8		0
15	8	0	1	7
16	8	6	1	1
17	5	1		4
18	5	3		2
19	5	2		3
20	5	3		2
21	5	5		0
22	5	3		2
23	5	4		1
24	5	4		1
25	5	3		2
26	5	2		3
27	5	5		0
28	5	4		1
29	5	1		4
30	5	3		2
31	4	1		3
32	3	0		3
33	3	1		2
34	3	1		2
35	3	2		1
36	3	2		1
37	3	1		2
38	3	1		2
39	3	1		2
40	3	0		3
41	3	0		3
42	3	1		2
43	3	0		3
44	3	0		3
45	3	2		1
46	3	1		2
47	3	0		3
48	3	1		2
49	3	2		1
50	3	1		2
51	3	0		3
52	2	1		1
54	[illegible]	5		3
56	8	[illegible]		1
58	8	7		1

*Both raters checked **Neither rater checked

Checklist Items (Cont'd)

Item	Pairs	Positive Agreements	Disagreements	Negative Agreements
67	8	8		0
122	8	6		2
123	8	0		8
124	8	0		8
125	8	1	1	6
	249	124	5	120

Over all items, raters agreed positively (both checked item) in 49.7% of cases, agreed negatively (neither checked item) in 48.2% of cases, and disagreed (only one rater checked) in 2.0% of cases.

Of the total items receiving checks from one or both raters, there was agreement in 96.1% of the cases, and disagreement in 3.9%.

Note: The number of pairs differ for some items because certain items applied only for reading classes or only for math classes.

Table 1

Observation Scale 1 Teacher Behavioral Controls

Teacher and children observed in these activities more frequently than are other classes		Item-scale Correlation
53	Teacher works with whole classroom	.56
59	Teacher gives same task to whole group no child-child interaction	.70
63	Teacher directs children to activities	.45
69	Loss of privileges as a reward strategy	.35
72	Reminding children of rules	.48
73	Negative statements or warnings	.65
78	Commands given without reasons for behavior	.26
103	Teacher passes judgment on pupils behavior or work	.76
131	Global assessment: pacing as more "rushed"	.67
138	Global assessment: rules as more "frequently cited"	.82
142	Global assessment: student movement as more teacher determined	.81
Teacher and children observed in these activities less frequently than are other classes		
9*	Children move from student to student	.80
10*	Children move from activity to activity	.75
61*	Variety of activities going on in subgroups	.52
62*	Children engaged in individual activities, not grouped	.48
63*	Children direct themselves according to interests	.78
105*	Teacher withholds judgment of pupils' behavior or work	.07

Table 1 continued

121* Children gather around other pupils at terminals	.46
138* Global assessment: few apparent rules for children	.81
140* Global assessment: classroom decision making as decentralized	.71

Alpha reliability of sum of standardized items = .89

Table 2

Observation Scale 2 Teacher Input

Teacher and children relatively more frequently observed in these activities	Item-scale Correlation
101 Specific step-by-step instructions are given	.42
106 Teacher immediately reinforces pupil's answer	.42
141 Global assessment of task choice as more teacher determined	.59
Teacher and children relatively less frequently observed in these activities	
54* In working with whole class, children do most of talking	.34
56* In working with subgroups, children do most of talking	.38
57* Teacher works with single pupils	.45
58* In working with individual pupils, child does most talking	.24
100* Instruction is adjusted to student concerns and interests	.60
102* Guidelines are given with some freedom of interpretation	.61
107* Teacher has pupil decide when question has been answered satisfactorily	.63
110* Teacher gives pupil time to sit and think, mull things over	.62

Alpha reliability of sum of standardized scores = .67

Table 3

Scale 3 Narrow Focus: Reading

Teacher and children relatively more frequently observed in these activities	Item-scale Correlation
23 Spelling, punctuation	.05
26 Using textbook/workbook	.42
92 Emphasis on memorization, rote learning, as instructional technique	.72
94 Only one answer is accepted as being correct	.55
97 Focus is on facts and rules	.70
143 Global judgment of lower emphasis on individual attention	.42

Teacher and children relatively less frequently observed in these activities	
15* Visual aids in use	.13
16* Concrete materials in use	.35
17* Experience stories (children dictating)	.36
29* Teacher-generated stories	.31
30* Games	.41
90* Children express own experiences and judgments	.71
91* Emphasis on discussion, relationships among ideas, inquiry as instructional techniques	.67
95* Pupil is permitted to suggest additional or alternative answers	.64
96* Focus is on generalizations and understanding of structures or patterns	.62

Alpha = .75

Table 4

Scale 4 Narrow Focus: Mathematics

Teacher and children relatively more frequently observed in these activities		Item-scale Correlation
92	Emphasis on memorization, rote learning as instructional technique	.73
94	Only one answer accepted as being correct	.49
97	Focus is on facts and rules	.61
99	Topics or preset plans are narrowly adhered to	.40
143	Global judgment of lower emphasis on individual attention	.31

Teacher and children relatively less frequently observed in these activities		
15*	Visual aids in use	.15
32*	Introduction of rules by discovery or inductive approach	.55
36*	Children asked for illustrations of concepts	.50
44*	Measurement as topic	.40
45*	Estimation as topic	.60
49*	Child-generated problems (as opposed to textbook or workbook)	.47
50*	Teacher-generated problems (as opposed to textbook or workbook)	.45
51*	Real-life problems (as opposed to textbook or workbook)	.13
90*	Children express own experiences and judgments	.67
91*	Emphasis on discussion, relationships among ideas, inquiry as instructional techniques	.71
95*	Pupil is permitted to suggest additional or alternative answers	.56
96*	Focus is on generalizations and understanding of structures and patterns	.71

Alpha = .81

Table 5

Involvement with PLATO

	Teacher and children relatively more frequently observed in these activities	Item-scale Correlation
113	Teacher uses feedback from PLATO system to group pupils for special PLATO-related instruction or remediation	.58
116	Teacher disciplines pupils at PLATO terminals (tells them to be quiet, keeps children from interfering with others' work)	.47
117	Teacher walks by terminals to observe pupils' work	.65
118	Teacher helps pupils at the terminal	.60
144	Global assessment of PLATO as a more integrated resource in the classroom	.45

Alpha = .41

Influences of Teachers' Conceptions
on Curriculum Implementation in a CAI Project

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There are no census figures to back it, but the estimate is plausible: a greater number of programs intended to change classroom instruction was rained down on elementary schools in the past twenty years than during the entire history of public schooling. The nature of the desired change varied with the interests -- vested and intellectual -- of the reformers, and this diversity of ends was exceeded only by the varied means chosen to bring them about. The blueprints differed from one another on some critical aspects of effecting change. One of these, the part the teacher plays in implementing proposed innovations, is the focus of this paper. Conceptions of the teacher's role in reshaping educational practices have ranged widely, from the view of teacher as obstacle to change, whose influence is best counteracted or neutralized, to one that solicits the active support of the teacher and, in fact, views teacher development as the predominant aim. In all cases, the presence of the teacher must be confronted by anyone seeking to alter school life.

Given the teacher's centrality in the classroom, it is surprising that decisions about implementation strategies have often been made with scant knowledge about the pedagogical values and constructs held by teachers. The question of the compatability of a program's goals with those of the teachers has seldom been raised. This curious lack of interest in the teachers' viewpoint, the "odd gap" in teacher research (Lortie, 1973), is all the more remarkable if one considers the universal aim of many innovations, bent on no less than the improvement of all classrooms.

The rare study that attended to teachers' constructs did so in search for factors influencing successful implementation. Thus, in a thoughtful report, Regan and Leithwood (1973) inferred some relationships between teachers' beliefs and values and the fate of a program in their room. Our own interests (the Early Education Group) in teachers' understandings grew out of a study concerned with the implementation of a Follow Through program, which was programmatic only in the sense that it sought to transmit to teachers a set of views on the nature of teaching and learning, rather than impose a set of specific instructional behaviors. For the purpose of that inquiry, we developed a semi-structured, fairly lengthy (1 1/2 to 3 hours) interview to gain access to teachers perceptions and understandings. A framework and coding scheme were developed for describing and classifying constructs held by teachers on several dimensions of curricular concerns and priorities, on the teaching role, on children as learners, and on related topics presumed to underlie decision making in the classroom. (Bussis, Chittenden, and Amarel, 1976)

The framework again seemed relevant when the challenge of evaluating an innovative CAI program was posed to a number of ETS researchers. This paper will consider a few of our preliminary findings on the relationship between teachers' views and values and their use of a new instructional resource in the classroom. Let us first describe that program as briefly as we can: For over a dozen years, the University of Illinois has been the site for the development of a system with the memorable acronym PLATO, designed to deliver computer-aided instruction. Our evaluation has focused on only a portion of a much larger effort: the introduction of reading and mathematics curricula into elementary classrooms. The reading lessons are aimed at beginning readers, K through 1st grade, and the math strands are designed for 4th and 6th grade classes. The lessons are delivered through a sophisticated interactive terminal placed in the classroom. Printed messages and animated graphics are presented as patterns of tiny orange dots on a plasma screen, and the student communicates with the central computer via a full keyboard of alpha-numeric characters or by touching portions of the screen. In addition, reading lessons are augmented by computer controlled, but user changed random access audio discs and microfiche projected through the terminal screen. The math curriculum consists of three tutorial strands: a game-like whole number arithmetic strand, a carefully sequenced fraction strand, and a strand introducing the elements of graphs, variables, and linear equations. The reading materials comprise an eclectic set of lessons, beginning with visual and auditory discrimination, followed by exercises in phoneme-grapheme correspondence, identification of sight words and microfiche illustrated stories.

Before the start of the 1974-75 school year a call went out in the school districts adjacent to the University for volunteer teachers to participate in the field trial of the computer-aided curricular materials. The program developers made no systematic effort to select teachers possessing a particular affinity for the program's goals. They did, however, assume the volunteers were hospitable to trying something new. In fact, we found the teachers' understanding of the innovation at the beginning of the year to be uneven, their expectations and motivations mixed (Amarel and Swinton, 1975). Twenty-five teachers constituted the first group to try to incorporate the resource into their regular classroom instruction.[1]

[1] The first year of the field trials were a pilot year, with the curricular materials and the delivery system still in the process of development. In interpreting the teachers' responses, we found it difficult to disentangle the effects of their coping with the vicissitudes of unreliable technology and fragmented materials from the effects of their trying to integrate new and old curricular resources and practices. This situation is regrettable, but it is not uncommon, since many innovations are introduced into classrooms in their formative stage.

The mythology surrounding computer-aided instruction perpetuated the belief that it is impervious to teacher effect. Close observation of the use of CAI in a school rather than laboratory setting quickly dispels that notion. Yet there is a dearth of good documentation of the transformations a single program can undergo in different settings. Our familiarity with elementary classrooms and the fate of previous innovations primed us to expect variations in the use of the PLATO resource. These expectations were also supported by the expressed intention of the PLATO developers to create materials that could accommodate to a range of instructional contexts, and to provide and welcome alternate modes of utilization. Believing one of the major responsibilities of evaluation to be a faithful portrayal of the program, (Stake, 1975) we set out to describe the course of the implementation, and any variations that would emerge.

The data related to the effects of the teacher and her working context on the use of PLATO derive from four primary sources: systematic classroom observations,[2] logs kept by several teachers describing the impact of the terminals on the classroom, on-line records of usage retained by the computer, and an end-of-year interview with the teachers.

Several ways that the teachers could affect the utilization of the program became evident as the year progressed. With most classrooms housing two to four terminals, the curricular materials became an additional resource, yet at the same time a scarce one, requiring controlled

[2] Observations were made of the whole classroom, and of individual children at the terminal. The instruments are described in detail in Swinton, Amarel, Stake & Wardrop, 1975.

access to ensure that its distribution would not be capricious. Thus scheduling children for time on the terminals imposed the first tax on the teacher's time in return for the resource, as well as bringing teacher judgment into play in deciding on a pattern of usage suited to the class. The teacher was limited by the length of lesson-time allotted to each child, which was 15 minutes per day in reading and 30 minutes for the math program. Within this constraint the teacher could exercise a number of options: schedule children immediately before and after school, as well as throughout the day, limit access to the terminal during some portions of the school day, set up tight schedules and monitor them closely, or have a more laissez-faire attitude towards the use of the resource. We found teachers adopting the full spectrum of possibilities, with the mode of use chosen reflecting some of their pedagogical conceptions, a point to which we will return. Each of these management modes has its own effect on access and hence on students' total contact hours with the curriculum during the course of the school year.

Teachers, in addition to influencing the program through impact on the pattern of pupil access, affected it by the degree to which they integrated the program into the ongoing curricular activities of the classroom. Integration could, and did, take many forms. In some classrooms the teacher made little effort to find out what the children were doing at the terminals, and made few attempts to bridge curricula of the classroom and of PLATO. In other rooms, the teacher required the students to keep a running record on their PLATO lessons, which she used for guiding supplementary classroom activities. Some teachers prepared PLATO-related worksheets, and devoted a certain amount of mathematics instructional time to the coverage of problems arising from PLATO lessons. The teachers differed in their familiarity with the PLATO materials themselves, as well as with the students' use of them.

In addition to allocating and augmenting the students' work on the terminal, the teachers were to have the means to select and sequence the PLATO lessons for individuals or groups of children. These teacher options were only partially realized, since both the lessons and the router, the computer program regulating their access, were being developed during the pilot year. It became clear, however, that thoughtful prescription of lessons required considerable investment of teacher time, as it called for familiarity with the available lessons, as well as close observation of the children's progress through them. Teachers varied in how much engagement they wanted to have with the PLATO curriculum, and in how they used the feedback provided about the children's activities at the terminal.

Differences in implementation are interesting to document for their own sake, but the more difficult challenge by far is to begin to understand these differences in the light of the teachers' curricular conceptions and values. We derived knowledge of these primarily through interviewing the teachers at the beginning of the school year, before the PLATO system was functioning in most rooms. The interview schedule used was a modified version of the one we had developed for the earlier study of teacher constructs. The interview first elicited the teacher's description of a typical school day and then went on to explore the teacher's curricular concerns and priorities, her perceptions of the role of children in shaping the course and content of classroom activities, her view of the teaching role and the institutional supports and constraints affecting her practice. A set of specifically developed questions also probed the teacher's familiarity with features of the PLATO system and her expectations regarding this instructional resource. The teacher views on mathematics or reading instruction were also tapped depending on the program intended for her room.

To relate differences in implementation to the teachers' values and concepts, we began by looking at an easily available indicator of implementation: total number of hours per student on the terminal in the eleven classrooms utilizing the math program[3]. This variable, posited by Carroll and elaborated by Bloom, has recently received renewed attention through the work of Anderson, and of Harnischfeger and Wiley. (Anderson, 1973; Bloom, 1973; Carroll, 1963; Wiley, 1973; Wiley & Harnischfeger, 1974). We found student contact time ranging from 73 to 30 hours for the school year, a significant difference, considering all classrooms had had roughly equal access to the system. Although student time on the terminal may appear a crude indicator of implementation, it was, in fact, a good reflection of the teacher's management of student access. A high rate of use could not be achieved without the teacher's placing priority on the resource, thereby ensuring its use. It required a well functioning, monitored system of scheduling, prompt reporting of terminal breakdowns, flexibility in working around system

[3]Because of time limitations, this paper considers only some of our findings regarding the mathematics curriculum.

failures, and not holding students back for other classroom activities. Moderate use could indicate a more loosely run ship or the valuing of other activities over PLATO when conflicts arose. A low-using class signalled a room where the computer-delivered materials were seen as one resource among many, and hence their use was not actively promoted and perhaps even withheld on occasion.

Relating the teachers' perceptions prior to their PLATO experiences to their class' average amount of a terminal use was accomplished by that often employed but seldom credited multivariate technique: eye-balling. The first finding uncovered by this versatile method was the curvilinear relationship exhibited by several of the interview item codes when arrayed against amount of PLATO usage. High and low users tended to be more alike in their perceptions than were the moderate users. In the area of curricular priorities, for example, the moderate users held less complex and less comprehensive cognitive goals for their students, aiming mostly at the acquisition of grade-level skills. In contrast, the high and low users hoped to develop certain qualities and ways of functioning in the children as well, such as independence, initiative and problem solving capacities. In the area of personal-social concerns, the dominant priority of the moderate users was socialization into the pupil role, reflected in good behavior and work habits, whereas the outlying users also stressed fostering their pupils' self-confidence, awareness, and self-expression.

The same trend is present in the manner in which the three groups of teachers differentiated children. The extreme groups of users were more likely to cite malleable dimensions, such as interests and motivation, as those on which children vary, while the middle group was more likely to differentiate children along more static dimensions as I.Q., sex, and specific abilities.

Ranking teachers on the degree to which they assume an evaluative posture toward the math curriculum again reveals the familiar U-shaped curve. The high and low users tend to assume a judgmental posture, questioning assumptions, whereas the moderate users are apt to accept prescribed or proposed curricula less critically.

Not all dimensions of teacher constructs related to amount of PLATO utilization. When we arrayed the teachers' conception of the curriculum on a continuum ranging from viewing it as a pre-established plan to seeing it as a flexible agenda influenced by the abilities, interests and understandings of children, we could discern no meaningful relationship to PLATO usage.

Another set of possible couplings between teacher sentiments and mode of implementation did not, to our surprise, prove to have much predictive value: the teachers' expectations and attitudes concerning PLATO. Expectations at the beginning of the year tended to be unfocused and vague about anticipated benefits, or difficulties. The majority of teachers expected the principal outcome to be motivational, at the same time citing machine supervision of drill and practice as a welcome prospect.

A few relatively clear connections in evidence were found between low usage and the expressed fear that PLATO would take over part of the teachers' role. Teachers who hoped that PLATO would be capable of reaching children who did not respond to traditional teaching -oaches, or expected improved work habits, were also among the low users. The expectations of high and moderate users, however, did not form a discernable pattern.

The teachers' view of the curriculum, however, was consistent with their perceptions of the role of children in learning math along an active-passive continuum. Those who professed pre-established curricula tended to see children as passive recipients of knowledge, whereas teachers who modified their curriculum in response to learner characteristics, construed children as active constructors and integrators of experience. While these dimensions of teachers' views did not appear to effect usage, they did bear on the teachers' involvement in the students' work on the terminal. The teachers who took greater responsibility for curricular decisions, and saw children as active agents in the learning process, tended to keep close tabs on their students' progress through PLATO lessons, clarifying and augmenting them on occasion. These teachers also integrated the lessons into the ongoing curriculum more consistently.

A suggestive pattern emerges from this first pass at relating variations in using a new resource to selected teacher conceptions. It appears that teachers whose instructional decisions are influenced by both the characteristics of children and school priorities, whose goals reach beyond fostering grade-level skills to include qualities of the child, and whose view of themselves is that of critical decision makers rather than conduits of externally mandated instructional plans, are likely either to vigorously support or reject a program than give it indifferent acceptance.

The temptation to generalize these observations to other teachers working in other environments is perilous, but irresistible. Despite the risk, we would commend these tentative interpretations to planners of change, suggesting that such rough-cut conclusions do point a way to go beyond labeling teachers as "high or low innovators" when planners are anxious to predict how teachers will adopt a program or adapt to it. In introducing a new approach to instruction, planners have a choice of strategies which entail different risks: to introduce the program to teachers who are purposeful constructors of instructional experiences is to risk possible rejection of the program, but to gain the chance of its thoughful implementation. A safer course is to work with teachers who are amenable to merely transmitting a suggested curriculum. However, this strategy of prudence is likely to result in little more than having the new program accorded a perfunctory, albeit good-natured, trial.

Bibliography

Amarel, M., Bussis, A. M., and Chittenden, E. A., Beyond Surface Curriculum: An Interview Study of Teachers' Understandings. Westview Press, Boulder, Colorado, 1976.

Amarel, M., and Swinton, S., The introduction of innovative instructional systems: Implementation and program evaluation. 1. The practitioner: Selection, training, and program evaluation. Symposium presented at the meeting of the American Educational Research Association, Washington, D. C., 1975.

Anderson, L. W. Time and school learning. Unpublished Ph.D. Dissertation, Department of Education, University of Chicago, 1973

Bloom, B. S. Time and Learning. Thorndike Address, 81st Annual Convention of the American Psychological Association, Montreal, 1973.

Carroll, J. B. A model for school learning. Teachers College Record, 1963, 64, 723-33.

Lortie, D. Observations on Teaching as Work. In R. M. Travers, (Ed.) Second Handbook of Research on Reading. Rand McNally and Company, Chicago, 1973.

Regan, E. M. and Leithwood, K. A. Effecting Curriculum Change, Experiences with the Conceptual Skills Project: Ontario Institute for Studies in Education, Toronto, 1974.

Stake, Robert E. Program Evaluation, Particularly Responsive Evaluation. Occasional Paper #5, College of Education, Western Michigan University, Kalamazoo, Michigan, 1975.

Swinton, S., Amarel, M., Stake, B, and Wardrop, C., The introduction of innovative instructional systems: Implementation and program evaluation. 11. Degree of implementation and classroom observation. Symposium presented at the meeting of the American Educational Research Association, Washington, D.C., 1975.

Wiley, D. E. Another hour, another day: Quantity of schooling, a potent path for policy. Studies of Educative Processes. No. 3. University of Chicago, July 1973. To be published in: Sewell, W. H., Hauser, R. M., and Featherman, D. L. (Eds.), Schooling and achievement in American society. (In preparation).

Wiley, D. E. and Harnischfeger, A. Explosion of a Myth: Quantity of Schooling and Exposure to Instruction, Major Educational Vehicles, Educational Researcher, Vol. 3, No. 4, April 1974, 7-12.

APPENDIX B

Demonstration Year Means and Standard Deviations

	GRADE 4				GRADE 5				GRADE 6			
	PLATO		CONTROL		PLATO		CONTROL		PLATO		CONTROL	
	46		48		91		108		77		84	
	PRE	POST	PRE	POST	PRE	POST	PRE	POST	PRE	POST	PRE	POST
1 I am very proud of the way I read.												
Yes	73.9	76.1	64.6	52.1	65.6	61.5	69.4	75.9	58.4	62.3	57.1	55.4
?	15.2	17.4	18.8	33.3	25.6	26.4	18.5	17.6	27.3	22.1	21.4	27.7
No	10.9	6.5	16.7	14.6	8.9	12.1	12.0	6.5	14.3	15.6	21.4	16.9
2 Reading is the hardest thing I have to do.												
Yes	4.4	0.0	6.3	2.1	5.6	11.0	2.8	7.4	0.0	2.6	7.1	4.8
?	0.0	4.4	16.7	14.6	2.2	8.8	8.3	4.6	3.9	3.9	11.9	12.1
No	95.7	95.7	77.1	83.3	92.2	80.2	88.9	88.0	96.1	93.5	81.0	83.1
3 I get worried when I am asked to read something.												
Yes	15.2	13.0	16.7	14.6	14.4	10.0	9.3	7.4	14.3	10.5	13.1	9.6
?	10.9	8.7	6.3	27.1	10.0	11.1	9.3	10.2	19.5	14.5	15.5	13.3
No	73.9	78.3	77.1	58.3	75.6	78.9	81.5	82.4	66.2	75.0	71.4	77.1
4 I like to read to people.												
Yes	52.2	50.0	51.1	45.8	50.0	48.4	49.5	51.4	48.0	54.6	51.2	15.8
?	13.0	15.2	25.5	31.3	18.9	22.0	21.5	23.4	18.7	16.9	15.5	25.3
No	34.8	34.8	23.4	22.9	31.1	29.7	29.0	25.2	33.3	28.6	33.3	28.9
5 I am slow at reading.												
Yes	19.6	17.4	18.8	16.7	11.1	16.7	17.8	12.0	10.5	10.5	26.5	18.1
?	17.4	15.2	14.6	35.4	17.8	21.1	15.9	21.3	17.1	23.7	15.7	24.1
No	63.0	67.4	66.7	47.9	71.1	62.2	66.4	66.7	72.4	65.8	57.8	57.8
6 Reading is fun.												
Yes	71.7	88.4	80.0	60.4	71.1	68.1	71.3	75.0	66.2	61.0	60.7	65.9
?	4.4	7.0	11.1	22.9	20.0	18.7	14.8	13.9	20.8	19.5	20.2	18.3
No	23.9	4.7	8.9	16.7	8.9	13.2	13.9	11.1	13.0	19.5	19.1	15.9
7 I am a good singer.												
Yes	41.3	51.1	27.1	22.9	38.2	40.0	29.0	29.0	42.7	38.2	27.4	24.1
?	26.1	22.2	39.6	47.9	38.2	34.4	31.8	35.5	36.0	44.7	33.3	45.8
No	32.6	26.7	33.3	29.2	23.6	25.6	39.3	35.5	21.3	17.1	39.3	30.1

	GRADE 4				GRADE 5				GRADE 6			
	PLATO		CONTROL		PLATO		CONTROL		PLATO		CONTROL	
	46		48		91		108		77		84	
	PRE	POST	PRE	POST	PRE	POST	PRE	POST	PRE	POST	PRE	POST
8 I like school.												
Yes	77.3	57.8	66.7	54.2	51.7	47.7	54.7	51.9	55.8	49.4	48.8	48.2
?	13.6	22.2	18.8	31.3	27.0	23.9	24.5	25.9	27.3	28.6	29.8	25.3
No	9.1	20.0	14.6	14.6	21.4	28.44	20.8	22.2	16.9	22.1	21.4	26.5
9 I get worried when I am asked to play sports.												
Yes	15.2	15.2	12.5	12.5	7.8	7.7	6.5	11.1	11.7	6.5	1.2	4.8
?	6.5	2.2	20.8	16.7	2.2	8.8	9.3	9.3	6.5	7.8	14.3	10.8
No	78.3	82.6	66.7	70.8	90.0	83.5	84.3	79.6	81.8	85.7	84.5	84.3
10 Drawing pictures is hard for me.												
Yes	6.7	9.1	22.9	20.8	15.6	21.1	17.0	20.4	18.2	19.5	27.4	26.5
?	11.1	9.1	10.4	14.6	15.6	12.2	10.4	17.6	14.3	14.3	14.3	18.1
No	82.2	81.8	66.7	64.6	68.9	66.7	72.6	62.0	67.5	66.2	58.3	55.4
11 I like to show people how to play games.												
Yes	64.4	53.3	66.7	55.3	51.1	56.0	65.7	56.5	55.8	57.1	53.6	45.8
?	6.7	15.6	16.7	27.7	21.6	19.8	13.0	24.1	24.7	23.4	20.2	34.9
No	28.9	31.1	16.7	17.0	27.3	24.[illegible]	21.3	19.4	19.5	19.5	26.2	19.3
12 I like to beat other kids at games.												
Yes	60.0	52.2	56.3	58.3	48.9	52.8	52.8	48.6	45.5	52.0	45.2	46.3
?	15.6	28.3	27.1	31.3	24.4	31.5	27.8	35.5	37.7	37.7	27.4	40.2
No	24.4	19.6	16.7	10.4	26.7	15.7	19.4	15.9	16.9	10.4	27.4	13.4
13 Math is fun.												
Yes	58.7	67.4	48.9	41.7	44.4	50.6	62.3	46.3	54.6	54.6	60.7	58.5
?	13.0	21.7	17.0	27.1	25.6	21.8	14.2	29.6	23.4	22.1	21.4	25.6
No	28.[illegible]	10.9	34.0	31.3	30.0	27.6	23.6	24.1	22.1	23.4	17.9	15.9
14 Math is the hardest thing I have to do.												
Yes	13.0	8.7	31.3	27.1	17.8	16.5	12.0	16.7	13.0	16.9	13.1	10.8
?	4.4	2.2	8.3	20.8	7.8	13.2	15.7	14.8	16.9	6.5	14.3	15.7
No	82.6	89.1	60.4	52.1	74.4	70.3	72.2	68.5	70.1	76.6	72.6	73.5

	GRADE 4				GRADE 5				GRADE 6			
	PLATO		CONTROL		PLATO		CONTROL		PLATO		CONTROL	
	46		48		91		108		77		84	
	PRE	POST	PRE	POST	PRE	POST	PRE	POST	PRE	POST	PRE	POST
15 I am good at math.												
Yes	69.6	73.9	43.8	37.5	47.8	61.5	48.2	47.2	44.2	46.8	50.0	47.0
?	19.6	19.6	47.9	41.7	37.8	20.9	32.4	42.6	42.9	41.6	32.1	37.4
No	10.9	6.5	8.3	20.8	14.4	17.6	19.4	10.2	13.0	11.7	17.9	15.7
16 I get worried when asked to do a math problem.												
Yes	13.0	8.7	10.4	25.0	16.5	12.1	16.7	14.8	15.6	14.3	19.1	16.7
?	10.9	15.2	14.6	22.9	14.3	9.9	8.3	13.9	16.9	20.8	9.5	20.2
No	76.1	76.1	75.0	52.1	69.2	78.0	75.0	71.3	67.5	64.9	71.4	63.1
17 I would rather do almost anything than math.												
Yes	15.2	17.4	27.1	20.8	17.6	24.4	25.0	24.1	23.4	13.0	20.2	13.1
?	13.0	10.9	18.8	31.3	23.1	17.8	17.6	19.4	14.3	13.0	16.7	16.7
No	71.7	71.7	54.2	47.9	59.3	57.8	57.4	56.5	62.3	74.0	63.1	70.2
18 I like to show people how to do math problems.												
Yes	69.6	50.0	62.5	47.9	56.0	50.6	56.5	55.1	54.7	50.0	51.2	42.9
?	15.2	21.7	25.0	35.4	18.7	18.7	14.8	22.4	20.0	25.0	16.7	32.1
No	15.2	28.3	12.5	16.7	25.3	30.8	28.7	22.4	25.3	25.0	32.1	25.0
19 I am slow at doing math.												
Yes	21.7	13.0	25.0	22.9	20.2	17.6	18.9	17.8	17.1	17.6	21.4	15.5
?	13.0	10.9	16.7	35.4	22.5	16.5	20.8	31.8	21.1	23.0	21.4	22.6
No	65.2	76.1	58.3	41.7	57.3	65.9	60.4	50.5	61.8	59.5	57.1	61.9
20 I like math better this year than I did before.												
Yes	73.3	76.1	48.9	45.8	54.4	58.2	51.9	50.9	41.6	52.0	53.6	52.4
?	6.7	6.5	17.0	20.8	21.1	15.4	17.6	21.3	20.8	18.2	17.9	25.0
No	20.0	17.4	34.0	33.3	24.4	26.4	30.6	27.8	37.7	29.9	28.6	22.6

	GRADE 4				GRADE 5				GRADE 6			
	PLATO		CONTROL		PLATO		CONTROL		PLATO		CONTROL	
	46		48		91		108		77		84	
	PRE	POST	PRE	POST	PRE	POST	PRE	POST	PRE	POST	PRE	POST
21 Math is my favorite subject.												
Yes	33.3	41.3	37.5	29.2	19.8	37.8	31.1	27.8	32.9	32.9	44.6	40.5
?	6.7	17.4	10.4	14.6	17.6	11.1	17.9	13.9	22.4	11.8	19.3	21.4
No	60.0	41.3	52.1	56.3	62.6	51.[illegible]	50.9	58.3	44.7	55.3	36.1	38.1
22 I like learning about decimals.												
Yes	33.3	54.4	18.8	14.6	20.0	55.6	22.4	31.8	30.3	52.6	36.6	31.0
?	35.6	26.1	45.8	52.1	38.9	21.1	34.6	21.5	35.5	26.3	31.7	32.1
No	31.1	19.6	35.4	33.3	41.1	23.3	43.0	46.7	34.2	21.1	31.7	36.9
23 I like learning about fractions.												
Yes	45.7	69.6	59.6	56.3	50.6	64.8	48.2	58.3	53.3	63.2	44.1	56.6
?	21.7	19.6	10.6	20.8	24.2	15.4	16.7	13.0	20.8	21.1	21.4	20.5
No	32.6	10.9	29.8	22.9	25.3	19.8	35.2	28.7	26.0	15.8	34.5	22.9
24 I like learning about graphs.												
Yes	54.4	47.8	51.1	47.9	48.4	42.9	43.8	44.4	48.7	42.1	27.7	29.8
?	21.7	21.7	29.8	29.2	25.3	20.9	33.3	13.9	26.3	30.3	42.2	33.3
No	23.9	30.4	19.2	22.9	26.4	36.3	22.9	41.7	25.0	27.6	30.1	37.0
25 Mathematics is often very boring.												
Yes	31.1	26.1	39.6	41.7	46.1	38.6	35.5	44.4	36.4	36.4	34.9	29.8
?	13.3	17.4	22.9	25.0	13.5	18.2	18.7	22.2	18.2	28.6	19.3	22.6
No	55.6	56.5	37.5	33.3	40.5	43.2	45.8	33.3	45.5	35.1	45.8	47.6
26 I feel smart when I'm working on Math.												
Yes	66.7	58.7	48.9	29.8	36.7	50.0	46.7	27.8	44.7	46.8	37.0	36.9
?	11.1	23.9	29.8	42.6	27.8	27.8	23.4	46.3	26.3	22.1	30.9	31.0
No	22.2	17.4	21.3	27.7	35.6	22.2	29.9	25.9	29.0	31.2	32.1	32.1
27 I liked math better when I was younger.												
Yes	41.3	21.7	45.8	40.4	40.0	35.2	47.2	49.5	37.7	36.8	38.1	34.5
?	6.5	8.7	8.3	21.3	17.8	8.8	11.1	18.7	16.9	17.1	13.1	20.2
No	52.2	69.6	45.8	38.3	42.2	56.0	41.7	31.8	45.5	46.1	48.8	45.2

	GRADE 4				GRADE 5				GRADE 6			
	PLATO		CONTROL		PLATO		CONTROL		PLATO		CONTROL	
	46		48		91		108		77		84	
	PRE	POST	PRE	POST	PRE	POST	PRE	POST	PRE	POST	PRE	POST
28 I usually understand directions to math problems the teacher gives me.												
Yes	87.0	76.1	66.7	60.4	71.4	73.6	64.8	66.4	64.9	64.9	66.7	61.9
?	8.7	15.2	22.9	22.9	16.5	20.9	20.4	26.2	22.1	26.0	21.4	29.8
No	4.4	8.7	10.4	16.7	12.1	5.5	14.8	7.5	13.0	9.1	11.9	8.3
29 I like working on math with other kids.												
Yes	71.7	56.5	72.9	68.8	70.3	71.4	59.8	62.0	69.7	71.1	75.6	75.0
?	6.5	19.6	14.6	10.4	17.6	11.0	15.9	18.5	10.5	10.5	8.5	15.5
No	21.7	23.9	12.5	20.8	12.1	17.6	24.3	19.4	19.7	18.4	15.9	9.5
30 I like working on math with my teacher.												
Yes	58.7	43.5	63.8	47.9	39.6	36.3	38.7	40.7	34.2	36.4	48.2	40.5
?	10.9	32.6	21.3	31.3	24.2	30.8	30.2	25.9	25.0	31.2	20.5	29.8
No	30.4	23.9	14.9	20.8	36.3	33.0	31.1	33.3	40.8	32.5	31.3	29.8
31 I like working on math with a textbook.												
Yes	45.7	34.8	45.8	18.8	44.0	34.1	41.7	39.3	61.8	47.4	54.8	33.3
?	21.7	28.3	29.2	39.6	25.3	17.6	22.2	21.5	18.4	23.7	16.7	36.9
No	32.6	37.0	25.0	41.7	30.8	48.4	36.1	39.3	19.7	29.0	28.6	29.8
32 I like to work on math alone.												
Yes	55.6	58.7	47.9	31.3	50.6	38.5	54.2	47.2	47.4	44.7	42.9	42.9
?	15.6	28.3	18.8	39.6	18.7	30.7	23.4	28.3	27.6	27.6	27.4	28.6
No	28.9	13.0	33.3	29.2	30.8	30.7	22.4	24.5	25.0	27.6	29.8	28.6
33 I often disagree with what the teacher says.												
Yes	21.7	19.6	14.9	31.3	23.1	34.4	20.6	23.4	23.7	26.3	24.1	28.6
?	6.5	21.7	25.5	29.2	16.5	30.0	25.2	29.9	19.7	25.0	26.5	27.4
No	71.7	58.7	59.6	39.6	60.4	35.6	54.2	46.7	56.6	48.7	49.4	44.1

	GRADE 4				GRADE 5				GRADE 6			
	PLATO		CONTROL		PLATO		CONTROL		PLATO		CONTROL	
	46		48		91		108		77		84	
	PRE	POST	PRE	POST	PRE	POST	PRE	POST	PRE	POST	PRE	POST
34 I like working on math with PLATO.												
Yes		67.4				91.2				72.4		
?		17.4				5.5				10.5		
No		15.2				3.3				17.1		
35 Teachers sometimes make me feel bad when I make a mistake.												
Yes	34.8	28.3	47.8	47.9	40.7	31.9	43.4	48.1	36.8	41.6	52.4	46.4
?	15.2	17.4	19.6	18.8	24.2	23.1	17.0	9.4	22.4	14.3	19.1	20.2
No	50.0	54.4	32.6	33.3	35.2	45.1	39.6	42.5	40.8	44.2	28.6	33.3
36 I like teachers to let me decide myself what I'm going to do in school.												
Yes	73.9	52.2	81.3	72.9	85.6	82.4	68.2	68.5	70.7	70.1	71.4	60.7
?	8.7	17.4	14.6	16.7	6.7	9.9	14.0	15.7	14.7	19.5	13.1	23.8
No	17.4	30.4	4.2	10.4	7.8	7.7	17.8	15.7	14.7	10.4	15.5	15.5
37 Kids in this class are very friendly.												
Yes	73.9	48.9	60.4	47.8	63.3	60.0	62.3	63.6	44.7	62.7	54.8	37.4
?	10.9	24.4	25.0	30.4	31.1	26.7	26.4	28.0	39.5	28.0	29.8	44.6
No	15.2	26.7	14.6	21.7	5.6	13.3	11.3	8.4	15.8	9.3	15.5	18.1
38 I am happy most of the time in this class.												
Yes	84.8	73.9	79.2	74.5	81.1	73.3	77.8	69.2	80.3	68.8	60.2	66.7
?	6.5	8.7	8.3	21.3	8.9	13.3	9.3	16.8	4.0	22.1	22.9	23.8
No	8.7	7.4	12.5	4.3	10.0	13.3	13.0	14.0	15.8	9.1	16.9	9.5
39 I can learn at my own speed in this class.												
Yes	60.9	65.2	66.7	50.0	67.8	69.2	56.5	56.5	56.6	74.0	58.3	51.2
?	32.6	17.4	22.9	37.5	21.1	15.4	23.2	26.9	30.3	19.5	32.1	31.7
No	6.5	17.4	10.4	12.5	11.1	15.4	20.4	16.7	13.2	6.5	9.5	17.1

	GRADE 4				GRADE 5				GRADE 6			
	PLATO		CONTROL		PLATO		CONTROL		PLATO		CONTROL	
	46		48		91		108		77		84	
	PRE	POST	PRE	POST	PRE	POST	PRE	POST	PRE	POST	PRE	POST
40 The amount that I learn in school depends mostly on my teacher.												
Yes	35.6	37.0	37.5	33.3	29.7	37.4	37.4	32.7	42.1	32.4	40.5	28.9
?	20.0	34.8	29.2	37.5	18.7	27.5	16.8	32.7	26.3	17.6	20.2	18.1
No	44.4	28.3	33.3	29.2	51.7	35.2	45.8	34.6	31.6	50.0	39.3	53.0
41 The amount that I learn in school depends mostly on me.												
Yes	61.4	50.0	51.1	41.7	71.4	76.9	68.5	68.2	65.3	77.9	63.1	73.5
?	11.4	34.8	31.9	45.8	20.9	15.4	15.7	19.6	21.3	16.9	17.9	18.1
No	27.3	15.2	17.0	12.5	7.7	7.7	15.7	12.2	13.3	5.2	19.1	8.4
42 If I do badly on a test it's because the teacher didn't teach me well.												
Yes	11.1	6.7	14.9	2.1	6.6	6.7	7.5	5.6	9.2	14.3	10.7	11.9
?	8.9	8.9	25.5	25.5	11.0	20.0	13.1	14.0	10.5	9.1	19.1	19.1
No	80.0	84.4	59.6	72.3	82.4	73.3	79.4	80.4	80.3	76.6	70.2	69.1
43 If I do badly on a test it's because I didn't work hard enough.												
Yes	72.7	65.2	51.1	50.0	71.4	68.1	72.2	81.31	72.0	75.3	72.6	68.7
?	9.1	10.9	29.8	29.2	17.6	12.1	14.8	14.0	13.3	15.6	20.2	14.5
No	18.2	23.9	19.2	20.8	11.0	19.8	13.0	4.7	14.7	9.1	7.1	16.9
44 I would like to work with computers when I grow up.												
Yes	52.2	30.4	44.7	27.1	57.1	40.7	44.4	27.8	48.7	37.7	26.2	27.7
?	13.0	17.4	21.3	47.9	22.0	26.4	23.2	33.3	22.4	26.0	28.6	36.1
No	34.8	52.2	34.0	25.0	20.9	33.0	32.4	38.9	29.0	36.4	45.2	36.1
45 Watching TV is one of my favorite things to do.												
Yes	67.4	54.4	56.3	43.8	50.6	39.6	62.0	46.2	49.3	42.9	59.5	45.2
?	6.5	10.9	22.9	31.3	25.3	25.3	17.6	28.3	21.3	20.8	23.8	27.4
No	26.1	34.8	20.8	25.0	24.2	35.2	20.4	25.5	29.3	36.4	16.7	27.4

	GRADE 4				GRADE 5				GRADE 6			
	PLATO		CONTROL		PLATO		CONTROL		PLATO		CONTROL	
	46		48		91		108		77		84	
	PRE	POST	PRE	POST	PRE	POST	PRE	POST	PRE	POST	PRE	POST
46 It's hard to see how my teacher's math lessons fit together.												
Yes		6.7		29.2		24.4		20.6		19.7		19.1
?		37.8		41.7		25.6		47.7		22.4		47.6
No		55.6		29.2		50.5		31.8		57.9		33.3
47 I would rather do almost anything than work on PLATO.												
Yes		8.7				6.6				5.2		
?		21.7				11.0				22.1		
No		69.6				82.4				72.7		
48 PLATO is fun.												
Yes		82.6				90.0				69.7		
?		10.9				8.9				22.4		
No		6.5				1.1				7.9		
49 PLATO is often very boring.												
Yes		21.7				14.3				40.3		
?		13.0				19.8				22.1		
No		65.2				65.9				37.7		
50 I like playing games on PLATO.												
Yes		93.5				94.3				83.1		
?		2.2				3.4				7.8		
No		4.4				2.3				9.1		
51 I get mad when PLATO doesn't work.												
Yes		58.7				60.4				63.6		
?		17.4				17.6				19.5		
No		23.9				22.0				16.9		
52 PLATO helps me like math better.												
Yes		64.4				78.9				56.6		
?		15.6				11.1				15.8		
No		20.0				10.0				27.6		

523

	GRADE 4 PLATO 46 POST	GRADE 5 PLATO 91 POST	GRADE 6 PLATO 77 POST
53 I learn math more easily on PLATO.			
Yes	66.7	71.4	49.4
?	11.1	13.2	18.2
No	22.2	15.4	32.5
54 There are alot of times when PLATO doesn't work.			
Yes	60.0	57.1	63.6
?	13.3	25.3	20.8
No	26.7	17.6	15.6
55 PLATO cheats in games.			
Yes	28.9	27.5	32.5
?	17.8	23.1	23.4
No	53.3	49.5	44.2
56 When PLATO gives me math problems to do, I usually understand the directions.			
Yes	80.4	79.1	77.9
?	10.9	17.6	13.0
No	8.7	3.3	9.1
57 PLATO sometimes makes me feel bad when I make a mistake.			
Yes	15.6	13.2	11.7
?	4.4	9.9	13.0
No	80.0	76.9	75.3
58 My friends think PLATO is fun.			
Yes	67.4	75.6	75.3
?	26.1	23.3	19.5
No	6.5	1.1	5.2

	GRADE 4 PLATO 46 POST	GRADE 5 PLATO 91 POST	GRADE 6 PLATO 77 POST
59 My friends think PLATO doesn't teach you anything.			
Yes	20.5	5.6	18.2
?	31.8	30.0	26.0
No	47.7	64.4	55.8
60 My teacher thinks PLATO helps me learn.			
Yes	67.4	78.9	66.2
?	32.6	20.0	28.6
No	0.0	1.1	5.2
61 My teacher thinks PLATO is a waste of time.			
Yes	8.7	3.3	7.8
?	28.3	19.8	31.2
No	63.0	76.9	61.0
62 My parents think PLATO helps me learn.			
Yes	63.0	69.2	57.1
?	30.4	28.6	36.4
No	6.5	2.2	6.5
63 My parents think PLATO is a waste of time.			
Yes	10.9	2.2	5.2
?	30.4	23.3	31.1
No	58.7	74.4	63.6
64 PLATO is fun but I don't learn much math from it.			
Yes	30.4	26.4	32.5
?	10.9	12.1	16.9
No	58.7	61.5	50.7

	GRADE 4	GRADE 5	GRADE 6
	PLATO	PLATO	PLATO
	46	91	77
	POST	POST	POST
65 PLATO is fun at first but after a while it gets boring.			
Yes	37.8	31.5	52.0
?	20.0	12.4	15.6
No	42.2	56.2	32.5
66 I like math better with PLATO than with my teacher.			
Yes	36.4	60.4	31.6
?	29.6	13.2	31.6
No	34.1	26.4	36.8
67 I learn more math from PLATO than from my teacher.			
Yes	20.5	22.2	20.0
?	29.6	31.1	16.0
No	50.0	46.7	64.0
68 I get frustrated because PLATO can't answer my question.			
Yes	35.6	38.5	43.4
?	20.0	16.5	21.1
No	44.4	45.1	35.5
69 It's hard to see how PLATO math lessons fit together.			
Yes	34.1	36.0	33.8
?	29.6	23.6	23.4
No	36.4	40.5	42.9
70 I often get confused by PLATO lessons.			
Yes	26.7	29.7	31.2
?	22.2	8.8	20.8
No	51.1	61.5	48.1

	GRADE 4 PLATO	GRADE 5 PLATO	GRADE 6 PLATO
	46	91	77
	POST	POST	POST
71 The pictures on PLATO help me learn more than the words.			
Yes	44.4	43.3	32.5
?	17.8	21.1	20.8
No	37.8	35.6	46.8
72 You can often get through a PLATO lesson without really knowing what is going on.			
Yes	37.8	32.2	48.1
?	20.0	11.1	23.4
No	42.2	56.7	28.6
73 If you don't know how to do a problem on PLATO, you can just type in anything and get through.			
Yes	6.7	16.7	15.6
?	13.3	6.7	13.0
No	80.0	76.7	71.4

5.5

Table

CTBS Computation - Level 2 Form R

Grade 4

Teacher	N	CTCM PRE Mean	CTCM PRE SD	CTCM POS Mean	CTCM POS SD
PH	22	23.18	8.16	38.68	4.52
CJ	16	18.63	9.09	31.56	6.77
PE	10	16.00	4.69	30.10	7.14
CE	18	16.33	6.52	23.89	8.84
PA, B, C	19	13.26	4.99	28.95	10.52
CA, B	23	17.30	7.30	27.30	6.52
Total	108	17.70	7.67	30.23	8.85

Table

CTBS Concepts - Level 2 Form R

Grade 4

Teacher	N	CTCO PRE Mean	CTCO PRE SD	CTCO POS Mean	CTCO POS SD	CTCM PRE Mean	CTCM PRE SD
PH	22	15.27	6.08	21.73	6.15	23.18	8.16
CJ	15	11.73	6.02	18.73	5.80	19.33	8.94
PE	10	9.60	2.50	13.90	5.84	16.00	4.69
CE	18	8.67	4.00	13.50	7.18	16.33	6.52
PA, B, C	19	16.84	5.74	22.63	5.30	13.26	4.99
CA, B	23	15.91	6.38	20.91	6.15	17.30	7.30
Total	107	13.55	6.25	19.18	6.93	17.79	7.65

Table

CTBS Applications - Level 2 Form R

Grade 4

Teacher	N	CTAP PRE Mean	CTAP PRE SD	CTAP POS Mean	CTAP POS SD	CTCM PRE Mean	CTCM PRE SD
PH	22	9.91	4.33	12.68	4.87	23.18	8.16
CJ	14	8.07	3.85	11.00	3.94	20.50	8.01
PE	10	5.10	1.85	8.80	2.74	16.00	4.69
CE	18	5.44	2.45	7.72	4.70	16.33	6.52
PA, B, C	19	9.21	3.90	13.84	4.56	13.26	4.99
CA, B	21	9.00	4.30	13.29	3.96	17.81	7.28
Total	104	8.12	4.05	11.56	4.79	18.05	7.54

Table

Curriculum Referenced Whole Numbers Test

Grade 4

Teacher	N	SMTA PRE Mean	SMTA PRE SD	SMTA POS Mean	SMTA POS SD	CTCM PRE Mean	CTCM PRE SD
PH	22	8.09	4.45	18.18	3.07	23.18	8.16
CJ	12	4.67	2.90	9.08	5.16	17.58	9.04
PE	10	5.00	3.33	8.60	5.42	16.00	4.69
CE	18	4.61	3.65	7.61	4.54	16.33	6.52
PA, B, C	16	9.25	4.75	13.75	5.09	13.63	5.16
CA, B	21	8.14	5.30	12.62	3.65	17.57	7.22
Total	99	6.93	4.61	12.29	5.73	17.80	7.59

Table

Curriculum Referenced Fractions Test

Grade 4

Teacher	N	SMTB PRE Mean	SMTB PRE SD	SMTB POS Mean	SMTB POS SD	CTCM PRE Mean	CTCM PRE SD
PH	19	3.37	2.67	16.16	6.28	24.05	8.23
CJ	12	1.08	1.38	5.25	4.52	20.25	9.57
PE	10	1.00	0.82	6.70	4.60	16.00	4.69
CE	18	0.90	1.35	2.33	2.77	16.33	6.52
PA, B, C	16	4.38	4.94	10.38	9.45	13.63	5.16
CA, B	20	4.60	4.47	7.25	4.98	17.45	7.59
Total	95	2.80	3.53	8.32	7.37	18.12	7.85

Table

Curriculum Referenced Graphing Test

Grade 4

Teacher	N	SMTC PRE		SMTC POS		CTCM PRE	
		Mean	SD	Mean	SD	Mean	SD
PH	20	3.90	2.27	9.35	3.07	23.75	8.16
CJ	16	3.25	1.91	5.44	3.01	18.63	9.09
PE	10	5.20	1.32	6.50	1.18	16.00	4.69
CE	17	2.82	2.35	5.00	2.32	17.12	5.78
PA, B, C	16	5.06	2.49	7.38	4.00	13.63	5.16
CA, B	20	8.10	3.80	11.40	3.53	17.25	7.71
Total	99	4.78	3.14	7.78	3.83	18.05	7.7C

Table

Attitudes Toward Mathematics

Grade 4

Teacher	N	ATMT PRE		ATMT POS		CTCM PRE	
		Mean	SD	Mean	SD	Mean	SD
PH	20	19.80	5.40	17.95	4.83	23.15	8.50
CJ	10	22.20	4.02	23.90	6.01	17.90	8.91
PE	9	18.00	4.44	17.67	6.44	15.78	4.92
CE	17	20.35	5.63	22.88	6.20	16.18	6.68
PA, B, C	17	19.12	4.72	18.53	4.82	13.35	5.04
CA, B	21	21.43	5.59	21.90	4.99	17.48	7.61
Total	94	20.22	5.17	20.44	5.78	17.59	7.72

Table

Attitudes Toward Reading

Grade 4

Teacher	N	ATRD PRE		ATRD POS		CTCM PRE	
		Mean	SD	Mean	SD	Mean	SD
PH	20	7.95	2.80	8.05	1.91	23.15	8.50
CJ	10	8.40	2.76	9.40	3.41	17.90	8.91
PE	9	9.11	2.89	8.11	1.62	15.78	4.92
CE	17	8.76	2.02	9.12	2.39	16.18	6.68
PA, B, C	17	9.59	2.48	8.59	2.12	13.35	5.04
CA, B	21	9.00	3.21	9.62	2.77	17.48	7.61
Total	94	8.79	2.71	8.84	2.42	17.59	7.72

Table

Locus of Control

Grade 4

Teacher	N	ATLO PRE Mean	ATLO PRE SD	ATLO POS Mean	ATLO POS SD	CTCM PRE Mean	CTCM PRE SD
PH	20	6.75	1.89	6.90	2.17	23.15	8.50
CJ	10	6.80	1.14	7.00	1.89	17.90	8.91
PE	9	7.11	2.09	6.44	1.94	15.78	4.92
CE	17	7.59	1.70	6.35	1.41	16.18	6.68
PA, B, C	17	5.59	1.50	6.24	1.48	13.35	5.04
CA, B	21	6.52	1.89	7.00	1.95	17.48	7.61
Total	94	6.68	1.81	6.67	1.81	17.59	7.72

APPENDIX B

Mathematics Achievement Means and

Standard Deviations

Table

CTBS Computation - Level 2 Form R

Grade 5

Teacher	N	CTCM PRE Mean	CTCM PRE SD	CTCM POS Mean	CTCM POS SD
PI	24	36.29	7.24	39.08	7.21
CK	20	30.15	10.32	34.25	9.40
PL	22	31.50	7.34	40.23	6.29
PM	23	26.04	9.49	38.17	7.39
PF	28	29.57	8.93	34.39	9.5[illegible]
CF	24	30.83	8.07	39.46	6.49
CG	26	29.54	8.71	40.81	6.39
PE	5	28.40	8.74	34.80	7.46
CE	6	22.83	7.17	32.00	6.13
CC	6	27.50	8.46	29.33	9.7[illegible]
CD	9	24.78	12.81	29.22	10.96
PD	7	25.57	5.32	35.71	9.32
CL	16	33.06	7.50	38.13	3.56
CM	17	31.82	8.52	36.18	7.21
Total	233	30.12	8.96	37.07	8.06

Table

CTBS Computation - Level 3 Form Q

Grade 5

Teacher	N	CTCM PRE Mean	CTCM PRE SD	CTCM POS Mean	CTCM POS SD
PI	24	36.29	7.24	28.38	12.54
CK	16	30.13	11.34	18.38	7.74
PL	7	39.86	4.98	34.00	7.64
CC	5	28.80	8.76	20.00	13.10
CD	9	24.78	12.81	21.89	10.86
PD	7	25.57	5.32	20.43	8.18
CL	15	33.53	7.51	26.67	7.77
CM	16	31.44	8.65	22.44	6.09
Total	99	32.16	9.46	24.36	10.25

Table

CTBS Concepts - Level 2 Form R

Grade 5

Teacher	N	CTCO PRE		CTCO POS		CTCM PRE	
		Mean	SD	Mean	SD	Mean	SD
PI	22	24.00	5.81	25.41	5.86	36.32	7.58
CK	19	19.47	7.15	23.11	6.25	31.47	8.69
PL	22	19.68	6.88	24.18	6.36	31.50	7.34
PM	22	15.77	6.58	21.23	4.83	26.68	9.20
PF	28	18.04	7.12	21.82	6.37	29.57	8.93
CF	24	19.54	7.13	22.67	5.55	30.83	8.07
CG	24	18.63	5.73	22.38	5.56	29.71	8.61
PE	5	10.80	2.17	16.20	4.32	28.40	8.74
CE	6	8.83	2.48	15.67	2.58	22.83	7.17
CC	6	21.00	7.90	21.50	6.47	27.50	8.46
CD	9	16.89	9.01	17.78	7.79	24.78	12.81
PD	7	18.29	8.56	24.00	3.56	25.57	5.32
CL	16	22.50	5.69	26.13	2.31	33.06	7.50
CM	17	20.29	5.07	22.35	5.72	31.82	8.52
Total	227	19.02	7.06	22.55	5.92	30.28	8.78

Table

CTBS Applications - Level 2 Form R

Grade 5

Teacher	N	CTAP PRE Mean	CTAP PRE SD	CTAP POS Mean	CTAP POS SD	CTCM PRE Mean	CTCM PRE SD
PI	22	14.68	4.31	16.27	4.01	36.32	7.58
CK	19	11.84	5.54	12.11	4.69	31.47	8.69
PL	22	11.82	6.46	14.18	4.46	31.50	7.34
PM	22	8.55	4.30	12.41	3.98	26.68	9.20
PF	28	10.54	5.26	13.18	4.71	29.57	8.93
CF	24	11.42	4.70	12.71	5.22	30.83	8.07
CG	25	10.64	4.55	12.48	4.93	30.00	8.55
PE	5	6.00	1.58	8.60	5.03	28.40	8.74
CE	6	5.83	2.79	7.33	3.78	22.83	7.17
CC	6	11.67	5.54	14.50	4.09	27.50	8.46
CD	9	9.44	6.23	11.33	5.32	24.78	12.81
PD	6	11.33	2.80	14.50	4.76	26.50	5.17
CL	16	14.00	3.31	15.38	2.92	33.06	7.50
CM	17	10.71	3.84	12.29	4.41	31.82	8.52
Total	227	11.12	5.08	13.11	4.73	30.36	8.76

Table

Curriculum Referenced Whole Numbers Test

Grade 5

Teacher	N	SMTA PRE		SMTA POS		CTCM PRE	
		Mean	SD	Mean	SD	Mean	SD
PI	24	15.42	5.03	17.17	4.62	36.29	7.24
CK	20	12.65	5.59	12.55	5.44	30.15	10.32
PL	19	12.47	4.53	15.79	4.47	32.42	7.04
PM	23	9.91	5.09	12.83	5.25	26.04	9.49
PF	26	11.46	4.79	15.08	5.10	30.38	8.58
CF	24	11.25	4.77	15.00	4.99	30.83	8.07
CG	26	11.38	5.24	15.46	5.49	29.54	8.71
PE	5	5.40	3.05	12.00	4.74	28.40	8.74
CE	5	5.00	2.74	11.40	4.39	22.40	7.92
CC	6	13.67	4.23	15.00	3.79	27.50	8.46
CD	9	11.00	4.95	10.67	6.86	24.78	12.81
PD	7	13.00	4.62	14.71	4.75	25.57	5.32
CL	14	13.50	3.80	18.00	3.04	33.29	7.73
CM	15	11.80	4.48	15.40	4.63	31.00	8.77
Total	223	11.85	5.11	14.80	5.16	30.22	8.98

Table

Curriculum Referenced Fractions Test

Grade 5

Teacher	N	SMTB PRE Mean	SMTB PRE SD	SMTB POS Mean	SMTB POS SD	CTCM PRE Mean	CTCM PRE SD
PI	22	9.68	6.82	16.82	8.22	35.68	7.26
CK	18	7.06	5.33	8.78	6.03	31.17	10.35
PL	20	6.80	6.53	18.15	6.47	31.80	7.56
PM	23	2.91	2.35	11.87	8.26	26.04	9.49
PF	26	4.58	4.54	12.81	9.30	30.38	8.58
CF	23	3.65	3.50	11.57	7.40	31.13	8.12
CG	26	4.81	4.94	12.35	7.82	29.54	8.71
PE	5	2.00	1.87	6.80	4.15	28.40	8.74
CE	6	1.00	1.10	3.83	1.94	22.83	7.17
CC	5	10.00	9.22	10.60	10.97	27.60	9.45
CD	9	6.00	5.87	6.89	7.79	24.78	12.81
PD	7	5.14	6.36	13.71	8.38	25.57	5.32
CL	14	7.21	4.48	14.71	6.35	33.29	7.73
CM	15	3.47	2.97	9.40	5.47	31.40	8.95
Total	219	5.39	5.32	12.32	8.05	30.19	8.98

Table

Curriculum Referenced Graphing Test

Grade 5

Teacher	N	SMTC PRE		SMTC POS		CTCM PRE	
		Mean	SD	Mean	SD	Mean	SD
PI	22	10.59	4.69	13.23	4.81	36.64	7.44
CK	18	8.33	4.37	9.00	3.66	30.17	10.72
PL	21	6.10	3.02	10.90	5.03	31.48	7.52
PM	22	4.32	1.59	7.23	3.00	26.36	9.59
PF	25	5.24	2.03	9.76	4.19	30.52	8.73
CF	23	5.91	1.90	6.74	2.47	31.00	8.21
CG	24	5.79	2.19	6.33	2.10	29.17	8.66
PE	5	6.20	3.96	7.40	1.52	28.40	8.74
CE	5	4.00	1.73	6.40	1.14	22.40	7.92
CC	4	7.50	2.89	8.50	5.45	28.50	10.67
CD	9	6.11	4.08	7.22	4.09	24.78	12.81
PD	7	5.43	2.30	11.29	3.90	25.57	5.32
CL	13	6.85	3.02	9.69	2.84	32.77	7.79
CM	16	5.06	1.88	7.38	1.45	31.44	8.65
Total	214	6.34	3.36	8.80	4.06	30.21	9.02

Table

Attitudes Toward Mathematics

Grade 5

Teacher	N	ATMT PRE Mean	ATMT PRE SD	ATMT POS Mean	ATMT POS SD	CTCM PRE Mean	CTCM PRE SD
PI	19	21.53	5.74	19.42	5.92	36.58	6.83
CK	16	24.38	6.46	24.06	5.93	31.94	8.34
PL	20	20.85	4.92	18.10	5.81	32.20	6.93
PM	19	21.21	7.19	21.11	6.87	27.05	9.82
PF	25	23.76	5.80	23.24	7.67	30.40	8.69
CF	20	20.60	6.69	22.70	7.95	29.90	8.12
CG	24	20.29	5.30	19.63	4.47	28.82	8.57
PE	4	15.50	2.38	15.75	1.71	26.25	8.42
CE	4	17.00	3.16	23.50	3.87	23.25	4.27
CC	6	22.33	5.92	22.50	7.82	27.50	8.46
CD	9	20.78	6.02	22.78	5.29	24.78	12.81
PD	4	18.00	3.56	20.50	6.40	23.25	4.72
CL	13	19.31	4.13	19.46	4.63	33.92	7.15
CM	15	20.67	5.51	21.53	4.55	31.80	8.83
Total	198	21.19	5.85	21.10	6.28	30.36	8.76

Table

Attitudes Toward Reading

Grade 5

Teacher	N	ATRD PRE Mean	ATRD PRE SD	ATRD POS Mean	ATRD POS SD	CTCM PRE Mean	CTCM PRE SD
PI	19	7.84	1.57	8.05	1.93	36.58	6.83
CK	16	9.06	2.29	8.38	1.71	31.94	8.34
PL	20	8.65	1.98	8.50	2.44	32.20	6.93
PM	19	8.10	2.05	9.74	2.98	27.05	9.82
PF	25	9.00	2.75	9.24	2.79	30.40	8.69
CF	20	8.15	2.46	7.55	2.11	29.90	8.12
CG	24	8.71	1.92	9.04	2.46	28.83	8.57
PE	4	9.75	2.87	9.50	3.70	26.25	8.42
CE	4	9.75	2.75	9.00	1.83	23.25	4.27
CC	6	10.00	3.16	10.17	3.76	27.50	8.46
CD	9	8.56	3.17	8.33	2.50	24.78	12.81
PD	4	10.25	3.20	9.25	2.22	23.25	4.72
CL	13	8.46	2.37	7.85	2.64	33.92	7.15
CM	15	7.87	2.17	7.67	1.11	31.80	8.83
Total	198	8.60	2.33	8.61	2.46	30.36	8.76

Table

Locus of Control

Grade 5

Teacher	N	ATLO PRE Mean	ATLO PRE SD	ATLO POS Mean	ATLO POS SD	CTCM PRE Mean	CTCM PRE SD
PI	19	6.21	1.99	6.00	1.25	36.58	6.83
CK	16	6.50	1.67	6.19	1.76	31.94	8.34
PL	20	5.15	1.63	5.55	1.19	32.20	6.93
PM	19	5.58	1.74	6.26	2.10	27.05	9.82
PF	25	5.88	2.11	6.76	2.89	30.40	8.69
CF	20	5.60	1.67	6.35	2.06	29.90	8.12
CG	24	5.71	2.03	5.63	1.44	28.83	8.57
PE	4	5.75	0.50	5.50	1.00	26.25	8.42
CE	4	8.25	0.50	6.25	1.71	23.25	4.27
CC	6	7.00	2.19	5.33	1.51	27.50	8.46
CD	9	7.22	1.09	6.67	1.80	24.78	12.81
PD	4	7.25	0.96	7.00	1.15	23.25	4.72
CL	13	4.92	1.19	5.54	1.45	33.92	7.15
CM	15	6.00	2.04	5.60	1.55	31.80	8.83
Total	198	5.92	1.85	6.05	1.70	30.36	8.76

Table

CTBS Computation - Level 2 Form R

Grade 6

Teacher	N	CTCM PRE Mean	CTCM PRE SD	CTCM POS Mean	CTCM POS SD
PJ	24	34.42	10.13	38.38	8.09
PK	26	36.27	10.08	41.12	6.53
PE	4	29.25	10.81	34.50	6.61
CE	5	31.00	7.18	36.60	6.84
PG	23	28.35	10.42	36.91	6.24
CH	24	29.58	8.93	34.71	7.92
CI	22	30.14	9.58	35.18	9.82
CC	13	24.46	10.17	33.77	9.01
CD	9	31.56	8.82	35.78	7.16
PD	14	37.00	8.64	40.86	9.05
CN	23	34.83	8.27	37.96	8.09
Total	187	32.02	9.94	37.29	8.09

Table

CTBS Computation - Level 3 Form R

Grade 6

Teacher	N	CTCM PRE		CTCM POS	
		Mean	SD	Mean	SD
RJ	24	34.42	10.13	28.58	10.72
PK	23	37.70	9.57	31.61	10.87
CC	13	24.46	10.17	16.69	5.81
CD	9	31.56	8.82	23.44	10.39
PD	14	37.00	8.64	29.64	12.85
CN	21	34.71	8.66	25.57	12.16
Total	104	34.06	10.05	26.86	11.58

Table

CTBS Concepts - Level 2 Form R

Grade 6

Teacher	N	CTCO PRE Mean	CTCO PRE SD	CTCO POS Mean	CTCO POS SD	CTCM PRE Mean	CTCM PRE SD
PE	4	13.00	4.55	10.75	3.86	29.25	10.81
CE	5	11.00	3.16	17.60	6.15	31.00	7.18
PG	23	16.61	5.36	20.52	5.62	28.35	10.42
CH	23	17.83	6.75	21.26	5.40	29.70	9.12
CI	22	17.27	6.83	19.73	6.88	30.14	9.58
CC	12	16.75	6.76	18.08	7.10	25.33	10.10
CD	9	20.44	8.71	22.00	8.22	31.56	8.82
PD	14	24.57	6.71	26.14	5.29	37.00	8.64
Total	112	17.93	7.03	20.60	6.69	30.14	9.70

Table

CTBS Concepts - Level 3 Form R

Grade 6

Teacher	N	CTCO PRE		CTCO POS		CTCM PRE	
		Mean	SD	Mean	SD	Mean	SD
PJ	22	21.45	8.23	18.59	6.98	34.86	9.87
PK	23	23.91	6.78	20.39	6.20	37.70	9.57
PD	1	30.00	0.0	0.0	0.0	26.00	0.0
CN	20	20.00	7.33	18.65	6.68	35.40	8.27
Total	66	22.00	7.53	18.95	6.94	35.88	9.25

Table

CTBS Applications - Level 2 Form R

Grade 6

Teacher	N	CTAP PRE Mean	CTAP PRE SD	CTAP POS Mean	CTAP POS SD	CTCM PRE Mean	CTCM PRE SD
PE	4	5.50	2.65	7.25	4.43	29.25	10.81
CE	5	6.60	2.51	12.60	3.58	31.00	7.18
PG	20	9.05	4.47	10.75	5.07	28.75	11.12
CH	23	9.96	4.78	10.78	4.64	29.70	9.12
CI	22	10.23	4.23	10.86	4.73	30.14	9.58
CC	12	8.17	4.20	11.17	4.43	25.33	10.10
CD	9	10.67	5.83	13.67	4.92	31.56	8.82
PD	14	14.64	4.52	16.14	3.61	37.00	8.64
Total	109	9.99	4.85	11.72	4.88	30.27	9.80

Table

CTBS Applications - Level 3 Form R

Grade 6

Teacher	N	CTAP PRE Mean	CTAP PRE SD	CTAP POS Mean	CTAP POS SD	CTCM PRE Mean	CTCM PRE SD
PJ	22	13.55	6.08	11.73	5.44	34.86	9.87
PK	24	14.00	4.72	13.63	4.73	36.33	10.20
CN	20	12.40	5.44	11.05	5.30	35.40	8.27
Total	66	13.36	5.38	12.21	5.19	35.56	9.42

Table

Curriculum Referenced Whole Numbers Test

Grade 6

Teacher	N	SMTA PRE		SMTA POS		CTCM PRE	
		Mean	SD	Mean	SD	Mean	SD
PJ	23	15.04	6.24	17.30	4.31	34.91	10.06
PK	26	15.08	5.96	17.00	5.76	36.27	10.08
PE	4	5.75	5.25	9.25	3.77	29.25	10.81
CE	4	9.00	1.63	13.75	4.50	31.25	8.26
PG	16	8.88	3.88	15.44	4.21	27.56	11.83
CH	22	11.91	5.98	14.82	6.00	29.32	9.27
CI	21	11.10	5.74	14.52	5.07	29.57	9.43
CC	12	9.75	5.24	13.67	4.85	25.33	10.10
CD	9	12.11	6.07	14.11	4.91	31.56	8.82
PD	14	15.64	5.89	18.79	4.17	37.00	8.64
CN	22	13.64	5.19	17.00	4.94	35.45	7.88
Total	173	12.60	5.98	15.83	5.19	32.26	10.07

Table

Curriculum Referenced Fractions Test

Grade 6

Teacher	N	SMTB PRE Mean	SMTB PRE SD	SMTB POS Mean	SMTB POS SD	CTCM PRE Mean	CTCM PRE SD
PJ	24	10.50	8.80	16.29	8.54	34.42	10.13
PK	26	9.81	6.99	17.81	8.84	36.23	10.08
PE	4	0.75	0.96	5.75	1.79	29.25	10.81
CE	4	1.75	.50	4.25	3.86	30.0	7.87
PG	22	2.82	2.38	10.73	8.02	28.45	10.65
CH	24	4.29	5.00	6.46	7.66	29.58	8.93
CI	21	3.19	2.48	6.76	5.58	30.57	9.59
CC	11	2.82	2.89	5.91	5.43	25.82	10.45
CD	9	6.78	6.40	9.67	8.50	31.56	8.82
PD	11	12.64	9.57	18.00	8.40	37.18	8.70
CN	22	6.73	6.72	13.73	9.31	35.45	7.88
Total	178	6.34	6.87	11.68	9.01	32.25	9.90

Table

Curriculum Referenced Graphing Test

Grade 6

Teacher	N	SMTC PRE		SMTC POS		CTCM PRE	
		Mean	SD	Mean	SD	Mean	SD
PJ	21	7.71	4.62	10.52	4.77	32.81	9.81
PK	25	8.92	4.19	12.48	4.88	37.32	8.71
PE	4	4.00	1.41	7.00	0.82	29.25	10.81
CE	5	4.40	1.14	6.80	1.30	31.00	7.18
PG	20	5.10	1.48	10.00	3.67	27.50	10.83
CH	21	5.38	2.11	7.24	3.42	30.05	9.25
CI	19	5.37	1.16	8.47	3.61	31.00	8.98
CC	10	4.60	2.50	6.50	2.32	25.20	9.62
CD	9	6.56	2.35	7.67	2.50	31.56	8.82
PD	14	10.79	5.94	13.07	4.32	37.00	8.64
CN	22	7.23	3.29	9.45	4.21	35.45	7.88
Total	170	6.79	3.77	9.61	4.36	32.34	9.65

Table

Attitudes Toward Mathematics

Grade 6

Teacher	N	ATMT PRE Mean	ATMT PRE SD	ATMT POS Mean	ATMT POS SD	CTCM PRE Mean	CTCM PRE SD
PJ	21	20.05	5.13	19.43	5.14	34.14	10.60
PK	23	21.74	5.35	22.26	5.10	35.30	10.34
PE	4	19.25	5.25	20.75	5.91	29.25	10.81
CE	5	16.80	3.11	18.20	6.76	31.00	7.18
PG	19	22.32	8.10	20.21	6.21	28.00	11.22
CH	21	22.62	5.70	21.00	5.39	30.71	8.88
CI	19	19.05	6.44	19.32	6.25	31.00	9.43
CC	10	21.60	5.78	20.80	5.73	27.30	9.92
CD	7	19.14	3.93	21.29	7.25	31.43	8.38
PD	10	18.80	4.71	21.00	4.59	37.00	7.12
CN	22	20.72	5.66	20.50	6.12	34.91	8.45
Total	161	20.73	5.85	20.52	5.65	32.29	9.76

Table

Attitudes Toward Reading

Grade 6

Teacher	N	ATRD PRE Mean	ATRD PRE SD	ATRD POS Mean	ATRD POS SD	CTCM PRE Mean	CTCM PRE SD
PJ	21	8.62	2.40	8.71	2.22	34.14	10.60
PK	23	8.65	2.19	8.48	2.04	35.30	10.34
PE	4	11.50	1.73	12.50	2.38	29.25	10.81
CE	5	10.00	3.94	11.00	4.24	31.00	7.18
PG	19	[illegible].84	2.03	9.42	2.80	28.00	11.22
CH	21	9.14	3.07	9.14	2.89	30.71	8.8[illegible]
CI	19	9.37	3.42	9.16	2.69	31.00	9.43
CC	10	9.60	3.66	8.70	3.06	27.30	9.92
CD	7	11.00	2.65	9.43	1.40	31.43	8.38
PD	10	8.30	2.00	6.80	1.03	37.00	7.12
CN	22	9.00	2.96	8.77	2.78	34.91	8.45
Total	161	9.12	2.76	8.96	2.64	32.29	9.76

Table

Locus of Control

Grade 6

Teacher	N	ATLO PRE Mean	ATLO PRE SD	ATLO POS Mean	ATLO POS SD	CTCM PRE Mean	CTCM PRE SD
PJ	21	5.95	1.72	6.52	2.16	34.14	10.60
PK	23	6.43	1.80	5.09	1.24	35.30	10.34
PE	4	5.25	2.50	4.25	0.50	29.25	10.81
CE	5	6.20	3.35	5.20	1.79	31.00	7.18
PG	19	6.68	2.56	6.42	1.77	28.00	11.22
CH	21	6.38	1.75	6.14	1.80	30.71	8.88
CI	19	5.79	1.62	5.58	1.77	31.00	9.43
CC	10	7.50	2.46	6.00	1.63	27.30	9.92
CD	7	7.00	2.89	6.86	0.90	31.43	8.38
PD	10	6.70	1.70	5.50	1.35	37.00	7.12
CN	22	6.00	2.18	6.27	1.98	34.91	8.45
Total	161	6.33	2.07	5.93	1.77	32.29	9.76

APPENDIX C

Instruments

TEACHER INTERVIEW

FOR

PLATO

Early Education Group
Educational Testing Service
Princeton, New Jersey
Winter, 1974

BACKGROUND

1. Number of years of experience?

   (How much of that in present school)

2. Grade levels taught?

3. Current grade level(s).

   -- number of children in class

4. General setting:

   a. self-contained - or shared space.

   b. work with other teachers or adults.

   c. interchange of children?

C. Overall View of Teaching/Learning Activities

1. Could you give a brief description of the organization of activities during the course of a "typical" school day. Starting with when the children arrive in the morning . . . what happens? (answer in terms of present time)

If not covered in answer, Probe for:

- what are specific things children typically do during any time the teacher is not directly interacting
- what is the teacher typically doing while children are working independently or in small groups
- are times for various activities fairly flexible or fixed

a. Are there things that children must do every day -- or almost every day?

2. On what basis do you divide your time and attention among children?

Probe for: - is allocation of time and attention a difficulty for you?

3. Do you need to spend any time outside of school hours on work connected with your teaching? If yes:

a. How do you spend that time? Let's take last week for example -- what kinds of work did you do outside of school hours?

Regarding planning time, Probe as necessary:

- what about planning and preparation time? Is this done during school or outside?
- what is it that you were planning or preparing?

D. Physical Setting and Materials

1. What about the arrangement of the classroom -- can you tell me generally how you have it set up?

   a. Has that been the general arrangement of the room all year?

      (If yes)
      - what made you decide on this particular set up?
      - what prompted your rearrangement of this particular set up? Can you tell me a little of the history of how it got this way?

2. With respect to material resources -- the things in your classroom -- how did they come to be there? Who ordered them or brought them in?

   Probe for:
   - locus of decision (teacher, children, advisors, etc.)
   - leaway in decision (ordering from prescribed list; any list)
   - homemade constructions (by T or children) -- what?
   - T buying things on own or bringing them from home -- what? -- what prompted her to buy or bring material in?
   - children bringing things from home or neighborhood -- what?

3. In your opinion, how valuable are the semi-structured kinds of material -- things like Cuisenaire rods, puzzles, or balance scales?

   a. Why do you think so?

   Probe for:
   - what type and variety of learning do they promote as far as you have seen?
   - any drawbacks or limitations?

4. What about natural and environmental materials -- sand, water, rocks, plants, tin cans, plastic bottles, egg cartons, and so on? How valuable do you think this type of material is? Why?

   Probe for:
   - kinds and variety of learning promoted.
   - any drawbacks or limitations?

5. If you had an extra sum of money in your teaching budget, how would you use it?

Reading Instruction

1. Since you will be using PLATO reading programs, could you describe major aspects of your current reading curriculum?

   - materials, texts
   - activities
   - ability groups

   1a. Are there other kinds of activities you consider important for reading?

2. Is there some kind of planned sequence that all (or most all) children would go through?

3. You mentioned ability grouping - what is the range of reading ability in the class?

   What do you think is the major difficulty of the children who have trouble learning how to read?

   - prerequisites to reading

4. Learning how to read is such a complex process, how do you you go about judging children's comprehension of what they are reading? Are most children this age understanding what they are reading?

5. How do you see reading related to other aspects of the curriculum?

6. Compared to other subject areas, how well do you like to teach reading?

   - own competence

7. How do you think PLATO will contribute to children learning how to read?

Mathematics Instruction

1. Since you will be using PLATO math programs, could you describe major aspects of your current math curriculum?

   - ability groups
   - materials, texts
   - activities

   1a. Are there other kinds of activities you consider important for math?

2. Is there some kind of planned sequence that all (or most all) children would go through?

3. What mathematical understandings do you find children have particular difficulty with?

   - how judge understanding
   - easier aspects

4. How do you see math related to other aspects of the curriculum?

5. Compared to other subject areas, how well do you like to teach math?

   - own competence

6. How do you think PLATO will contribute to children learning math?

E. <u>Children In The Classroom</u>

1. You indicated that children sometimes work in small groups. What benefits do you see in such small groupings?

2. In what ways do you think children tend to express their needs and feelings in the classroom?

   a. What benefits do you see in a more open expression of feelings?

   b. Does this (i.e., relatively free expression of needs and feelings) pose any difficulties for a teacher? what?

   c. Does it pose any difficulties for children? what?

   d. What about sensitive content -- such as sex, death, birth, fears that children have. How does such content come into the classroom?

3. What do you think is the role of children's interests, in the classroom? How do you go about utilizing or building on a child's interests? Can you give me some concrete examples?

   a. How about children who show little apparent interest in anything that you have in the room or who can't settle down and get involved? How do you deal with that situation?

4. In most every class there are times when some child or a group of children have a disruptive influence on the class. How do you generally handle this kind of problem?

F. Children's Ability to Benefit From the School Setting

1. What are some of the choices that the children can make during the course of the day? In your experience, how do children handle choice situations?. Can they make choices -- and on what basis do they choose?

Probe for:
- do you think most choices reflect genuine interest, a passing whim, or what? How do you tell the difference?
- perceived reason why some children can't handle choice very well or don't make purposeful choices (e.g., age, home background, personality problem, etc.)
- how do you help children make choices -- or can you?
- (does it bother you when a child persistently sticks to one or two activities?)

2. Aside from making choices, what other kinds of responsibilities do children have to learn to assume in your room?

G. Evaluating Teaching and Learning

1. Of all the various goals you have in mind as a teacher, which one (or ones) do you think you've made pretty good progress toward accomplishing this year?

Probe for: - what clues lead T to believe that progress has been made

2. What goal (or goals) do you feel least satisfied with--least sure that you have accomplished much progress?

Probe for: - what clues lead T to question that much progress has been made

H. Perception of Teaching Requirements and Rewards

1. What about your own interests -- do you have any interests that carry over to the classroom?

2. Do you think your own general knowledge in a subject area affects your capabilities or style as a teacher? In what ways?

    a. If you had the opportunity to take an extended period of time off for learning, what would you want to learn about? How would you go about it?

4. In thinking about your teaching experiences what aspects would you say are most satisying? Which least?

I. PLATO

1. Do you know how the program came to be introduced to your school?

   - Who made decisions?
   - Did you have a role to play in this?

2. How did you become aware of the purpose and potentials of PLATO?

   - Any workshops or training programs? Informal orientation?
   - Current training - need any preparation?

3. What influenced your decision to have your classroom participate in the program?

4. What do you see as possible problems?

5. What do you think is the general feeling about PLATO on the part of the other Ts in the school?

J. Other Adults In The School

1. Concerning other teachers: (not teachers designated as aides)

   - nature of cooperation (planning jointly, teaming etc.)
   - extent of cooperation (pairs? larger groups? how much of the time?)
   - is attempt being made to extend interactions? or are they diminishing?

   a. What do you see as the benefits of working in this way? Any disadvantages?

2. Any supervisors or other kinds of consultant available to help you with teaching questions?

   - helpful? How?

3. Do you have a classroom aide (or student teacher) working with you? If yes:

   a. How much of the time?

   b. What sorts of contributions does he/she make?

   c. What benefits or satisfactions does he/she receive?

   d. Do you see major differences between your role as the designated teacher and the role of the aide? What?

4. Turning now to the principal (vice-principal), what is the nature of your contact with him/her?

   - forms of interactions (classroom visits, staff meetings, etc.
   - extent of contact
   - typical content of interactions (education matters, policy matters, rules and regulations, etc.)

5. Concerning parents and the nature of your contact with them:

a. Are there regular or routine times when you talk with parents about their children? When?

b. Are there ways in which parents help in the classroom or contribute directly in other ways to your teaching?

- concrete examples
- is this typical?

c. Do you think parents generally understand the goals you are trying to achieve in your teaching?

<u>If yes</u> - were there ever any difficulties on this score?

<u>If no</u> - what do they seem to understand and what don't?

K. The School As An Institution

1. Thinking now about the school as an institution, I'd like to ask about expectations regarding your responsibility for children. Are you considered responsible for teaching all aspects of the curriculum -- or are there special teachers who instruct in certain areas? (music, art, etc.)

   - On the whole do you agree with this view of your responsibility, where . . . (recast answer) . . . ?

2. Are there any school policies, requirements, or regulations that interfere or conflict -- in major ways -- with your teaching?

   - what policies interfere
   - how they interfere

   a. Do you think there's anything you can do to influence a change in policy?

3. Are there any school policies you feel have been especially helpful or supportive of your efforts?

4. What do you see as the major concerns or preoccupations of the teaching staff at the present time? (major issues of discussion or debate -- at staff meetings or informally).

   - have these changed over time? since program initiated?

L. Summary Evaluation

1. Looking ahead . . . . where do you see yourself a few years from now?

PLATO CODING SCHEME

Teacher's name ____________

Coded by ____________

Date ____________

CODING CATEGORIES: PERCEPTIONS OF MATERIALS AND PROVISIONS

	SS	EN
1. Valuable for construing many possibilities. With younger children, the value may be seen in the development of symbolic functioning--i.e., the child can "sever" the meaning from an object and impose his own meaning onto it, using it in a variety of ways. Or, the material may lend itself to many possibilities for in-depth inquiry and the pursuit of substantive questions.		
2. Valuable for the richness of experiential learning. The emphasis here is on the child's direct experience with the material or phenomenon--e.g., experience with sand, water, and blocks promotes ideas of measurement, quantity, space. Or, children learn about a particular phenomenon from direct contact with it--e.g., learn about frogs, magnets, machines.		
3. Valuable for teaching a general concept. E.g., cuisenqire rods or pattern blocks assist the child in understanding the general notion of fractions. This category of response is occasionally accompanied by comments on the importance of visual imagery or concrete images.		
4. Valuable for personal/social reasons. The material may be valuable for intrinsic reasons--what it means to the owner or user promotes a sense of integrity or accomplishment. (E.g., what a child brings from home is important because it represents his legitimate contribution to the classroom.) Or, the material may promote valuable social interaction--e.g., children become engaged in discussion around the water table.		
5. Valuable for doing different things. The emphasis here may be on adding variety to the classroom, or on the fact that children can be "creative" with the material in a variety of ways. The possibilities remain unspecified, however.		
6. Valuable for teaching a very specific outcome. E.g., children learn that a square has four sides from pattern blocks; or that "four plus one equals five" from a balance beam. The teacher may comment on children "seeing it" for themselves, but there is no mention of imagery.		
7. Valuable for reinforcing effect. A demonstration with materials reinforces or "clinches" a concept taught verbally by the teacher or learned from a workbook.		
8. Valuable for motivational and managerial reasons. Children may play with materials when their work is done. Or, material is viewed as something to keep children occupied while the teacher works with small groups on an assignment.		
9. ______________		

Surface Curriculum

(1) Provisions of activities, materials: Variety of available materials and activities children can engage

___	___	___	___	___
routine, minimal		significant extras		rich array, many possibilities

(2) Connections between the activities and materials (that are not strictly the required basic routine) with the learning of mathematics and/or reading

___	___	___	___	___
such activities (whether few or many) are seen as essentially unrelated to R/M		some are related. (or) related in that they make room more interesting, and induce real learning.		such activities promote learning in R/M

Curriculum Priorities

Personal Social Priorities

_____Growing sense of self/of others - maturing

_____(L) Self awareness/acceptance

_____(M) Social Problem Solving

_____Satisfactions for self

_____(N) Self expression

_____(O) Confidence, contentment

_____Socialization into pupil role

_____(P) Socially responsible

_____(Q) Good behavior/workhabits

*   *   *   *   *   *   *

Cognitive

_____Reflectivity and Intentionality

_____Construct, pursue interest

_____Proficiency, competency

_____Initiative/Independence

_____Deciding/choosing

_____Thinking, problem solving

_____Grade Level Facts & Skills

_____Involvement, doing

Intersection of children's resources and curriculum:

____ Interactive/integrative

Teacher's instructional agenda significantly influenced by the abilities, interests, understandings of the particular children in class. The curriculum is shaped through the interaction of teacher/school priorities and resources, characteristics of children.

____ Coexistent

The teacher's curricular goals are modified to make room for children's interests, needs or abilities. Pre-established plans for basic skills carried out, with time provided for special projects which are responsive to children's concerns.

____ Pre-established

Curriculum plans are pre-ordained and comprehensive, allowing little alteration in content or leaving little room for additional activities. Allowances made for learning rates or general ability, but with few alternative routes to learning, or significant departures from consent, provided.

Differentiation of Children - Dimensions

_____general ability (IQ)

_____learning rate (fast ones, slow ones)

_____interests

_____maturity/social-getting along with peers and adults in general

_____work habits, staying on the job

_____motivation (some kids need more reinforcement, punishment, etc.)

_____modalities of learning (sound/sight; manipulative vs. not)

_____emotional "disabilities"

Teachers Views of Math

1. Insturctional Emphasis

______deductive-rule examples
______inductive or discovery examples of rules
______math as a tool (for science, daily life, etc.)
______math for its own sake

Tactics

______drill on a series of single-concept examples
______problem formulating
______discussion
______use of concrete materials
______visual presentations
______real life problems
______games

2. Teachers emphasis in outcomes of math instruction

______covering pre-established materials
______facts, rote-skills, recitation
______problem solving, correct application of basic rules
______understanding structure of problem
______understanding structure of subject matter

3. Comment on teacher's views on teaching math

____
____
____
____
____

4. Teachers evaluative posture toward the Math Curriculum

______ ______ ______ ______ ______

non-evaluative-Purposes and assumptions (alternative, etc.) not considered in critical fashion... Generally accepted as a given

-highly evaluative-critical inquiry, suspended judgment, question raised about assumptions. (Note-this does not mean that T is very dissatisfied necessarily-rather indicates that T characteristically asks fundamental questions)

Teachers Views of Reading

1. Instructional Emphasis

______phonics
______sight
______mixed
______"linguistic"
______experience
______other

2. Tactics

______word attack
______word meaning
______oral reading
______silent reading

2. Teachers view of Reading comprehension (check all that apply)

______rote-ability to recall, retention
______ability to answer limited factual questions
______ability to draw correct, more complex inferences
______interpretation, personal judgement, multiple meaning

3. Comment on teacher's views on teaching reading

____

____

____

____

____

4. Teachers evaluative posture toward the Reading Curriculum

______ ______ ______ ______ ______

non-evaluative-Purposes and assumptions (alternatives, etc.) not considered in critical fashion... Generally accepted as a given

-highly evaluative-critical inquiry, suspended judgment, questions raised about assumptions. (Note-this does not mean that T is very dissatisfied necessarily-rather indicates that T characteristically asks fundamental questions)

5. Views the necessity of a set sequence of skill learning math

___	___	___	___	___
set sequence which all children must or should go through		set sequence for majority-but sig. minority learns via other route(s)		common patterns perhaps, but no prescribed sequence

6. Role of child in learning math

___	___	___	___	___
child's passive/ receptive: job is to work diligently through lessons-which will teach him math		child must be motivated to work through lessons and benefit from them		Active, integrative: Child seeks evidence, constructs & puts together

5. Views the necessity of a set sequence of skills learning reading

set sequence which all children must or should go through	set sequence for majority-but sig. minority learns via other route(s)	common patterns perhaps, but no prescribed sequence

6. Role of child in learning to read

child's passive/ receptive: job is to work diligently through lessons-which ill teach him how to read	child must be motivated to work through lessons and benefit from them	Active, integrative: Child seeks evidence, constructs & puts together

Modes of PLATO use

A. Positive Expectations

1. Instructional/subject matter focus

	Global	Tutorial/Expository		Drill and Practice/ Review "Reinforcement"	
		Replaces	Adds	Replaces	Adds
Instructional "Content focus"					
Record Keeping/ Retrieval (CMI)					
Enrichment					
New Teaching Mode "Method apparatus focus					

2. Instructional - additional focus

_____a. motivation

_____b. acquisition of good work habits, increases attentiveness

_____c. computer literacy

_____d. learning to type

_____e. medium for encouraging cooperation/helping interactions among children. Social/personal learning

_____f. experience in interacting with complex technology

_____g. adding variety to classroom, or children can be creative with material.

_____h. development of symbolic functioning - child imposes own meaning

_____i. ____________________

Source of diagnostic information about child:

3. Diagnostic - information seeking inquiry:

_____a. more information about child -- for its own sake

_____b. leads to more effective PLATO utilization

_____c. leads to better use of other resources

_____d. communicate information to parents

_____e.

4. Classroom management

_____a. reward

_____b. control

_____c. isolation

_____d. behavior shaping

_____e. ____________________

B. Negative Expectations

_____a. distortion of child's conception of the nature of math or reading

_____b. fear of PLATO takeover

_____c. discipline problems

_____d. disruption of class routines

_____e. increased competitiveness

_____f. physical strain

_____g. PLATO encourages autistic trends

_____h. mechanical breakdowns

_____i. ____________________

C. Coding represents expectation [ ] or experience [ ] re: Plato

Global Ratings: PLATO

Teachers' views of PLATO's impact on classroom.

high	____	____	____	____	____	low
	radical change/ contribution		noticeable change		minor change	

Teacher's feeling tone towards PLATO

____	____	____	____	____
enthusiastic		-neutral or -ambivalent		apprehensive

Teacher's views of PLATO's impact on children

____	____	____	____	____
all children significantly affected		half of class		few children significantly affected

Global Ratings: Sources of Support

Teacher's view of support in school environment

___	___	___	___	___
Highly satisfied school seen as especially supportive		Generally satisfied		Dissatisfied Critical

Teacher's view of support offered by PLATO staff

___	___	___	___	___
Highly satisfied		Generally satisfied		Dissatisfied Critical

Teacher's expectations, knowledge of PLATO

___	___	___	___	___
Highly differentiated informed				Diffuse, uninformed

ETS
MA/SS

Post-PLATO Interview

Now that you've had a year's experience with PLATO in your classroom, I'd like to get your judgment on how it effected the day-to-day life of the room:
Early in the year, what was the most noticeable effect of having terminals in the room?

- children's initial reactions
- teacher's initial reactions
- noise
- space

How did you work out scheduling for PLATO?

- rationale of scheduling
- logistics
- how much time spent on it (hrs/week)
- impact on class schedule
- how long to settle in
- stability over time

At the beginning of the year, how long did it take for children to become independent at the terminal?

- what kind of help did they need
- who provided it: teacher
  CERL staff
  other children

How much time did you spend helping children at the terminal early in the year?

How much time do you spend now?

- interference with other activities
- what trade-off

How did you keep track of what the students were doing on PLATO?

- how useful information on terminal
- how accessible
- how much of available info used
- how much time does it take

In what ways and how often did you use the information about the student's performance on PLATO?

- prescribe lessons (for how many, how often)
- give extra help related to PLATO - teacher developed? provided by CERL?
- form groups based on info

What additional information that PLATO could provide might you find useful?

How many of the PLATO lessons have you worked through yourself?

- how much time spent

Did you get any ideas from the PLATO lessons that you used in your own teaching?

Are the PLATO lessons similar to your own teaching?

- how similar, in what ways
- how different, in what ways

On the whole, did you spend more or less time teaching reading/math since the terminals were placed in your room?

- did you give more or less homework than before
- what were the trade-offs

Do the students spend more or less time on reading/math than they did?

- what trade-offs

What is the general attitude of the students toward PLATO?

- how many like it
- how many didn't like it
- how many lost interest

What did the children learn from PLATO?

- topics usually covered by teacher
- new topics
- did some children progress faster than usual

What characterized the students who benefited most?

- ability
- sex
- shy/outgoing

What characterized the students who benefited least?

Was PLATO more effective when you introduced a topic, with PLATO providing practice and reinforcement, or when it preceded your introduction of a topic?

What are some characteristics of the PLATO system that limit what you could teach with it?

What are some of the system's characteristics that allow it to do what is not generally possible in the usual classroom situation?

Did you notice a difference in approach between the three strands?

- what were they
- which was most effective
- what particular topic done most effectively
  least effectively

Of the three main components of the reading program, phonics, sight words and stories, which did you find most effective? why? with whom?

What do other teachers in your school know and think about PLATO?

In what ways has the principal shown his attitude toward PLATO?

Do you think he will want to continue PLATO next year, if the school district has to pay for it?

If you could choose between PLATO and an aide in your room, what would be your choice?

Did you notice any changes in the student's learning patterns, approach, attitude to math/reading as a result of their experience with PLATO?

Did the PLATO experience have any effect on your own teaching?

A Coding Scheme for

<u>Post-PLATO Interview Data</u>

1. Noticeable effect of having terminal in the room.

   a) Initial period of disruption

      ____no disruption ____a week

      ____a few weeks ____more than a few weeks

   b) Noise level

      ____disrupting ____same as usual classroom

   c) Children's Curiosity

      ____high, then low ____fairly constant

      ____varied with lesson types ____low

   d) Initial reaction of children

      ____excited ____asked questions about the terminal

      ____noticed, but not excited ____no inquiry

   e) Initial reaction of the teacher

      ____delighted to have PLATO ____adjusted ot it immediately

      ____frustrated for a few weeks ____frustrated for more than a few weeks

      ____neutral

   f) Space

      ____has space problem ____no space problem

   g) Reactions of teachers and students to mechanical and system problems

      ____

   h) <u>Specific Comments</u>

2. Scheduling

      ____flexible ____fixed

      ____within school hours primarily ____includes outside school hours (before,after,lunch)

      ____within the subject period primarily

School subjects preempted: ____________________

School subjects for which PLATO is turned off: ________

a) Time spent to work out the schedule

____one hour or more per week ____less than a hour per week

____a few hours in the beginning of the year

____several times a week ____once a week ____daily

3. Students independence at the terminal

a) Became independent in

____a week ____a few weeks

____more than a month ____some skill need help

b) Procedural difficulties

Kinds of problem	No. of students	a week	more than a few weeks
disc	____	____	____
keys	____	____	____
touch	____	____	____
fiche	____	____	____

c) Conceptual difficulties

Strands	No of students	For how long
- - - - -	____	- - - - - -
- - - - -	____	- - - - - -
- - - - -	____	- - - - - -

d) Help at the terminal

CERL: Ho many total hours were CERL staff sitting with students orienting to the system?

____1-5 hours ____6-10 hours ____11-15 hours

____more than 15 hours ____in the beginning only

____regularly

Teacher:

____a few hours a week in the beginning ____regularly

Students helping each other

____more adept children helped less able

e) Teacher proficiency in handling the terminal

____adequate ____inadequate

f) Real mechanical problems encountered

____terminal ____system down

____audio ____touch panel

____microfiche ____telephone lines

____other

g) Interference with other activities

____considerable ____negligible

h) Specific Comments

4. Follow-up of students progress

a) Demand on teacher time

____can be met ____can't be met

____less than a hour a week ____one to three hours a week

____more than three hours a week

b) Teacher training on the use of records

____adequate ____some

____guidebook only ____none

c) Nature and format of record of students' progress

____easily understood, relevant ____easily accessible

____too many steps to remember ____change needed

d) Level of detail on students progress record

____too detailed ____about right for instructional decisions

____too general

e) On-line vs. hard copy student records

	On-line	Hard-copy
preference	____	____
convinience	____	____
interpretability	____	____

f) Whose idea to prescribe? ______________________

When? - - - - - - - - -

Amount of prescribing done by teacher

____all lessons prescribed by the teacher

____to a limited extent only

Kind of prescribing

Help with prescribing from whom?

Reactions to prescribing

1)

2)

5. Use of information provided by PLATO

____regularly ____sometimes

____for prescription for individual students ____for groupings

____in regular class teaching

a) Teachers

____go through lessons ____don't go through

When?

b) Specific Comments

6. Additional information that would have been useful

____about the terminal (mechanical/procedural)

____about the program ____about students progress ____reduction of information contained in print-outs to basic and relevant ones

Specific Comments

7. New ideas learned by teachers from

PLATO lessons	CERL staff
____need for careful planning	____integration with classroom teaching
____learning about children	____prescribing
____management techniques	____management techniques
____new approaches to teaching	____new approaches to teaching

Other

8. Similarities and differences between PLATO and usual teaching

____similarities ____differences ____both

Specific Comments

9. Time spent on teach ng and learning M/R after adoption of PLATO

	More	About the same		Less	How Much?
Teacher	____	____	____	____	____
Students	____	____	____	____	____

Specific Comments

10. General attitudes of students toward the machine

____positive ____neutral ____negative

Toward the program

____positive ____neutral ____negative

In general

____enjoyed it throughout ____novelty subsided

PLATO

____separated students wider than before

____brought them together closer

____had significent effects on disruptive students

11. Students' learning from PLATO

____new topics

____following directions

____other

____reinforcemtn of topics already taught

____taking responsibility

12. Characteristics of students who benifitted

	Ability			Sex		Attitude			Other
	Hi	M	Lo	M	F	Pos	Ind	Ne	
Most	__	__	__	__	__	__	__	__	__
Least	__	__	__	__	__	__	__	__	__

Specific Comments

13. Effective aspects of PLATO

Pedagogical

____individualization

____positive reinforcement

____immediate feedback

____irill

Technical

____animation

____touch panel

____sound

PLATO's roles in

____introducing new topics

____following-up classroom teaching

____completely taking up a unit

Specific Comments

14. Limiting aspects of PLATO

____mechanical/procedural

____too much reading required (in math)

____differnt program emphasis than teacher wanted

____audio

____children getting wrong responses

____record storage a problem

Other

15. Differences in strands

a) Most effective

(Math) ____Fraction ____Graphs ____Whole numbers

(Rd) ____Orientation ____Letternames ____Phonics

____Sight words ____Stories

b) Least effective

(Math) ____Fraction ____Graphs ____Whole numbers

(Rd) ____Orientation ____Letternames ____Phonics

____Sight words ____Stories

c) Approaches of differnt strands

____similarities ____differences

In what ways?

d) Teachers feel uncomfortable with

____strand ____format ____sequence ____exercises

e) ____desire to use math lessons in the future

16. Reactions of teachers, principals and parents

	Positive	Neutral	Negative
Teachers	____	____	____
Principals	____	____	____
Parents	____	____	____

Specific Comments

17. Continuation of PLATO with distinct fund

____yes ____have doubts ____no

PLATO or other material resources?

____PLATO ____materials

PLATO or aide?

____PLATO ____aide

Specific Comments

18. Changes in students' learning approaches, attitudes, etc.

____use of logical approach ____more understanding

____faster learning ____increase in interest

a) Shift of attitude toward the learning of subject matter(M/R)

____positive ____same as before ____negative

b) ____students wanted extra turns before or after school

c) ____students and/or teachers from non-PLATO classes came in and worked on terminals

d) ____students worked on terminals at CERL or at home

e) ____are the reactions of repeaters (2nd yr. PLATO students) different?

19. Changes in teachers' style

____more relaxed with subject matter

____more planning

____more individualization

____other

20. Specific anecdotes and suggestions

4/22/74

Teacher ______________________ School ______________ Date ______________
Mo/Day/Yr.

Time ______________________ Child's Name ______________ Observer ______________

STUDENT INTERACTION WITH TERMINAL

Except where indicated otherwise, coding is:

1 = none or never
2 = low level or seldom
3 = medium level or sometimes
4 = high level or often
5 = extremely high level or constantly
blank = no opportunity to observe

Lesson Identification (describe)

A	C
B	D

A. PROCEDURES AND CONTENT

	A	B	C	D
1.* Child's understanding of directions				
2.* Child's understanding of content				
3. General impression as to difficulty of lesson 1 = too easy 3 = about right 5 = too hard				

4. What do you think was source of any difficulty child had with lesson?

____

B. AFFECTIVE REACTION

Non verbal expressions of attitude:

	A	B	C	D
5. Attention to PLATO terminal 1 = no attention 5 = all attention				
6. 1 = bored 5 = highly involved				
7. 1 = tense 5 = relaxed				
8. 1 = discouraged 5 = confident				

Verbal expressions of attitude while on PLATO:

[1 = very negative 3 = neutral 5 = very positive]

	A	B	C	D
9. To self				
10. To other children				
11. To teachers				
12. To PLATO				

*Coding elaborated on attached sheets.

Note: A,B,C,D refer to separate lessons. If rating for item is same across lessons, rate only under lesson A and leave rest blank.

C. RESPONSE STYLE

[1 = child never acts this way 5 = child constantly acts this way]

Item	A	B	C	D
13. Impulsive - makes response before looking or thinking				
14. Hesitant				
15. Slow but confident				
16. Fast and accurate				
17. Self-motivated and purposeful in approach				
18. Tries to "beat system" (touching happy face to go on without reading, giving wrong responses to wait for machine to correct him, etc.)				

D. MECHANICAL DIFFICULTIES

Item	A	B	C	D
19.* Child facility with typing				
20.* Child facility with managing audio device				
21.* Child facility with managing microfiche				
22.* Child facility with managing touch panel				
23. System failure occurs 1=never 5=constantly Where in lesson? ______________________				
24. Other hardware failures occur 1=never 5=constantly What kind? ______________________				
25. Length of wait for lesson changes 1 = none 3 = acceptable 5 = excessive				
26. Portion of lesson received by child 1 = none at all 3 = part 5 = full lesson				

E. REQUESTS FOR HELP

	A	B	C	D
27. Proportion of time that C is assisted 1 = never 3 = several minutes 5 = constantly				
28. Request for help made to teacher [1 = never 3 = several times 5 = constantly]				
29. T responds by "doing for"				
30. T responds by guiding or giving information				
31. T acknowledges request but doesn't help				
32. Request made to other child(ren)				
33. C respond by "doing for"				
34. C respond by guiding or giving information				
35. C acknowledge request but don't help				
36. Request made to CERL staff member				
37. S/he responds by "doing for"				
38. S/he responds by guiding or giving information				
39. S/he acknowledges request but doesn't help				
40. Request made to ETS observer				
Interaction with child is initiated by: [1 = never 3=several times 5=constantly]				
41. Teacher				
42. CERL staff				
43. Other adult				

F. OTHER CHILDREN AT TERMINAL

	A	B	C	D
44. Other children spend time around terminal				
Children comment on or talk to child at terminal about:				
45. PLATO procedures				
46. PLATO content				
47. unrelated matters				
48. Children interact with child at terminal in disruptive or interfering way				

ELABORATION OF CODING

1. 1 - Child has so much trouble understanding directions that s/he gives up.

   2 - Child has great difficulties in understanding directions and asks for help.

   3 - Child has some difficulty in understanding directions, but gets by.

   4 - Child has only a little difficulty understanding directions.

   5 - Child follows directions quickly and confidently, or even anticipates them.

2. 1 - Child has so much trouble understanding content that s/he gives up.

   2 - Child has great difficulty in understanding content and asks for help.

   3 - Child has some difficulty in understanding content, but gets by without help.

   4 - Child has only a little difficulty understanding content.

   5 - Child grasps content quickly and confidently.

<u>19, 20, 21, 22</u>.

1 - Child has so much trouble that s/he gives up.

2 - Child has so much trouble that s/he asks for help.

3 - Child has considerable difficulty, but gets by.

4 - Child has only a little difficulty.

5 - Child has no difficulty, handles equipment confidently.

[These do not include difficulties resulting from hardware/system failure.]

3/3/75

Teacher__________ School__________ Date__________
Mo/Day/Yr

Time__________ Observer__________ No. Children__________

CLASSROOM OBSERVATION

Codes (except where other coding specified)

1=none or never

2=low level or seldom

3=medium level or sometimes

4=high level or often

5=extremely high level or constantly

blank=no opportunity to observe

A. CLASSROOM SETTING

1. Physical Setting (circle one):

a. Desks - rows + columns

b. Desks - informal arrangement

c. Balance of desks (tables) + activity centers

d. Activity centers predominate

never 1 2 3 4 5 constantly

2. Noise Level (circle one):

a. Quiet, children working

b. Quiet, but tense (teacher-enforced rather than spontaneous)

c. Hum of conversation

d. Noisy, children working

e. Noisy, disruptive

f. Other (describe)

never constantly

Functional Use of Space; children work at:

3. Activity Centers

4. Student desks

5. Circle or table

6. On the floor

Movement of children:

7. Raise hand for permission

8. Go to teacher for help

9. Move from student to student

10. Move from activity to activity

11. Wander looking for something to do

B. MATERIAL RESOURCES (check as many as apply)

____ 12. Textbooks in use

____ 13. Workbooks in use

____ 14. Other printed materials in use (specify):

____ 15. Visual aids in use (specify):

____ 16. Concrete materials in use (specify):

(e.g. cuisenaire rods, balance scales, structured educational games)

C. READING (check as many as apply)

Type of activity:

____ 17. Experience stories (children dictating)

____ 18. Word attack skills

____ 19. Word meaning

____ 20. Oral reading

____ 21. Silent reading

____ 22. Comprehension exercizes

____ 23. Spelling, punctuation

____ 24. Writing

____ 25. Handwriting, copying

Source of texts used:

____ 26. Textbook/workbook

____ 27. Child selected stories

____ 28. Child generated stories

____ 29. Teacher generated stories

____ 30. Games, specify:

____ 31. References to PLATO or activities based on PLATO materials

D. MATH (check as many as apply)

Type of activity:

____ 32. Introduction of rules by discovery or inductive approach

____ 33. Introduction of rules followed by examples--deductive

____ 34. Introduction of concepts, principles

____ 35. Practicing operations, rules--drill, use of material

____ 36. Children asked for illustrations of concepts (e.g., show addition on number, draw a picture of 1/2 and 1/4, etc.)

Topic:

____ 37. Whole numbers

____ 38. Fractions

____ 39. Decimals

____ 40. Graphing

____ 41. Geometry

____ 42. Writing open sentences, equations

____ 43. "Word problems"

____ 44. Measurement

____ 45. Estimation

____ 46. Mathematics Vocabulary ("sets," subtrahend," etc.)

____ 47. Other:

Source of problems:

____ 48. Textbook/workbook

____ 49. Child generated problems

____ 50. Teacher generated problems

____ 51. "Real-life" based on school or home environment

____ 52. References to PLATO or activities based on PLATO materials

never constantly

E. CLASSROOM ORGANIZATION

53. Teacher works with whole classroom

54. In working with the whole class, who does most of talking? (circle one)

a. Teacher

b. Children

c. Teacher spends about as much time listening as talking

55. Teacher works with subgroups

56. In working with subgroups who does most of talking? (circle one)

a. Teacher

b. Children

c. Teacher cpends about as much time listening as talking

1 2 3 4 5
never constantly

57. Teacher works with single pupils

58. In working with individual pupils, who does most of talking? (circle one)

a. Teacher

b. Children

c. Teacher spends about as much time listening as talking

59. Same task is given for whole group--children do not interact with each othe

60. Same task is given for whole group--with discussion, interaction

61. Variety of activities going on in subgroups

62. Children engaged in individual activities, not grouped

63. Teacher directs children to activities

64. Children direct themselves, but according to schedule dictated by teacher

65. Children direct themselves according to their own interests in school work

66. Children direct themselves according to social motivation

67. Shifts in activities or classroom organization are accomplished (circle one

a) reasonably smoothly

b) in a disruptive way

F. MOTIVATION, CONTROL

Teacher maintains motivation + control by:

68. Giving of privileges, prizes, grades

69. Loss of privileges

70. Direct praise

71. Emphasizing intrinsic value of ideas or activity

72. Reminding children of rules

73. Negative statements or warnings

74. Pointing out student(s) as positive model

75. Pointing out student(s) as negative model

76. Competition

77. Cooperation

78. Commands without reasons for behavior given

79. Emphasizing reasons for behavior

80. Physical contact positive

81. Physical contact negative

82. Isolating pupil(s)

83. Having pupil sit by teacher

84. Having pupil stay after school

1 2 3 4 5
never constantly

G. CLASSROOM ATMOSPHERE

85. Hard-working atmosphere
86. Playful, joking atmosphere
87. Casual atmosphere
88. Tense atmosphere
89. Children are discouraged or prevented from expressing own experience + judgments
90. Children express own experiences and judgments

H. DEVELOPMENT OF IDEAS

91. Discussion, relations among ideas, inquiry as instructional technique, are emphasized
92. Memorization, rote learning, as instructional technique, are emphasized
93. Attention is concentrated on particular group of students (especially bright, especially slow, noisy, boys, girls)
94. Only one answer is accepted as being correct
95. Pupil is permitted to suggest additional or alternative answers
96. Focus is on generalizations and understandings of structures or patterns
97. Focus is on facts and rules
98. Pupil is encouraged to experiment or try own ideas
99. Topics or preset plans are narrowly adhered to
100. Instruction is adjusted to student concerns and interests
101. Specific step-by-step instructions are given
102. Guidelines are given with some freedom of interpretation

I. ACADEMIC EVALUATION

103. Teacher passes judgment on p's work (positive)("Good")
104. Teacher passes judgment on p's work (negative)("Bad")
105. Teacher withholds judgment of p's work
106. Teacher immediately reinforces p's answer as "right" or "wrong"
107. Teacher has p decide when Q has been answered satisfactorily
108. Teacher asks another p to give answer if one p fails to answer quickly
109. Teacher provides answer to p who seems confused or puzzled
110. Teacher gives p time to sit and think, mull things over

1 2 3 4 5
never constantly

J. INTERACTIONS WITH PLATO

111. Teacher goes to terminal to get information from system on pupil performance
112. Teacher uses feedback from system to change p's assignment on PLATO
113. Teacher uses feedback from system to group p's for special PLATO-related instruction or remediation
114. P's are expected to leave their activities unfinished when it's their turn on PLATO
115. P's are expected to finish their activities before taking turn on PLATO
116. Teacher disciplines p's at the terminal (tells them to be quiet, keeps p's from interfering with other p's)
117. Teacher walks by terminals to observe p's work
118. Teacher helps p's at the terminal
119. Teacher uses child's turn at PLATO as reward or punishment
120 Teacher restricts child's PLATO use for educational reasons
121. Other children gather around p's at terminal

Check:

_____ 122. Teacher posts schedule for PLATO use, + schedule is adhered to

_____ 123. Teacher posts schedule for PLATO use, + schedule not adhered to

_____ 124. Teacher posts PLATO progress chart or other indication of how p's are doing on PLATO

_____ 125. PLATO-related materials are present in the room, specify:

Other children at terminals; mode of interaction:

126. Involving-work in cooperative interaction with p at terminal
127. Helping-help p at terminal with problem
128. Interfering-interact in negative way with p at terminal
129. Controlling-take over control
130. Socializing-interact in social way

K. GLOBAL IMPRESSIONS (circle one number)

131. PACING

Relaxed 1—2—3—4—5 Rushed

132. INVOLVEMENT

Absorbed 1—2—3—4—5 Bored

133. STUDENT RELATIONS

a. Cooperative 1—2—3—4—5 Competitive

b. Supportive 1—2—3—4—5 Critical

134. REWARD STRATEGIES

Approval/Privileges 1—2—3—4—5 Disapproval/Punishment

135. TEACHER PSYCHOLOGICAL DISTANCE

close 1—2—3—4—5 Aloof

136. STUDENT ABILITY TO FOLLOW INSTRUCTION

Clear Understanding 1—2—3—4—5 Confusion

137. CONTINUITY OF INSTRUCTION

Sequence of Unrelated tasks 1—2—3—4—5 Thematic absorption

138. RULES- TEACHER

Seldom Mentioned 1—2—3—4—5 Frequently Cited

139. RULES - STUDENT

Many Apparent Rules 1—2—3—4—5 Apparent Rules

140. CLASSROOM DECISION MAKING

Centralized 1—2—3—4—5 Decentralized

141. TASK CHOICE

Student Determined 1—2—3—4—5 Teacher Determined

142. STUDENT MOVEMENT

Student Determined 1—2—3—4—5 Teacher Determined

143. INDIVIDUAL ATTENTION

High Emphasis 1—2—3—4—5 Low Emphasis

144. PLATO INTEGRATION

Isolated Resource 1—2—3—4—5 Integrated Resource

145. Teacher retains responsibility for PLATO CONTROL 1—2—3—4—5 PLATO seen as responsible for PLATO content

146. Teacher consistency

Stable 1—2—3—4—5 Erratic

147. PLATO problems disrupt other activities:

Never 1—2—3—4—5 Frequently

K. GLOBAL IMPRESSIONS cont'd (circle one number)

148. TEACHER ENCOURAGEMENT OF PLATO USE

Low 1—2—3—4—5 High

149. TEACHER ENTHUSIASM

Flat 1—2—3—4—5 Gung-ho

150. CLARITY OF PRESENTATION

Low 1—2—3—4—5 High

151. TASK ORIENTATION

"Good Times" 1—2—3—4—5 "You're here to learn"

152. USE OF ORGANIZERS OR STRUCTURING COMMENTS (OVERVIEWS/SUMMARIES)

Low 1—2—3—4—5 High

153. INTELLECTUAL CHALLENGE

Low 1—2—3—4—5 High

154. TEACHER SEEKS TO DISCOVER CHILD'S UNDERSTANDINGS

Never 1—2—3—4—5 Often

155. TEACHER TAKES INTO ACCOUNT CHILD'S UNDERSTANDINGS

Never 1—2—3—4—5 Often

WHEN AN ITEM IS MARKED IN THE MIDDLE OF THE SCALE BECAUSE OF A COMBINATION OF LOW & HIGH INSTANCES, FOLLOW SCALE BY AN ASTERISK AND ELABORATE IN NARRATIVE.

SPECIAL CIRCUMSTANCES, COMMENTS, & ELABORATIONS.

Child's name (or first name and initial of last name):

____

School: _______________

Grade: _______________

Teacher: _______________

Date: _______________

SCHOOL ATTITUDES

This is about how you feel when doing different things.

If you feel good or happy when you do the thing, put a mark on

HAPPY

If you feel sad or unhappy when you do the thing, put a mark on

SAD

If you feel OK or in between happy and sad when you do the thing, put a mark on

OK

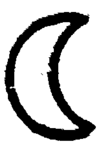
Here is an example:

When you eat ice cream, how do you feel?

HAPPY OK SAD

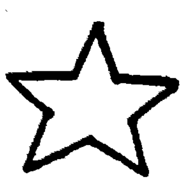
When you can spell a word, how do you feel?

HAPPY OK SAD



When you draw a pretty picture, how do you feel?

HAPPY OK SAD



When you don't have enough time to finish a game, how do you feel?

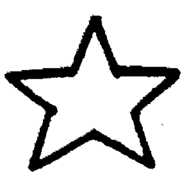
HAPPY OK SAD

When you go to school, how do you feel?

HAPPY OK SAD

When the teacher helps you learn to read, how do you feel?

HAPPY OK SAD



When you drop an ice cream cone, how do you feel?

HAPPY OK SAD

When you get a toy for a present, how do you feel?

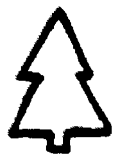
HAPPY OK SAD

When you get a book for a present, how do you feel?

HAPPY OK SAD

When number problems are too hard for you to do, how do you feel?

HAPPY OK SAD

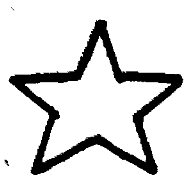


When you don't have enough time to finish your reading, how do you feel?

HAPPY OK SAD

When it is time to work on numbers, how do you feel?

HAPPY OK SAD



When it is time to work on reading, how do you feel?

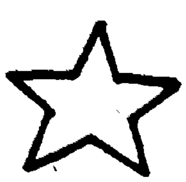
HAPPY OK SAD

When a story is too hard for you to read, how do you feel?

HAPPY OK SAD

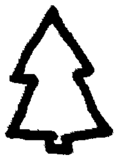
When you take home something you made at school, how do you feel?

HAPPY OK SAD



When you take a book home, how do you feel?

HAPPY OK SAD

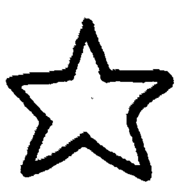


When your parents ask you to read a story, how do you feel?

HAPPY OK SAD

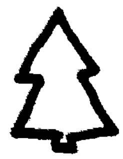
When the teacher asks you to read a story, how do you feel?

HAPPY OK SAD



When you play a reading game, how do you feel?

HAPPY OK SAD



When the teacher helps you learn about numbers, how do you feel?

HAPPY OK SAD

When the teacher reads you a story, how do you feel?

HAPPY OK SAD

#084

Child's name (or first name and initial of last name):

____

School: ______________________

Grade: _______________________

Teacher: _____________________

Date: ________________________

SCHOOL ATTITUDES

This is about how you feel when doing different things.

If you feel good or happy when you do the thing, put a mark on

HAPPY

If you feel sad or unhappy when you do the thing, put a mark on

SAD

If you feel OK or in between happy and sad when you do the thing, put a mark on

OK

Here is an example:

When you eat ice cream, how do you feel?

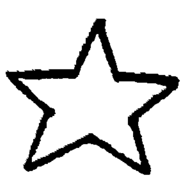
HAPPY OK SAD

When you can spell a word, how do you feel?

HAPPY OK SAD

When you draw a pretty picture, how do you feel?

HAPPY OK SAD

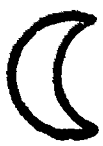


When you don't have enough time to finish a game, how do you feel?

HAPPY OK SAD

When you go to school, how do you feel?

HAPPY OK SAD



When the teacher helps you learn to read, how do you feel?

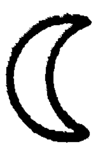
HAPPY OK SAD

When you drop an ice cream cone, how do you feel?

HAPPY OK SAD

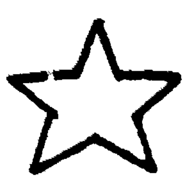
When you get a toy for a present, how do you feel?

HAPPY OK SAD



When you get a book for a present, how do you feel?

HAPPY OK SAD



When number problems are too hard for you to do, how do you feel?

HAPPY OK SAD

When you don't have enough time to finish your reading, how do you feel?

HAPPY OK SAD

When it is time to work on numbers, how do you feel?

HAPPY OK SAD

When it is time to work on reading, how do you feel?

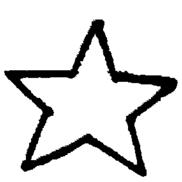
HAPPY OK SAD

When a story is too hard for you to read, how do you feel?

HAPPY OK SAD

When you take home something you made at school, how do you feel?

HAPPY OK SAD



When you take a book home, how do you feel?

HAPPY OK SAD

#085

Child's name (or first name and initial of last name):

____

School: ______________________

Grade: _______________________

Teacher: _____________________

Date: ________________________

SCHOOL ATTITUDES

This is about how you feel when doing different things.

If you feel good or happy when you do the thing, put a mark on

HAPPY

If you feel sad or unhappy when you do the thing, put a mark on

SAD

If you feel OK or in between happy and sad when you do the thing, put a mark on

OK

Here is an example:

When you eat ice cream, how do you feel?

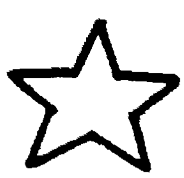
HAPPY OK SAD

When you can spell a word, how do you feel?

HAPPY   OK   SAD

When you draw a pretty picture, how do you feel?

HAPPY   OK   SAD



When you don't have enough time to finish a game, how do you feel?

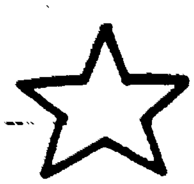
HAPPY   OK   SAD

When you go to school, how do you feel?

HAPPY   OK   SAD

When the teacher helps you learn to read, how do you feel?

HAPPY   OK   SAD



When you drop an ice cream cone, how do you feel?

HAPPY   OK   SAD

When you get a toy for a present, how do you feel?

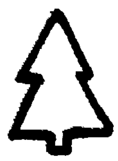
HAPPY | OK | SAD

When you get a book for a present, how do you feel?

HAPPY | OK | SAD

When number problems are too hard for you to do, how do you feel?

HAPPY | OK | SAD

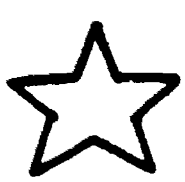


When you don't have enough time to finish your reading, how do you feel?

HAPPY | OK | SAD

When it is time to work on numbers, how do you feel?

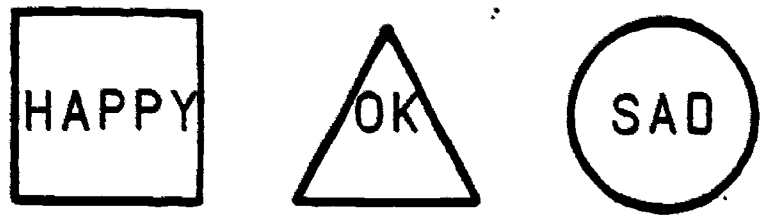
HAPPY | OK | SAD



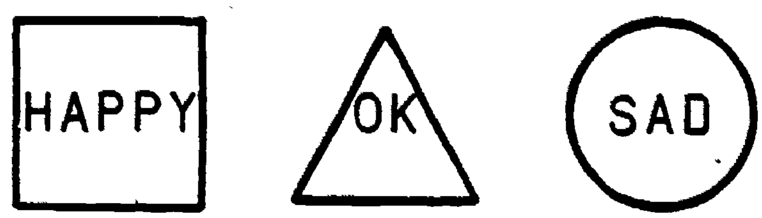
When it is time to work on reading, how do you feel?

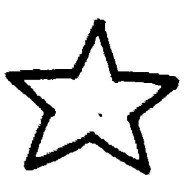
HAPPY | OK | SAD

When you read a story in a book, how do you feel?

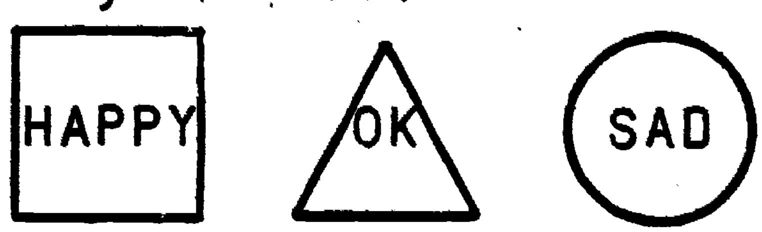


When you take home something you made at school, how do you feel?





When you take a book home, how do you feel?



When you read a story with other children, how do you feel?

HAPPY OK SAD

When you read a story by yourself, how do you feel?

HAPPY OK SAD

When you read a story with the teacher, how do you feel?

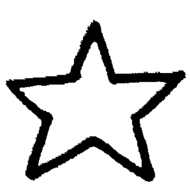
HAPPY OK SAD

When you play a reading game, how do you feel?

HAPPY OK SAD

When the teacher helps you learn about numbers, how do you feel?

HAPPY OK SAD



When the teacher reads you a story, how do you feel?

HAPPY OK SAD

Child's name (or first name and initial of last name):

____

School: ______________________

Grade: _______________________

Teacher: _____________________

Date: ________________________

SCHOOL ATTITUDES

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If you feel sad or unhappy when you do the thing, put a mark on

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If you feel OK or in between happy and sad when you do the thing, put a mark on

OK

Here is an example:

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When you can spell a word, how do you feel?

HAPPY OK SAD

When you draw a pretty picture, how do you feel?

HAPPY OK SAD

When you don't have enough time to finish a game, how do you feel?

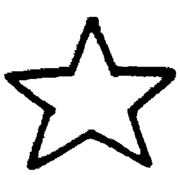
HAPPY OK SAD

When you go to school, how do you feel?

HAPPY OK SAD

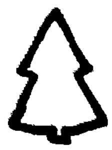
When the teacher helps you learn to read, how do you feel?

HAPPY OK SAD



When you drop an ice cream cone, how do you feel?

HAPPY OK SAD

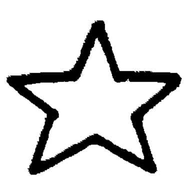


When you get a toy for a present, how do you feel?

HAPPY OK SAD

When you get a book for a present, how do you feel?

HAPPY OK SAD



When number problems are too hard for you to do, how do you feel?

HAPPY OK SAD

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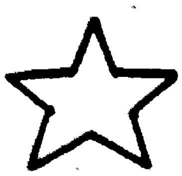
HAPPY OK SAD

When it is time to work on numbers, how do you feel?

HAPPY OK SAD



When it is time to work on reading, how do you feel?

HAPPY OK SAD

When you read a story in a book, how do you feel?

HAPPY OK SAD

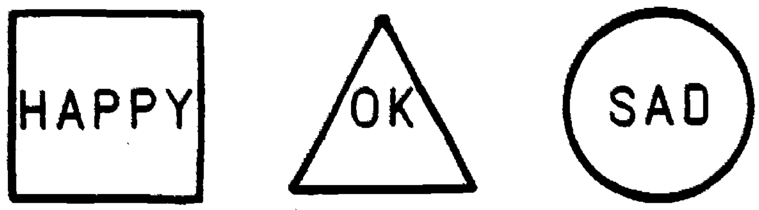
When you take home something you made at school, how do you feel?

HAPPY OK SAD

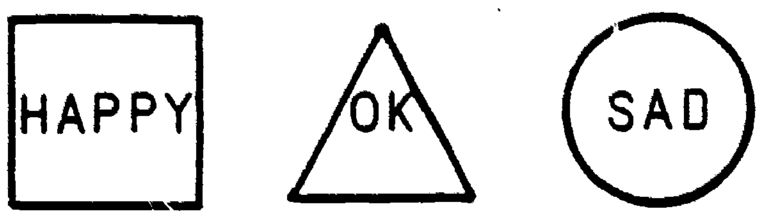
When you take a book home, how do you feel?

HAPPY OK SAD

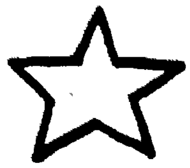
When you read a story with other children, how do you feel?



When you read a story by yourself, how do you feel?

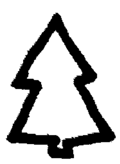


When you read a story with the teacher, how do you feel?



When you read a story on PLATO, how do you feel?

HAPPY OK SAD



When the teacher helps you learn about numbers, how do you feel?

HAPPY OK SAD

When it is time to work on PLATO, how do you feel?

HAPPY OK SAD

When you don't get a turn on PLATO, how do you feel?

HAPPY OK SAD

When PLATO doesn't work, how do you feel?

HAPPY OK SAD

When PLATO helps you learn to read, how do you feel?

HAPPY OK SAD

SCHOOL ATTITUDES

Here are some statements about feelings. The right answer is the way you feel about the statement, not how other people think you should feel. This is not a school test. No one in school or at home will look at your answers, so tell us just what you think.

Please print your name, grade and school on these lines.

Name ____

Grade ____________________ School ____________________

Read each sentence, and circle YES if you feel that you agree with the statement. Circle NO if you feel that you do not agree with the statement. If you are not sure about how you feel, circle the ?.

Examples:

Ice cream is good at any time of the year.	YES	?	NO
I think television is boring.	YES	?	NO

1.	I am very proud of the way I read.	YES	?	NO
2.	Reading is the hardest thing I have to do.	YES	?	NO
3.	I get worried when I am asked to read something.	YES	?	NO
4.	I like to read to people.	YES	?	NO
5.	I am slow at reading.	YES	?	NO
6/7.	Reading is fun.	YES	?	NO
8.	I am a good singer.	YES	?	NO
9.	I like school.	YES	?	NO
10.	I get worried when I am asked to play sports.	YES	?	NO
11.	Drawing pictures is hard for me.	YES	?	NO
12.	I like to show people how to play games.	YES	?	NO
13.	I like to beat other kids at games.	YES.	?	NO
14.	Math is fun.	YES	?	NO
15.	Math is the hardest thing I have to do.	YES	?	NO
16.	I am good at math.	YES	?	NO

17. I get worried when asked to do a math problem.	YES	?	NO
18. I would rather do almost anything than math.	YES	?	NO
19. I like to show people how to do math problems.	YES	?	NO
20. I am slow at doing math.	YES	?	NO
21. I like math better this year than I did before.	YES	?	NO
22. Math is my favorite subject.	YES	?	NO
23. I like learning about decimals.	YES	?	NO
24. I like learning about fractions.	YES	?	NO
25. I like learning about graphs.	YES	?	NO
26. Mathematics is often very boring.	YES	?	NO
27. I feel smart when I'm working on math.	YES	?	NO
28. I liked math better when I was younger.	YES	?	NO
29. When the teacher gives me math problems to do, I usually understand the directions.	YES	?	NO
30. I like working on math with other kids.	YES	?	NO
31. I like working on math with my teacher.	YES	?	NO
32. I like working on math with a textbook.	YES	?	NO

33. I like to work on math alone.	YES	?	NO
34. I often disagree with what the teacher says.	YES	?	NO
35. Teachers sometimes make me feel bad when I make a mistake.	YES	?	NO
36. I like it when the teacher lets me decide for myself what work I'm going to do in school.	YES	?	NO
37. Kids in this class are very friendly.	YES	?	NO
38. I am happy most of the time in this class.	YES	?	NO
39. I can learn at my own speed in this class.	YES	?	NO
40. The amount that I learn in school depends mostly on my teacher.	YES	?	NO
41. The amount that I learn in school depends mostly on me.	YES	?	NO
42. If I do badly on a test it's because the teacher didn't teach me well.	YES	?	NO
43. If I do badly on a test it's because I didn't work hard enough.	YES	?	NO
44. I would like to work with computers when I grow up.	YES	?	NO
45. Watching TV is one of my favorite things to do.	YES	?	NO

SCHOOL ATTITUDES

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6/7. Reading is fun.	YES	?	NO
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12. I like to show people how to play games.	YES	?	NO
13. I like to beat other kids at games.	YES	?	NO
14. Math is fun.	YES	?	NO
15. Math is the hardest thing I have to do.	YES	?	NO
16. I am good at math.	YES	?	NO

17. I get worried when asked to do a math problem.	YES	?	NO
18. I would rather do almost anything than math.	YES	?	NO
19. I like to show people how to do math problems.	YES	?	NO
20. I am slow at doing math.	YES	?	NO
21. I like math better this year than I did before.	YES	?	NO
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31. I like working on math with my teacher.	YES	?	NO
32. I like working on math with a textbook.	YES	?	NO

33. I like to work on math alone.	YES	?	NO
34. I like working on math with PLATO.	YES	?	NO
35. I often disagree with what the teacher says.	YES	?	NO
36. Teachers sometimes make me feel bad when I make a mistake.	YES	?	NO
37. I like it when the teacher lets me decide for myself what work I'm going to do in school.	YES	?	NO
38. Kids in this class are very friendly.	YES	?	NO
39. I am happy most of the time in this class.	YES	?	NO
40. I can learn at my own speed in this class.	YES	?	NO
41. The amount that I learn in school depends mostly on my teacher.	YES	?	NO
42. The amount that I learn in school depends mostly on me.	YES	?	NO
43. If I do badly on a test it's because the teacher didn't teach me well.	YES	?	NO
44. If I do badly on a test it's because I didn't work hard enough.	YES	?	NO
45. I would like to work with computers when I grow up.	YES	?	NO
46. Watching TV is one of my favorite things to do.	YES	?	NO
47. I would rather do almost anything than work on PLATO.	YES	?	NO

48. PLATO is fun.	YES	?	NO
49. PLATO is often very boring.	YES	?	NO
50. I like playing games on PLATO.	YES	?	NO
51. I get mad when PLATO doesn't work.	YES	?	NO
52. PLATO helps me like math better.	YES	?	NO
53. I learn math more easily on PLATO.	YES	?	NO
54. There are a lot of times when PLATO doesn't work.	YES	?	NO
55. PLATO cheats in games.	YES	?	NO
56. When PLATO gives me math problems to do, I usually understand the directions.	YES	?	NO
57. PLATO sometimes makes me feel bad when I make a mistake.	YES	?	NO
58. My friends think PLATO is fun.	YES	?	NO
59. My friends think PLATO doesn't teach you anything.	YES	?	NO
60. My teacher thinks PLATO helps me learn.	YES	?	NO
61. My teacher thinks PLATO is a waste of time.	YES	?	NO
62. My parents think PLATO helps me learn.	YES	?	NO
63. My parents think PLATO is a waste of time.	YES	?	NO
64. PLATO is fun but I don't learn much math from it.	YES	?	NO

65. PLATO is fun at first but after a while it gets boring.	YES	?	NO
66. I like math better with PLATO than with my teacher.	YES	?	NO
67. I learn more math from PLATO than from my teacher.	YES	?	NO
68. I get frustrated because PLATO can't answer my questions.	YES	?	NO
69. It's hard to see how PLATO math lessons fit together.	YES	?	NO
70. It's hard to see how my teacher's math lessons fit together.	YES	?	NO
71. I often get confused by PLATO lessons.	YES	?	NO
72. The pictures on PLATO help me learn more than the words.	YES	?	NO
73. You can often get through a PLATO lesson without really knowing what is going on.	YES	?	NO
74. If you don't know how to do a problem on PLATO, you can just type in anything and get through.	YES	?	NO

How many minutes of math homework do you usually do in a week? ________

What are things that you like most about PLATO?

What PLATO lessons do you like the best?

What are things that you don't like about PLATO?

What PLATO lessons do you dislike the most?

=806

<u>EXAMINER'S MANUAL</u>

CONCEPT-REFERENCED TEST

IN

PRIMARY READING

Special Considerations in Test Administration

Since we are assessing the ability of young children to perform rather specific objectives, great care is needed to ensure that the children are tested validly and fairly. However it is to be made clear to the children that they are not being graded on the results and that their work is only being used to help us find out how we can help them to learn.

Manuals

This Manual specifies the required procedures for administering each question. It is essential that the manual and test booklet be read in their entirety before attempting to administer the instruments to children.

Answer Sheets

The questions require the children to indicate their responses in the test books. But in no case are children required to fill out an answer sheet, since such a task might prove more difficult for them than actually answering the questions.

Group Size

The questions may be group administered. The size of the "group" is left to the discretion of the examiner. For most or even all questions, the examiner may decide that the entire class may be assessed at once. For other questions, the examiner may decide that five or two is the maximum group size that can be fairly measured at once. Any group administered questions may by individually administered, if desired.

Timing

The instruments have no fixed time limits. To the extent possible, every child should be given sufficient time to attempt each question. However, some objectives may be beyond what a child has achieved. To avoid frustrating children, tell them to try to do whatever they can, but do not force them if it appears they cannot do the work (assuming they do understand the directions). For the group administered questions, care is needed to be certain no children fail to keep up with the rest of the class. If certain children appear to be taking an inordinate amount of time and causing others in the group to become restless, they may be assessed individually.

Feel free to stop testing at any time after an objective has been measured if the children appear to lose interest or become tired. You may continue later in the day, or spread the testing over several days at your own discretion. You should, however, complete all the questions on one objective at the same time.

Student Questions

Clearly, it would be unfair to give some children additional information about the test questions that is denied to other children. The fairest policy for dealing with questions from the children during test administration is to limit yourself to repeating the relevant directions.

Incomplete Tests

If a child does not complete a section, it would be very helpful to have the reason noted on the test booklet, e.g., child was absent, or refused to participate, or items were too difficult. This will aid us in interpreting results.

Summary

It is obvious that no written instructions can cover all the possible events that might occur when testing children. If any situations arise that are not covered by the manual, keep in mind that our task is to decide if the student can perform the actions required by the objectives in a way that will be fair to the individual student without giving him an unfair advantage over other students responding to the same questions.

To help us improve the manual and the test, it would be greatly appreciated if you could keep a record of any problems so that procedures can be developed to help avoid them in the future.

Administering the Test

Administer only a few exercises each day.

Following are the directions to be read to the children for each administration.

NOW YOU ARE GOING TO DO SOME THINGS IN THESE BOOKS. WE WANT TO FIND OUT WHAT YOU ALREADY KNOW AND WHAT YOU STILL HAVE TO LEARN. THERE IS NO GRADE FOR THIS WORK BUT DO THE BEST WORK YOU CAN SO THAT WE CAN FIND OUT WHAT YOU NEED TO LEARN.

*[TRY TO DO EVERYTHING YOU CAN ON EACH EXERCISE WE DO. YOU CAN HAVE AS MUCH TIME AS YOU NEED BUT DON'T SPEND TOO MUCH TIME DOING ONE THING. IF YOU JUST CAN'T GET THE ANSWER TO ONE THING, TRY AGAIN ON THE NEXT ONE.]

*[IF YOU MARK ONE ANSWER AND THEN DECIDE TO CHANGE IT, BE SURE TO ERASE THE FIRST ANSWER AS WELL AS YOU CAN. THEN WRITE IN THE ANSWER YOU WANT TO MAKE. (THIS CAN BE HANDLED HOWEVER THE EXAMINER WISHES TO HANDLE ERASURES. IN SOME CASES THE CHILDREN HAVE THEIR OWN ERASERS WHEREAS IN OTHERS THE EXAMINER MAY NEED TO SUPERVISE CHANGING ANSWERS)].

*Optional

Notes for Test Administrator:

-Underlined letters, such as <u>k</u>, are sounds, and are to be given as sounds <u>not</u> the names of letters.

-Letters within quotation marks, such as "k", are the names of the letters, and are to be given as the names of the letters.

Objective 1: Associate vowel graphemes with the sounds they represent.

Materials: Examiner's Manual
Test booklet, #1-8, pages 1-3
Blackboard and chalk, or large sheet of paper and marker

Directions: Put on the board or paper:

i a u

oo u i

Hold up a test booklet open to the page with the squirrel on the top and say:

TURN TO THE PAGE WITH THE SQUIRREL ON TOP

Make sure everyone is on the correct page and say:

NOW LOOK AT THE FIRST ROW. THERE IS A PICTURE OF A KITE. PUT YOUR FINGER ON THE KITE. (Check to see that all have done so.)

NOW LOOK AT THE BOXES OF LETTERS NEXT TO THE KITE. THEY ARE LIKE THE ONES I HAVE UP HERE. (Point to the letters i, a, u.)

WHICH SOUND DO YOU HEAR AS PART OF THE WORD KITE? IS IT <u>i</u>, OR IS IT <u>a</u>, OR IS IT <u>u</u> (pointing to each choice and saying the sound)? (Children answer <u>i</u>.) GOOD, IT IS <u>i</u>. NOW FIND THE BOX THAT HAS THE LETTER THAT STANDS FOR THAT SOUND, THAT IS PART OF THE WORD KITE. PUT YOUR FINGER ON THAT LETTER. YOU SHOULD HAVE YOUR FINGER ON THIS LETTER. (Point to the letter "i" on the board or paper. Check to see that all have their finger on the letter "i".)

NOW PUT AN X ON THE LETTER "i" LIKE THIS. (Put an X on the board or paper over the "i".) WE PUT AN X ON THE LETTER "i" BECAUSE IT STANDS FOR A SOUND IN THE WORD KITE. (Check to see that every child has marked his book correctly. If it appears that the children have problems following the directions, go over the example again.)

NOW, FIND THE PICTURE OF THE SUN. PUT YOUR FINGER ON THE SUN. (See if each child has done this.) WHICH LETTER MAKES A SOUND THAT YOU HEAR AS PART OF THE WORD SUN? IS IT oo OR IS IT u OR IS IT i (pointing to each letter and saying the sound)? (Children answer u.) GOOD, IT IS u. NOW PUT AN X ON THE LETTER "u" BECAUSE IT MAKES A SOUND THAT WE HEAR IN THE WORD SUN. (Check to see that every child has marked his book correctly.)

FIND THE PICTURE OF THE BONE. PUT AN X ON THE LETTER THAT STANDS FOR A SOUND THAT YOU HEAR IN THE WORD BONE. (Repeat if necessary. Allow time for the children to mark their books.)

NOW TURN TO THE NEXT PAGE WITH TWO SQUIRRELS ON TOP.

Now continue and do questions 2 through 8 in the same manner as you did #1 (BONE). The pictures are of:

2. CAKE
3. LEAF
4. SPOON
5. DOLL
6. CAT
7. BED
8. RABBIT

After #8, say:

NOW PUT YOUR PENCILS DOWN.

Objective 2: Associate consonant graphemes and digraphs with the sounds they represent.

Materials: Examiner's Manual
Test booklet, pages 4-8

Directions: Say to the children:

> TURN TO THE PAGE WITH THE LION AT THE TOP.

Make sure everyone is on the right page. Hold up the test booklet open to page 4.

> SEE THE PICTURE OF THE BALL AT THE TOP OF THE PAGE. PUT YOUR FINGER ON THE BALL. (Check to see that all have done this.) SEE THE LETTERS NEXT TO THE BALL. WHICH LETTER MAKES A SOUND THAT IS IN THE WORD BALL? IS IT f OR IS IT b OR IS IT c (pointing to each letter and saying the sound.) (Children answer b. Repeat if necessary.) GOOD, IT IS b. NOW WHICH LETTER MAKES THE SOUND b? PUT YOUR FINGER ON THAT LETTER. (Children point to "b".) THAT'S RIGHT. NOW PUT AN X ON THE LETTER "b", BECAUSE IT STANDS FOR A SOUND IN THE WORD BALL. (Check to see that each child has marked the item correctly. If children are having problems, go over the example again.)
>
> NOW PUT YOUR FINGER ON THE FAN. WHICH LETTER MAKES A SOUND THAT YOU HEAR IN THE WORD FAN? IS IT m OR IS IT s OR IS IT n (pointing to each letter and saying the sound)? (Children say n.) GOOD. NOW PUT AN X ON THE LETTER THAT MAKES THE SOUND n. (Make sure that children have correctly marked the books.)
>
> NOW TURN TO THE NEXT PAGE, WITH TWO LIONS AT THE TOP.
>
> FIND THE PICTURE OF THE DOLL. PUT AN X ON THE LETTER THAT STANDS FOR A SOUND THAT YOU HEAR IN THE WORD DOLL. (Repeat if necessary.)

Continue with questions 2 through 12 in the same manner as with #1 (DOLL). The pictures are of:

2. CAR
3. MOP
4. CUP
5. BOOK
6. HAMMER
7. LEAF
8. WAGON
9. QUEEN
10. HOUSE
11. CHAIR
12. FRUIT

When the children have finished, say:

NOW PUT YOUR PENCILS DOWN.

Objective 3: Associate a picture with the word to which the picture refers.

Materials: Examiner's Manual
Test Booklet, pages 9-10
Blackboard and chalk, or large paper and marker

Directions: Put on the board or paper:

boat car train

Hold up a test booklet open to the page with the elephant on the top and say:

> TURN TO THE PAGE WITH THE ELEPHANT ON TOP.

Make sure everyone is on the correct page and say:

> NOW LOOK AT THE FIRST ROW. THERE IS A PICTURE OF A BOAT. PUT YOUR FINGER ON THE BOAT. (Check to see that all have done so.)
>
> NOW LOOK AT THE BOXES OF WORDS NEXT TO THE BOAT. THEY ARE LIKE THE ONES I HAVE UP HERE. (Point to the words on the board or paper.)
>
> THE WORD THAT SAYS BOAT IS THIS ONE. (Point to the word on the board.) PUT YOUR FINGER ON THE WORD BOAT. (Check to see that all have done so.)
>
> GOOD. NOW PUT AN X ON THE WORD BOAT JUST AS I AM DOING UP HERE. (Put an X on Boat.) WE PUT AN X ON THE WORD BOAT BECAUSE IT NAMES THE PICTURE. THE OTHER WORDS ARE CAR AND TRAIN (point to the words as you say them). THEY DO NOT NAME THE PICTURE SO WE DO <u>NOT</u> PUT AN X ON THEM.

NOW GO ON AND DO THE REST OF THIS PAGE AND THE NEXT PAGE. FIND THE WORD THAT NAMES EACH PICTURE. (Repeat directions as necessary.)

Walk through the class making certain that the children are working on the correct pages Allow as much time as necessary for completion.

When the children are finished say

NOW PUT YOUR PENCILS DOWN.

Objective 4: Identify a written sentence with the same sentence read aloud.

Materials: Examiner's Manual
Test booklet, pages 11-12

Directions: Hold up a test booklet open to page 11 and say:

> TURN TO THE PAGE WITH THE TURTLE ON THE TOP.

Make sure everyone is on the right page and say:

> FIND THE BOX WITH THE FLOWER AT THE TOP OF THE PAGE. PUT YOUR FINGER ON THE FLOWER. NEXT TO THE FLOWER THERE ARE THREE SENTENCES. ONE SENTENCE SAYS "THAT IS A DOG". PUT YOUR FINGER ON THE SENTENCE THAT SAYS "THAT IS A DOG". (Check to see that all have done this.) GOOD. NOW PUT A LINE THROUGH THE SENTENCE THAT SAYS "THAT IS A DOG". (Check to see that the children do this. If necessary, demonstrate with a blank booklet.)
>
> NOW, FIND THE BOX WITH THE MOON. PUT YOUR FINGER ON THE MOON. WHICH SENTENCE SAYS "THE GIRL WILL RUN"? PUT A LINE THROUGH THE SENTENCE THAT SAYS "THE GIRL WILL RUN". (Repeat instructions as necessary.)

Continue with items #2 through 5, reading each sentence as with #1. The sentences are:

2. He can go fast.
3. They went on over, not under.
4. Could that many big ones be full?
5. Where would they go if it were empty?

When the children have completed the items, say:

NOW PUT YOUR PENCILS DOWN.

Objective 5 Identify a picture that represents the meaning of a short sentence.

Materials: Examiner's Manual
Test Booklet, #1-7, pages 13-14

Directions: Hold up a test booklet open to page 13 and say:

TURN TO THE PAGE WITH THE FROG ON THE TOP.

Make sure everyone is on the correct page. Then point to the words inside the first arrow-shaped outline and say:

READ THE WORDS IN THE BIG ARROW TO YOURSELF. NOW LOOK AT THE PICTURES NEXT TO THE WORDS. THERE'S A BLACK CAT, A WHITE CAT, A BLACK CAR, AND THE BACK OF A WHITE CAT. (Point to each choice.) WHICH PICTURE GOES BEST WITH THE WORDS IN THE ARROW? (Children answer "black cat.") GOOD. THE WORDS SAY "SEE THE BLACK CAT." PUT A BIG X ON THE PICTURE OF THE BLACK CAT.

Make sure everyone has marked the black cat. Go over the example again if necessary. Then say:

LET'S DO ALL THE REST OF THE ARROWS. READ THE WORDS IN EACH ARROW TO YOURSELF. LOOK AT THE PICTURES NEXT TO THE WORDS. THEN PUT AN X ON THE PICTURE THAT SHOWS WHAT THE WORDS ARE SAYING. NOW READ THE WORDS IN THE NEXT ARROW TO YOURSELF, AND PUT AN X ON THE PICTURE THAT GOES BEST WITH THE WORDS.

Repeat the instructions as necessary. When the children have completed all 7 questions, say:

NOW PUT YOUR PENCILS DOWN.

Key

CRT3
#806

PRIMARY READING

Pupil's Name ______________
(First Name, Initial of last Name)

Grade ______

Teacher's Name ______________

Date ______________

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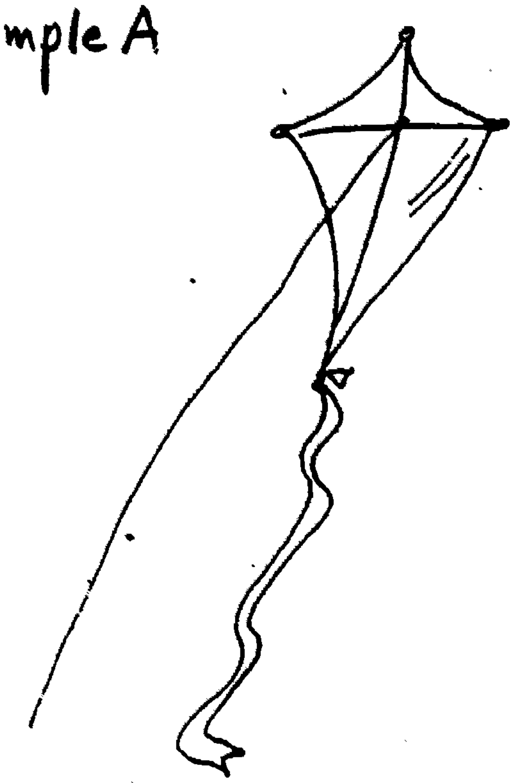
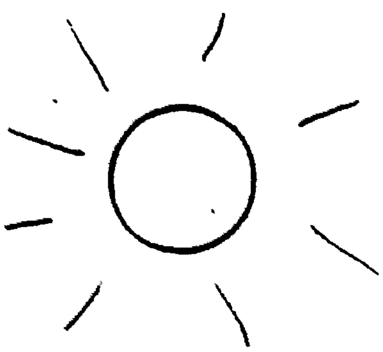
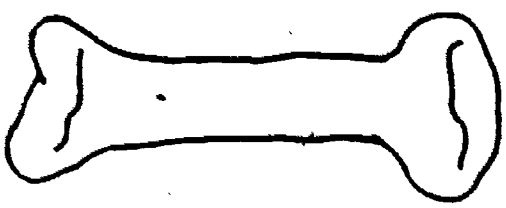
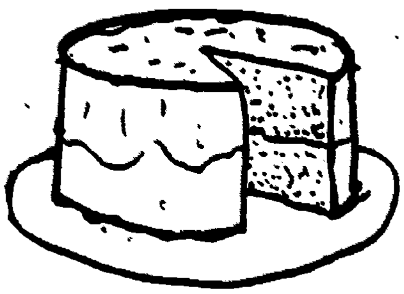
Sample A 	~~i~~	a	u
Sample B 	oo	~~u~~	i
1. 	u	a	~~o~~

2. 	o	~~a~~	i
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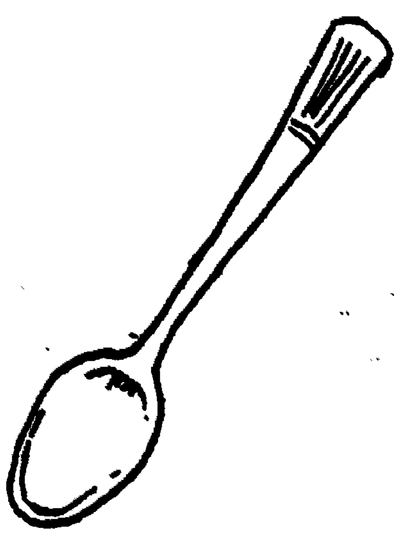
4. 	oa	ou	~~oo~~

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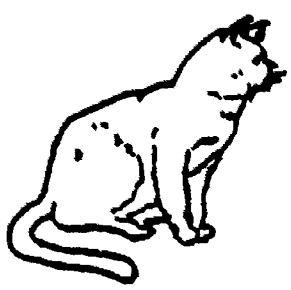
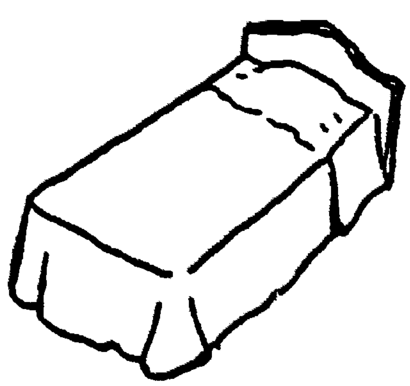
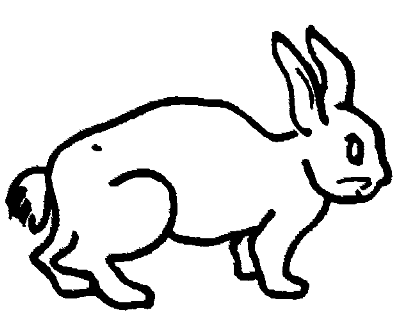
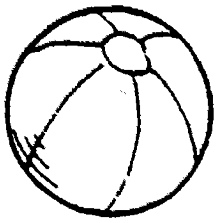
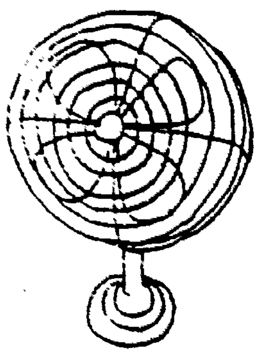
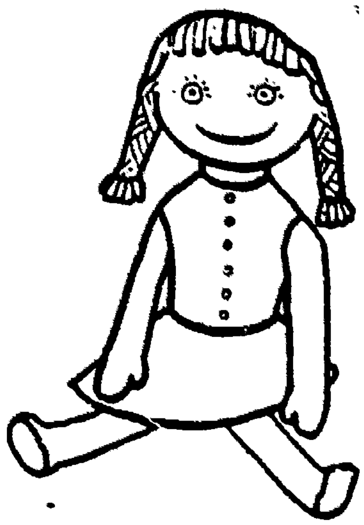
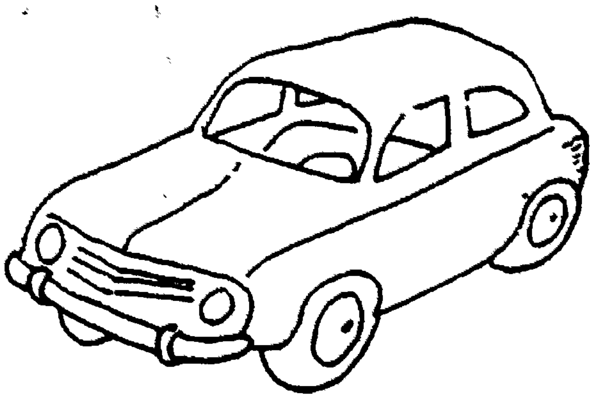
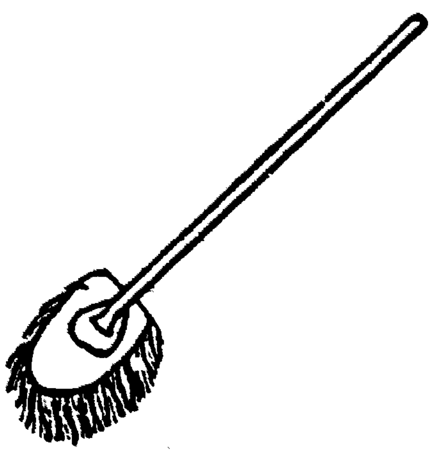
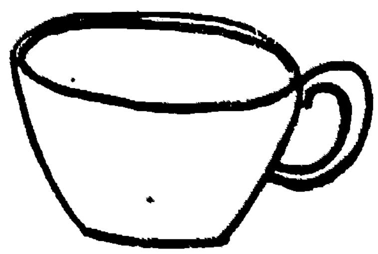
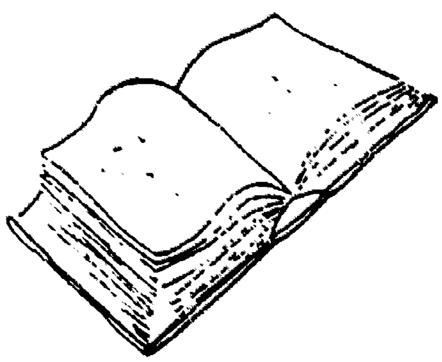
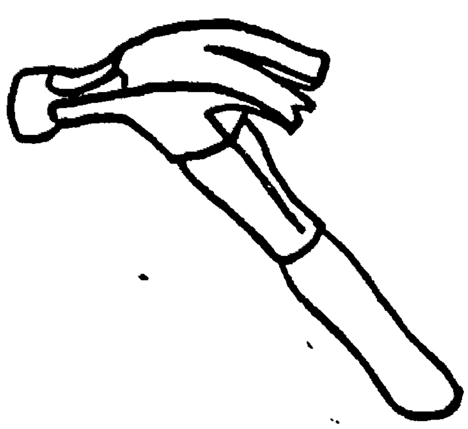
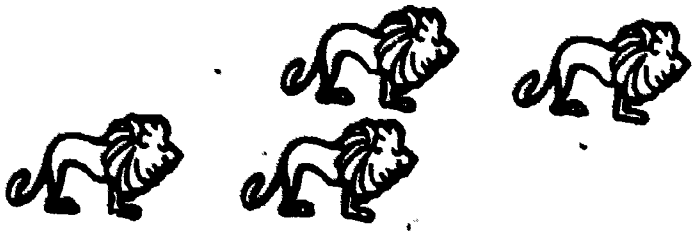
6. 	~~o~~	e	i
7. 	u	i	~~e~~
8. 	~~i~~	u	o

Sample A 	f	~~b~~	c
Sample B 	m	s	~~n~~

1. 	t	p	~~d~~
2. 	~~r~~	w	l
3. 	n	~~m~~	r

4. 	y	t	~~c~~
5. 	d	~~k~~	f
6. 	~~h~~	k	n



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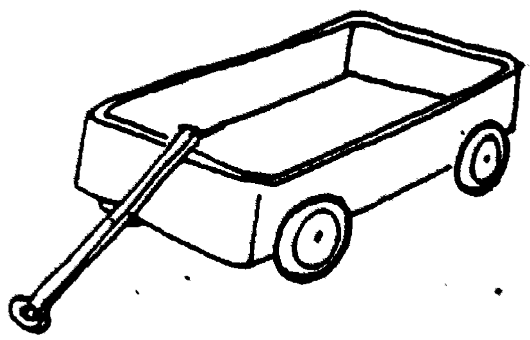
8. 	~~w~~	m	v
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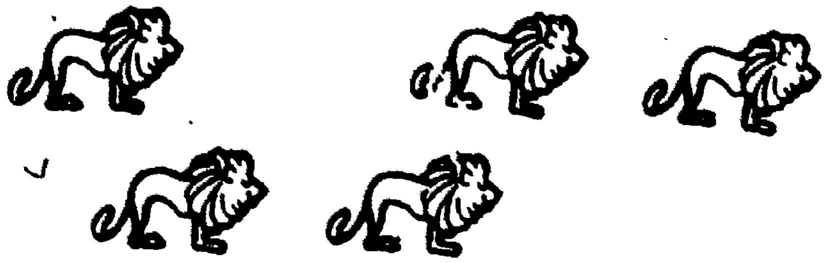
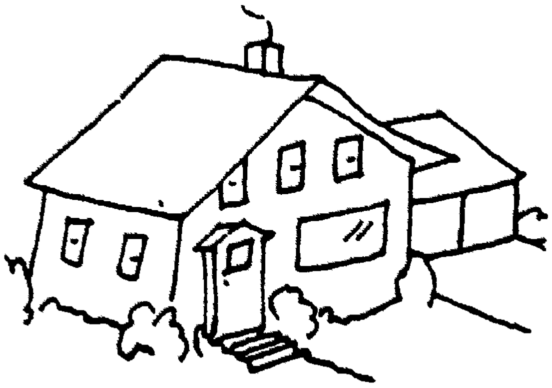
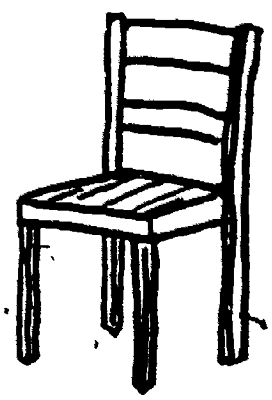
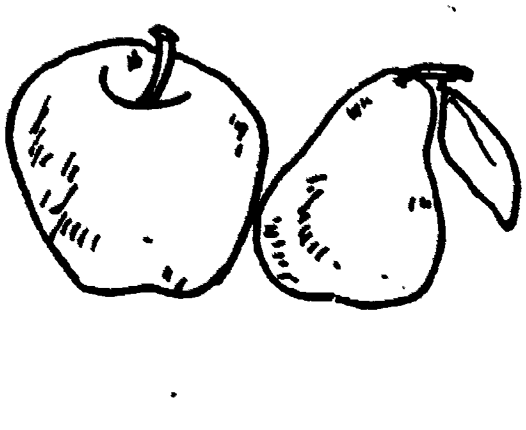
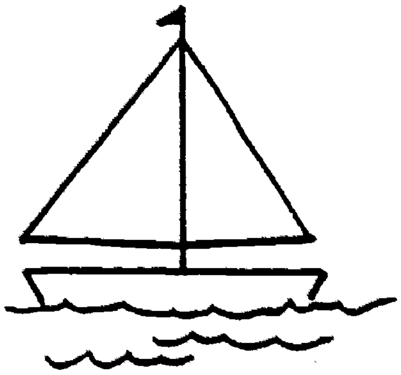
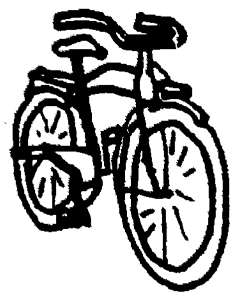
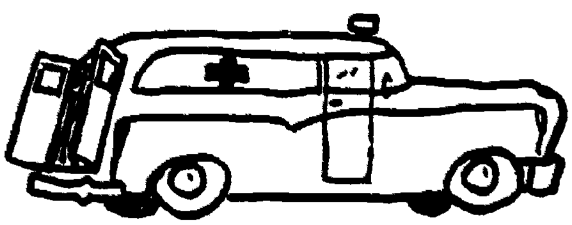
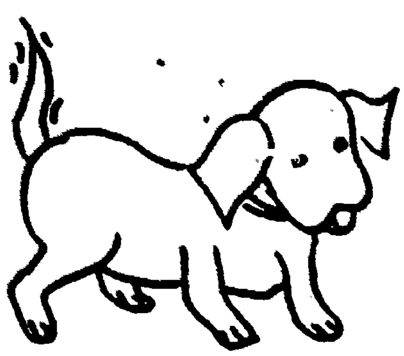
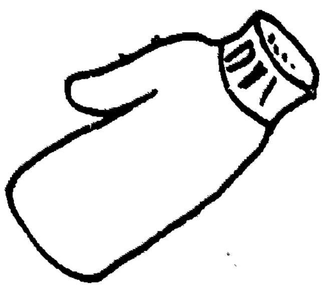
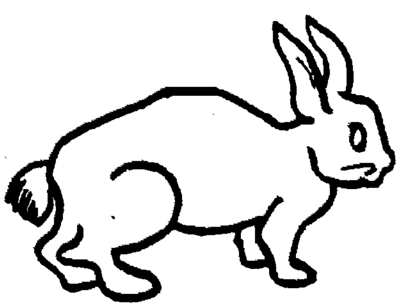
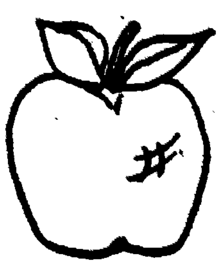


10. 	ay	~~ou~~	ie
11. 	~~ch~~	th	wh
12. 	sh	tr	~~fr~~

Sample 	~~boat~~	car	train
1. 	basket	~~bicycle~~	biscuit
2. 	applesauce	amber	~~ambulance~~
3. 	party	daddy	~~puppy~~

4. 	mattress	matches	mansions
5. 	mitten	milkman	million
6. 	better	rubbers	rabbit
7. 	happy	address	apple
8. 	pitching	pitcher	pitched

Sample:

There is a hat.

That is a dog.

The cow is big.

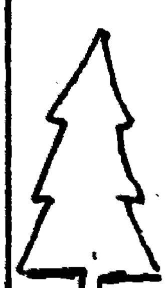
1.

The grill was red.

They grow well done.

~~The girl will run.~~

2.



~~He can go fast.~~

Her car goes last.

His cat got left.

3.

They want no oven, nor a door.

Then won't Ron love her, or adore?

~~They went on over, not under.~~

4.

Cold things make bites only be small?

~~Could~~ that many big ~~ones be full?~~

Called thin man, Bill won by a fall?

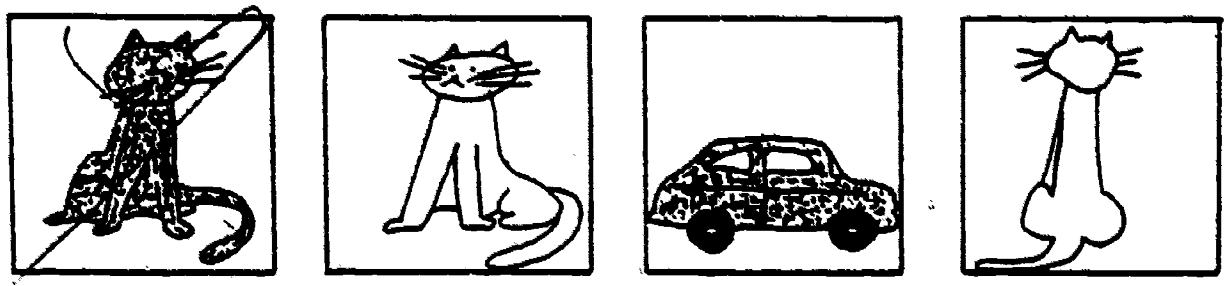
5.

~~Where would they go if it were empty?~~

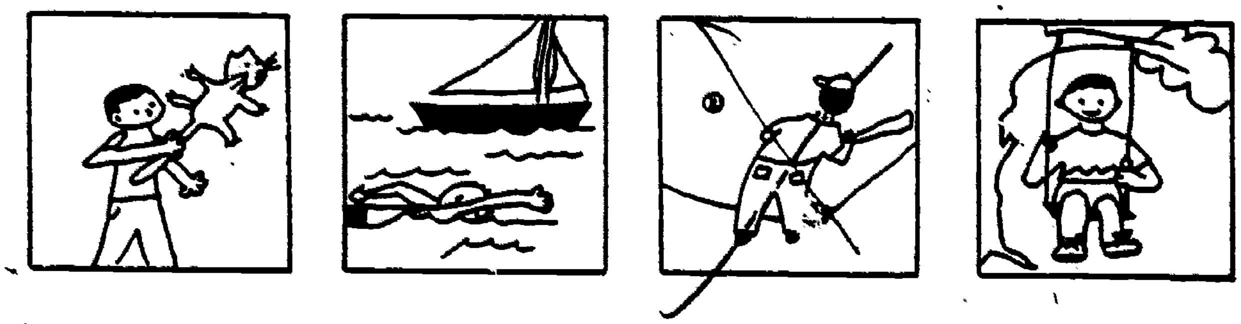
Here wood things got fixed with putty?

What would the goat find at her end, tea?

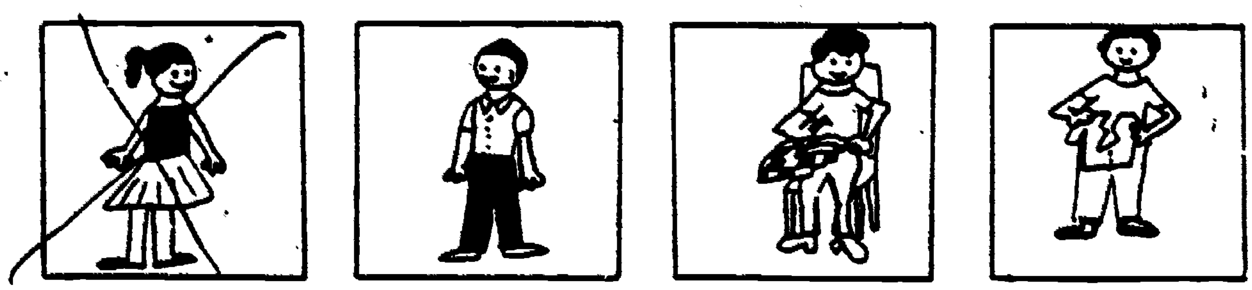
1 See the black cat.



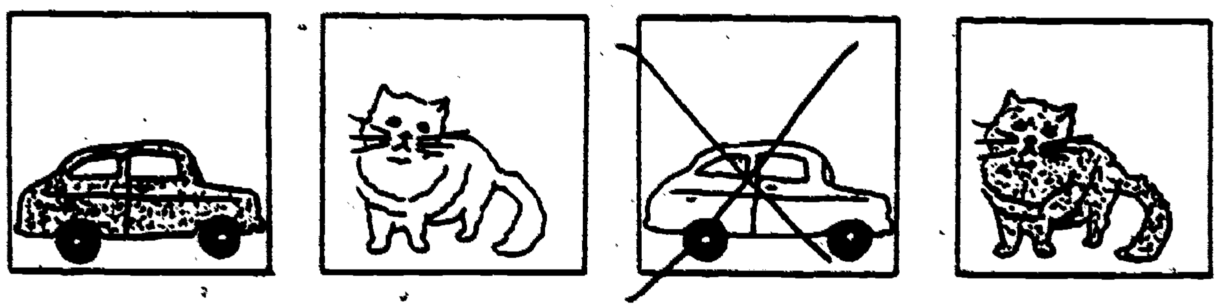
2 He swings the bat.



3 She is wearing a skirt.

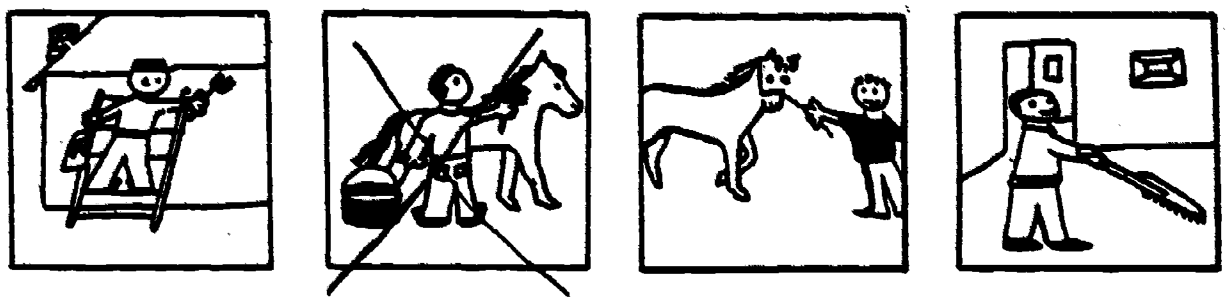


4 The car is white.



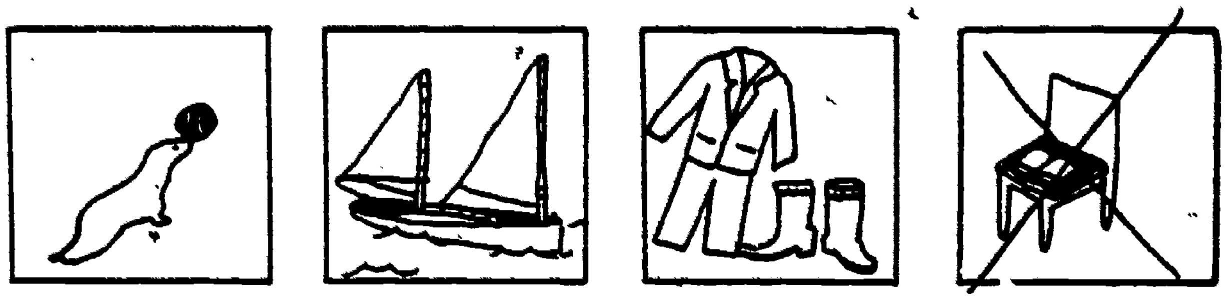
5

He is cleaning the horse.



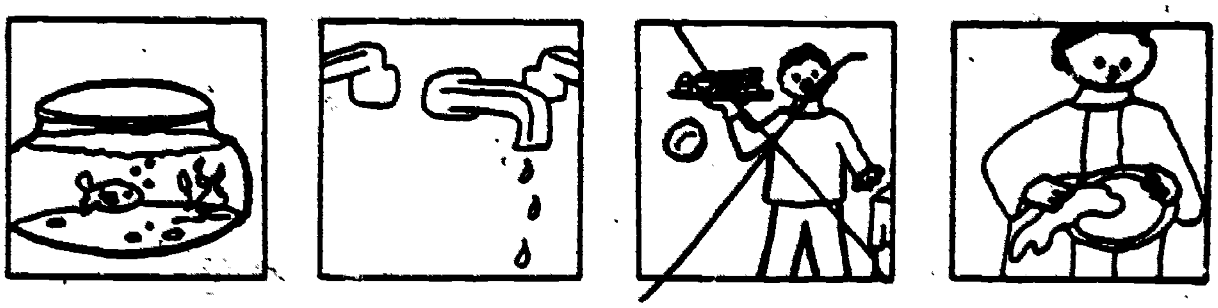
6

The book is on the seat.



7

The waiter drops a dish.



TO THE TEACHER

We are asking that you give three "Checkups" for the PLATO Program:

CHECKUP A	(Whole Numbers)
CHECKUP B	(Fractions)
CHECKUP C	(Graphs)

30 minutes is the estimated time for each checkup. To prevent student fatigue, we suggest that the checkups be administered separately with at least a few hours between them. They should be given in the order A, B, and C. Checkup C will be new to most students, particularly the problems toward the end. Therefore, it might alleviate concerns if you tell them to do their best, but not to be concerned if some of the problems are not familiar. The following directions should be read for Checkup A and repeated less formally for Checkups B and C.

> Fill in your first name and last initial, my name [or teacher's name, if you are not the teacher], and our grade on the cover. Do not start until I tell you to turn to page 1. [After a suitable time, say:] This is a checkup test. A few of the problems in it may not seem familiar to you. You will have about 30 minutes to work on the questions, so do not spend too much time on any one question. The space to the right of each page is for scratchwork. Write your answers clearly on the line or in the place indicated. If you finish before time is called, check your work. Now turn to page 1 and begin.

Note the starting time, as we would like to know how long it takes for most students to finish each checkup. Walk around the room occasionally and when it appears that most have finished say:

> THAT'S ALL FOR NOW.

Collect the checkups and, when the three checkups have been administered, return both used and unused checkups to Carol Wardrop.

The attached sheet can be used to indicate the working time required for each checkup and other comments which you feel will assist in modifying the checkup problems. We appreciate your assistance in this phase of the project.

COMMENT SHEET

Teacher's Name ____________________

School ____________________

Grade ____________________

Checkup A   Working time: ________ minutes

Comments:

Checkup B   Working time: ________ minutes

Comments:

Checkup C   Working time: ________ minutes

Comments:

CHECKUP A

YOUR NAME ________________
(First name + initial of last name)

YOUR TEACHER'S NAME ________________

GRADE ________________

CHECKUP A

Work each of these problems.

1.
$$\begin{array}{r} 650 \\ -\quad 1 \\ \hline \end{array}$$

2.
$$\begin{array}{r} 399 \\ +\quad 2 \\ \hline \end{array}$$

3. There are 8 mints in a pack
How many mints are in 10 packs? ____________

4. Write the number
two hundred ten thousand,
eighty-six. ________________________

Here is a way to make 17:

$17 = 2 \times 4 + 9$

Make 17 two other ways.

5. 17 = ________________

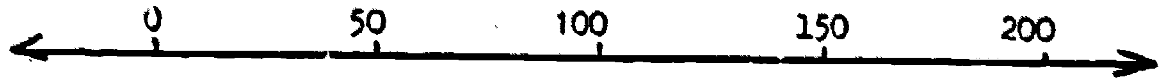
6. 17 = ________________

Fill in the blanks to make two names for 9.

7. 9 × ________ = 9

8. 20 + ________ - ________ = 9

9. Put an X on the number line to show where 40 is.



10. Put an O on the number line to show where 109 is.

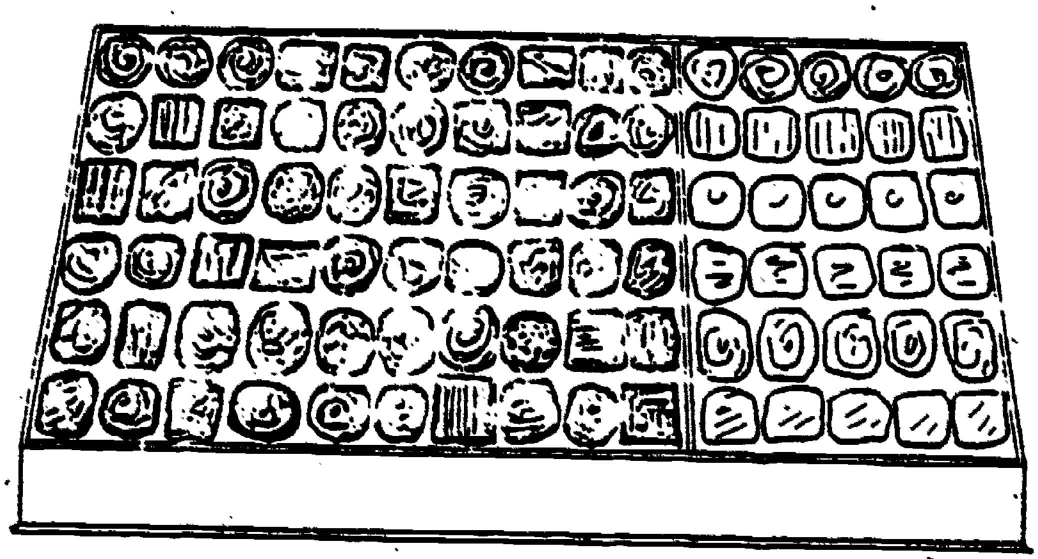
11. Three girls go shopping. Each has a quarter, a dime, and a penny. How much money do the girls have altogether? ________

12. In Mrs. Green's classroom, there are 4 rows of desks, with 6 desks in each row. The students moved their desks in the room.

Now there are 8 rows of desks with

________ desks in each row.

13. Write a number sentence that tells that 8 fours equal 32. ________________



14. Write an arithmetic sentence that tells how many pieces of candy are in the box above.

____

15. Draw a picture with dots that shows that
$7 \times 3 = 21$

There are 48 cookies and 6 children.
You want to share all the cookies equally among the children.

16. Write an arithmetic problem that tells how many cookies each child should get.

____

17. How many cookies will each child get? ________________

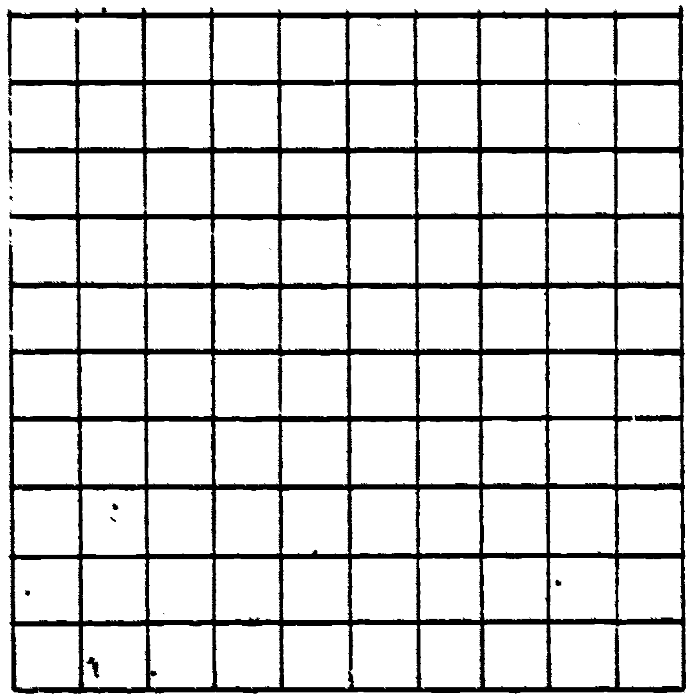
18. If you have 86¢, what is the greatest number of nickels you could have? ________

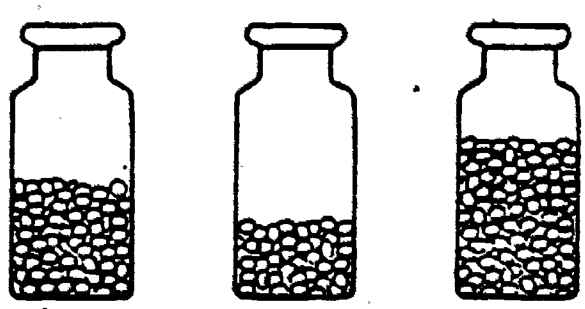
What is the greatest number of dimes you could have? ________

19. I am thinking of a number.
If you add 27 to my number, you get 158. Write a number sentence for this.

____

20. Use these squares to draw a rectangle that has an area of 16 squares.





300 Beans | 215 Beans | 425 Beans

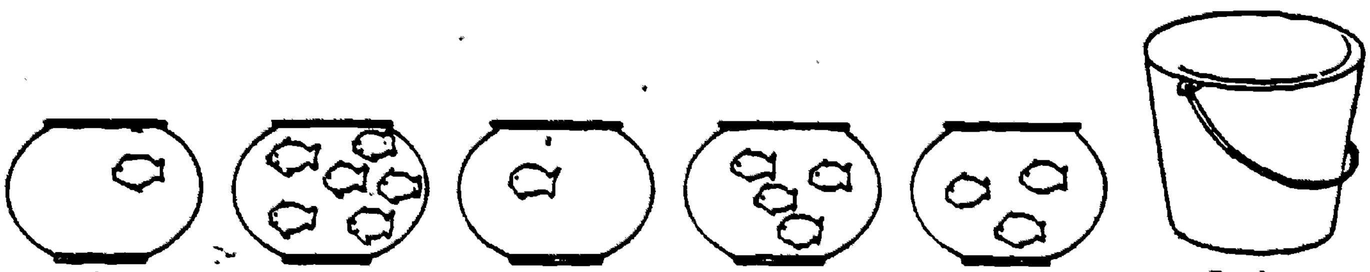
21. If you put all the beans from jar A into jar B, then which jar will have more--jar B or jar C? ________

How many more? ________

22. $8 \times 17 = 136$
$16 \times 17 = 272$

$24 \times 17 =$ ________

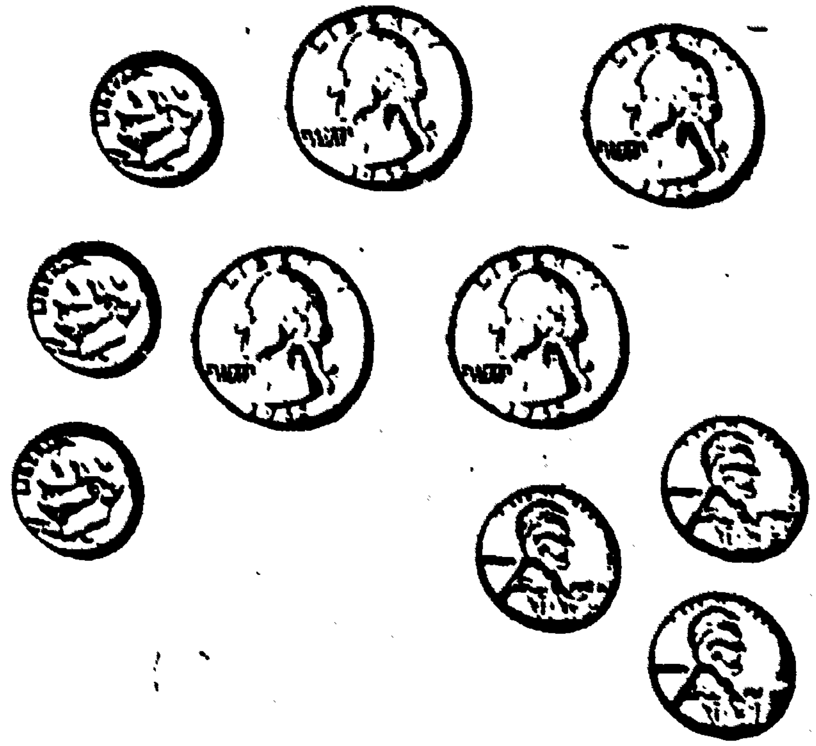
23. If 48×16 is 768, how much is 49×16 ? ________________



24. These bowls have goldfish in them. Fred empties all the bowls into a pail. Then he puts all the fish back into the bowls, so that each bowl has the same number of fish.

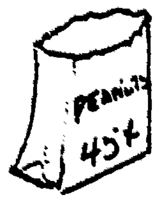
Now how many fish are in each bowl?

____



25. This is the money you have in your pocket

You want to buy these 2 things.



How much do the candy and peanuts cost altogether? ____________

Draw a ring around the coins that you would give the store owner.

How much change should the store owner give you ? ____________

THAT'S ALL FOR NOW!

CHECKUP B

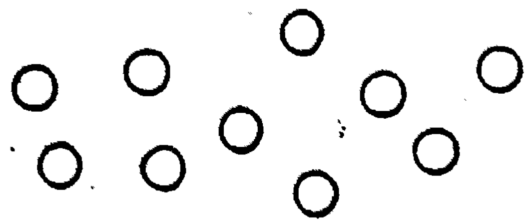
YOUR NAME ______________________
(First name + initial of last name)

YOUR TEACHER'S NAME ______________________

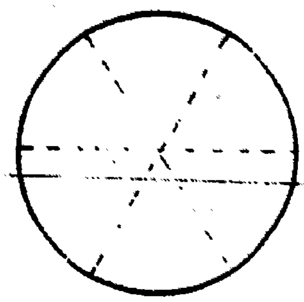
GRADE ______________________

CHECKUP B

1. Fill in $\frac{1}{5}$ of these circles.



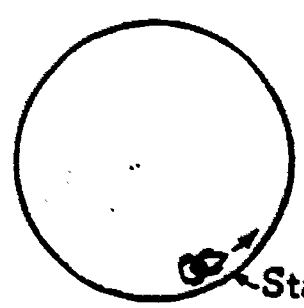
2. Color $\frac{2}{3}$ of the pie.

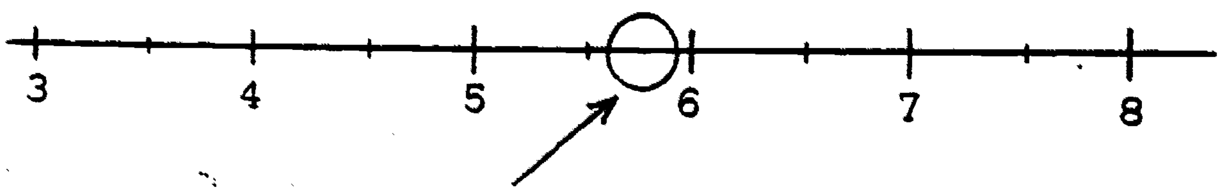


3. How many fourths of a pie make $1\frac{1}{2}$ pies? ________

4. Write a mixed number name for $\frac{8}{3}$. ________

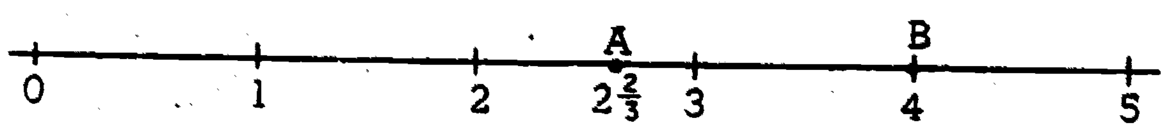
5. The race car goes $\frac{5}{8}$ of the way around the track. Put an X where the car will end up.





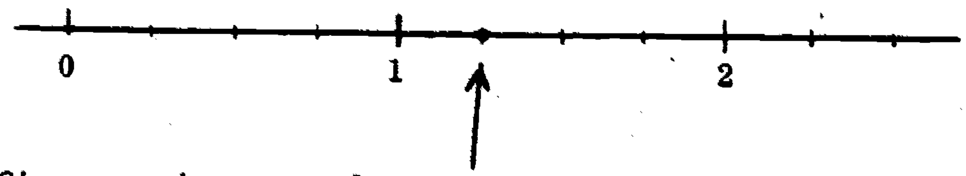
6. Name a point inside this circle.

7. Write another fraction that is a name for $\frac{2}{5}$. ________



8. How far is it from A to B? ________

9. Five girls share 3 cupcakes fairly.
What fraction of a cupcake does each
girl get?



10. Give a number name for this point. ________

11. Name a number that is between $1\frac{4}{5}$ and 2.

12. Draw $\frac{7}{4}$ of a pie.

13. $\frac{1}{2} \pm \frac{4}{5} =$

14. $$\begin{array}{r} 2\frac{2}{3} \\ +3\frac{2}{3} \\ \hline \end{array}$$

15. $1 - \frac{1}{7} =$

16. $\begin{array}{r} 2\frac{1}{2} \\ -\ \frac{3}{4} \\ \hline \end{array}$

17. $\frac{4}{3} \times \frac{2}{5} =$

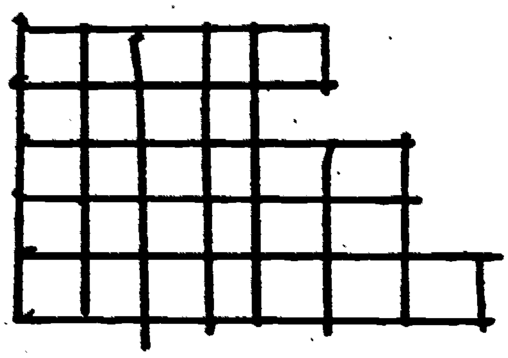
18. $\frac{1}{3} \times 6\frac{1}{2} =$

19. $3 \div 27 =$

20. Draw a picture to show that $\frac{1}{2} \times \frac{1}{3} = \frac{1}{6}$.

THAT'S ALL FOR NOW!

CHECKUP B



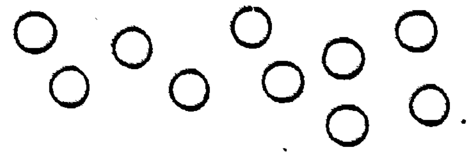
Your Name ______________________

Your Teacher's Name ______________________

Grade __________

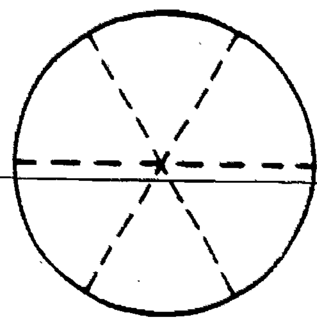
Date __________

1 Fill in $\frac{1}{5}$ of these circles.



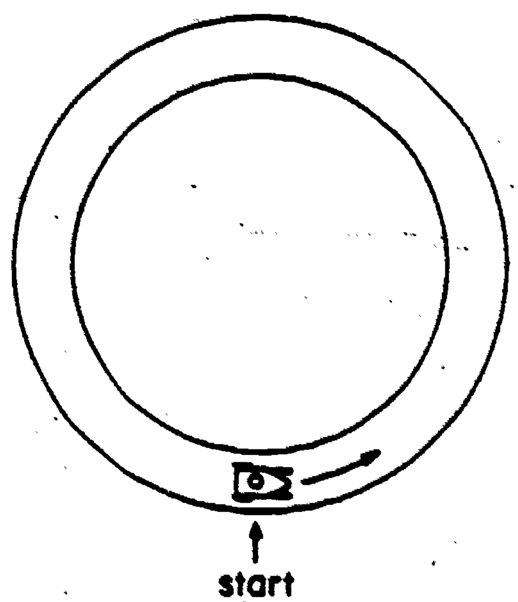
2. How many fourths of a pie make $1\frac{1}{2}$ pies? ________

3. Color $\frac{2}{3}$ of the pie.

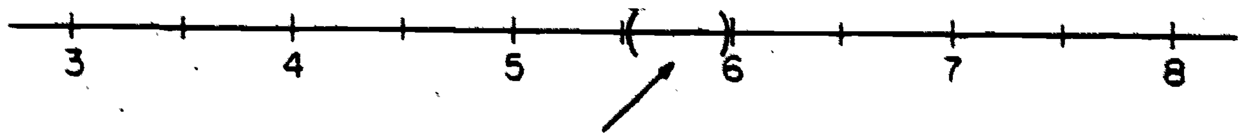


4. Write a mixed number name for $\frac{8}{3}$. ________

5. The race car goes $\frac{5}{8}$ of the way around the track. Put a dot where the car will end up.



6

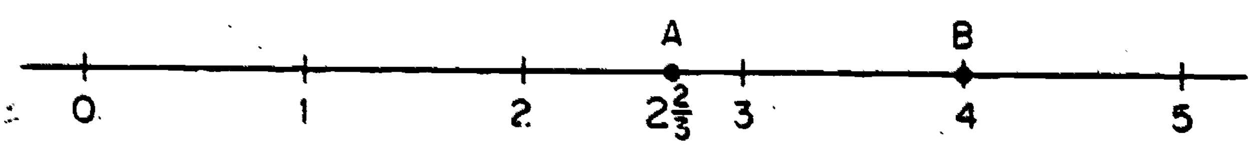


Give a number name for a point that is between the brackets.

Write the name on this line. ______

7 Write another fraction that is a name for $\frac{2}{5}$. ______

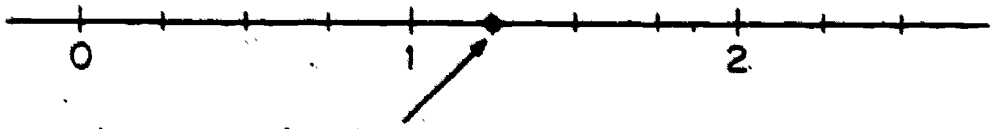
8.



How far is it from A to B? ______

9. Draw $\frac{7}{4}$ of a pie.

10.



Give a number name for this point. ________

11.

$$\begin{array}{r} 2\frac{2}{3} \\ +\ 3\frac{2}{3} \\ \hline \end{array}$$

12. Five girls share 3 cupcakes equally.

What fraction of a cupcake does each girl get? ________

13. Circle each fraction that is a name for $\frac{7}{2}$.

$\frac{14}{10}$ $\frac{2}{7}$ $\frac{14}{4}$ $\frac{21}{6}$ $\frac{2}{20}$ $\frac{1}{2}$

14.

$\frac{1}{2} + \frac{4}{5} =$

15. Name a number that is between $1\frac{4}{5}$ and 2. ________

16. Circle each number that is a name for 3.

$2\frac{2}{2}$ $\quad 2\frac{7}{4}$ $\quad 1\frac{10}{5}$ $\quad 0\frac{3}{3}$ $\quad \frac{18}{6}$ $\quad 3\frac{0}{4}$

17. $4 - \frac{1}{7} =$

18. $\frac{4}{3} \times \frac{2}{5} =$

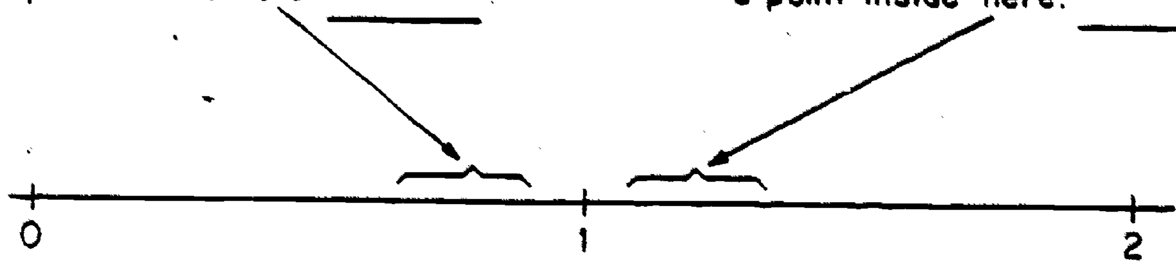
19.
$$\begin{array}{r} 2\frac{1}{2} \\ -\ \frac{3}{4} \\ \hline \end{array}$$

20. $\frac{1}{3} \times 6\frac{1}{2} =$

21. $1\frac{1}{5} \times 10 =$

22. Use a decimal number to name a point inside here. ______

23. Use a decimal number to name a point inside here. ______



24. Name a number between 1.6 and 1.7 ______

25. Write .53 as a fraction. ______

Write each of these numbers as a decimal:

26. $3\frac{3}{10}$ = ______

27. $5\frac{7}{100}$ = ______

28. $\frac{15}{100}$ = ______

THAT'S ALL FOR NOW!

CHECKUP C

YOUR NAME ______________________

YOUR TEACHER'S NAME ________________

GRADE ______________________________

DATE _______________________________

CHECKUP C

For each problem on this page, put a number in the box to make the sentence true.

1. $\square - 5 = 5$

2. $(3 \times 0) + 4 = \square$

3. $(3 \times 4) + \square = 18$

4. $(3 \times \square) + 2 = 5$

5. $\square - 7 = {}^{-}3$

6. $2 - 5 = \square$

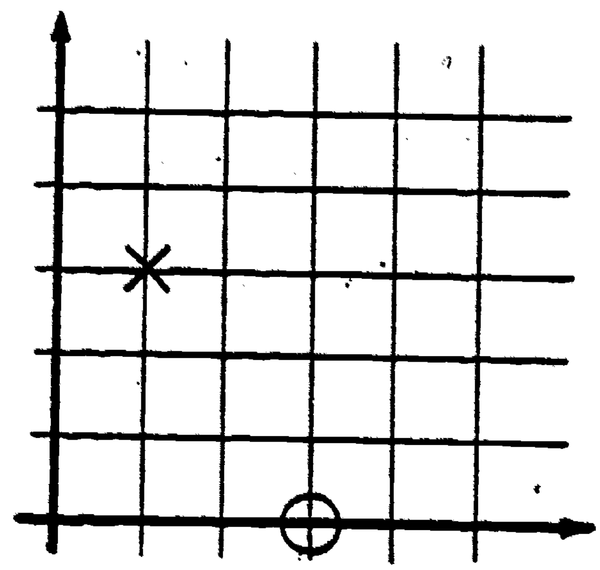
7. $3 - \square = {}^{-}1$

8. ${}^{-}8 + 5 = \square$

9. ${}^{-}9 - 2 = \square$

10. ${}^{+}2 \times {}^{-}3 = \square$

11. Write the two numbers to locate the X.

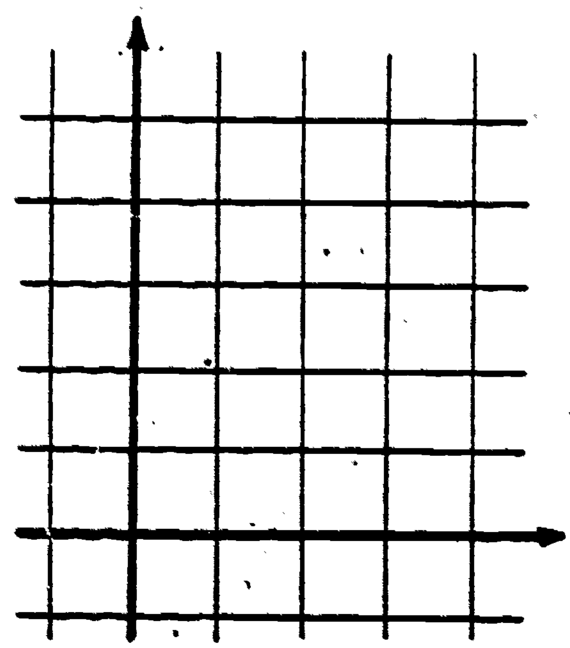


____

12. Write the two numbers to locate the O.

____

13. Mark the point (4, 2) with an X.



14. Mark the point (-1, 0) with an O.

15. Put a 3 in each □ below. Then put a number in the ⬡ that makes the sentence true.

$$(\square \times \square) + 2 = ⬡$$

16. In the table below, write the missing number so that all the pairs are true for one rule.

□	⬡
1	2
2	5
3	8
4	
5	14

17. Complete the following table so that each pair will make this sentence true:

$$\left(2 \times \square\right) + 5 = \hexagon$$

□	⬡
0	
1	
2	
3	

18. In the table below, write 4 true pairs for this rule:

$$\left(5 \times \square\right) + 4 = \hexagon$$

□	⬡

19. The O graph is $\left(2 \times \square\right) + 5 = \hexagon$. What is the open sentence for the X graph? $\left(\underline{\qquad\quad} \times \square\right) + \underline{\qquad\quad} = \hexagon$