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AUTHOR	Hofstetter, Fred T.
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ABSTRACT

A brief history of the Delaware PLATO project and descriptions of new developments in facilities, applications, user services, research, evaluation, and courseware produced since the Third Summative Report (1978) are provided, as well as an overview of PLATO applications at the University of Delaware. Sample lessons, illustrations, and activity summaries are presented for the 27 departments currently using PLATO and seven pre-college applications sponsored by the project; new sites of development in psychology, nursing, and physical education are indicated; and applications recently begun in biology, sociology, health education, and microprocessor implementations are described. The use of a standard questionnaire to gather student opinions about PLATO is described, and a copy of the questionnaire is included. Program growth is discussed in terms of the number of on-campus terminals, the capacity of the central computer, and the addition of new staff members. Brief abstracts summarize faculty research in the areas of perception, student achievement, and programming strategies, and a catalog of programs currently under development is appended. (BK)

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Fourth Summative Report of the Delaware PLATO Project

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BY

FRED T. HOFSTETTER

JULY 1, 1979

udplato®

University of Delaware
PLATO Project

IR009346

Outline History of the Delaware PLATO Project

Fall, 1974
- PLATO Project established following deliberations of the university's Computer Applications to Education Committee

Spring, 1975
- First authoring terminal installed
- Coordinating committee of faculty members from 17 academic areas formed to demonstrate system
- Three student assistants hired
- Author training seminars begun
- Proposals from university departments solicited
- 10 departmental proposals submitted:

Agriculture	Home Economics
Art	Music
Computer Science	Nursing
Continuing Education	Physical Education
Education	Sociology

Summer, 1975
- 10 departmental proposals approved
- Eight part-time student programmers hired

Fall, 1975
- Second authoring terminal installed
- Number of departments increased to 14
- First full-time professional programmer/analyst hired

Spring, 1976
- Number of authoring terminals increased to 8
- Proposal for 24 student terminals submitted and approved
- Student programmers increased to 12
- New projects started in:

Communications	Physics
Curriculum and Instruction	Psychology
Languages	Upward Bound

Summer, 1976
- First Summer Institute in Computer-Based Education held for Delaware public school teachers; funded by the Delaware School Auxiliary Association
- Second professional programmer/analyst hired

Fall, 1976
- PLATO classroom established in room 309 Willard Hall Education Building
- Number of terminals increased to 12
- Automatic answering device installed on one port to enable tie-in from anywhere in Delaware
- P.S. DuPont High School received one terminal for an evaluation of the potential of PLATO for urban high schools
- New projects started in Statistics and Theatre

Spring, 1977
- Number of terminals increased to 32
- Six student programmers promoted to Junior Programmer/Analysts
- UDPLATO hosted the 1977 National Convention of the Association for the Development of Computer-Based Instruction Systems
- Faculty Senate held open hearings on PLATO
- New projects established in:

Chemistry	Honors Program
Counseling Center	Professional Services
Economics	Reading Center
Educational Foundations	Speech
French	

- Program established for high school students to use PLATO

Fall, 1977
- Assistant to the Director hired
- Number of terminals increased to 50
- New projects in:

Anthropology	Military Science
English	Writing Center
Mathematics	

- Offices established at 46 East Delaware Avenue
- Project selected as one of 10 exemplary case studies in academic computing by HumRRO
- Dover site established in the Honors Center

Spring, 1978
- New projects in Civil Engineering and Accounting
- New site established in Smith Hall
- Installation of the Delaware PLATO System (CYBER 173), officially accepted on St. Patrick's Day, March 17, 1978
- First outside users signed Participating Institution contracts
- Funding granted by National Science Foundation and Delaware School Auxiliary Association for the second Summer Institute in Computer-Based Education for public school teachers in Delaware and surrounding states
- Aural perception laboratory jointly established with the Psychology Department

Fall, 1978
- New site established in Psychology
- New projects started in Biology and Sociology
- Staff additions of a Senior Electronics Specialist, a User Services Coordinator, and two analyst trainees
- University awarded TAA services contract by the GSA
- Number of terminals increased to 75 on campus
- Central system resource doubled in capacity

Spring, 1979
- New projects in health education and microprocessor implementations.
- New sites in Nursing and Physical Education
- Grants received from the National Science Foundation for projects in Psychology and Chemical Engineering, and for the 1979 Summer Institute in Computer-Based Education for teachers of Mathematics, Chemistry, Physics and Social Science
- Grant received from the Delaware School Auxiliary Association for the 1979 Summer Institute for teachers of biology and business
- Project leaders in Art and Chemistry receive teaching effectiveness awards

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INTRODUCTION

This Fourth Summative Report of the Delaware PLATO Project summarizes work done at the University of Delaware with the Control Data PLATO system from the beginning of the Delaware PLATO Project in March of 1975 through June 30, 1979. Each of the four summative reports which have been published to date contains special emphasis on events during the immediately preceding academic year, and therefore this report concentrates on developments during the 1978-79 academic year. More information on events of previous academic years can be found in prior issues of the summative report, which are available from the Delaware PLATO Project.

During the 1978-79 academic year, new sites were established in Psychology, Nursing, and Physical Education, where the use of PLATO matured to the point at which these departments could justify having PLATO terminals in their own buildings. New applications were begun in Biology, Sociology, Health Education and microprocessor implementations, bringing the number of departments using PLATO to a total of thirty-two. Nearly 100,000 hours of instruction were delivered on the Delaware PLATO system during 1978-79, and additions were made to both the equipment and staff of the Project in order to support this level of utilization. The number of on-campus terminals increased from 50 to 75, and the size of the central computer was doubled in capacity. A Senior Electronics Specialist was added to the staff for the purpose of supervising the maintenance of PLATO terminals and peripherals. A professional User Services Coordinator was also hired in order to coordinate PLATO services for the Project's growing base of outside users.

The level of funding from outside sources increased through five awards. The University was awarded a services contract by the General Services Administration for the support of the PLATO Project in the Federal Aviation Administration. Faculty members in Psychology and in Chemical Engineering received grants from the National Science Foundation for support of their respective projects. The National Science Foundation also provided support for the 1979 Summer Institute in Computer-Based Education for teachers of mathematics, chemistry, physics, and social science, and the Delaware School Auxiliary Association provided support for the 1979 Summer Institute in Computer-Based Education for teachers of agriculture, biology, business and economics. During the 1978-79 academic year, the Project's training curriculum was formally opened to educators and professionals outside the University, and training seminars were held for personnel from the University of Akron, the University of Umeå in Sweden, the University of Brussels, and the University of Amsterdam. This training curriculum is being more widely advertised by means of a brochure describing the training curriculum, copies of which are available from the Delaware PLATO Project office.

The Fourth Summative Report is divided into three main divisions: Project History and Development, Departmental Applications, and Evaluation. Following these is an appendix which contains a catalogue of courseware under development at Delaware. The same level of information will be provided in each section as was provided in the third summative report, except for the evaluation section, where too much work is being done to continue detailed reporting in a reasonable number of pages. Instead of providing detailed reports for each evaluation project, abstracts of the evaluations have been included, along with sources to which the reader may refer for further information. Grateful acknowledgement is made to Professor Ray Nichols of the University's Art Department for producing the photographs used in this report.

CHAPTER I. HISTORY AND DEVELOPMENT OF THE DELAWARE PLATO PROJECT

-Background-

The Delaware PLATO Project originated in the Fall of 1974 during deliberations of the university's computer applications to education committee. The committee planned a series of seminars and demonstrations for the purpose of making available to the Delaware faculty information on how a computer-based educational system may function in a university, and of evaluating what part such a system might play in the future of the university and its supporting community. A major portion of the committee's planning consisted of the review and selection of a computer-based educational system which could support the demonstration. The criteria used in making the selection provide a summary of the reasons why PLATO was chosen for the demonstration. They required that the demonstration system contain:

1) An overall system design which can support many instructional strategies such as gaming, simulations, testing, drill-and-practice, and self-paced programmed instruction.

2) An existing library of demonstration programs encompassing many academic areas.

3) A programming language which is both easy for faculty members to learn, and at the same time powerful enough to support instructional computing.

4) A student record-keeping capability to support educational research in learning behaviors.

5) High-speed interactive graphics for both textual and pictorial displays.

6) A very good overall system reliability.

The first terminal was installed at the university on March 14, 1975. A committee of faculty members selected from seventeen academic areas coordinated demonstrations of PLATO for each of the respective areas, encouraged interested faculty members to enroll in a seven-week seminar on author training, and solicited proposals from each college regarding the implementation of existing courseware and/or the development of new PLATO programs. By the end of May, nine departments had proposed to develop materials and try out PLATO with students.

During the summer of 1975 the proposals were approved, and the university ordered seven additional PLATO terminals to support program development. The first full-time professional PLATO programmer/analyst was hired to teach

PLATO seminars and assist faculty members with difficult programming problems, and eight part-time student programmers were employed to help write programs for individual departments. The project was held back somewhat by the amount of lead time needed to procure the additional PLATO terminals. One terminal was available right away, and was installed in September of 1975. However, the other six took longer to procure and were not installed until February of 1976.

This delay prevented large scale development of PLATO programs during the Fall of 1975, when the two available terminals were used mainly for lesson review, demonstrations, author training, and planning the development of new material. During this period the faculty committee refined its PLATO proposals, and made plans for the first large-scale use of PLATO with Delaware students to begin during the Fall semester of 1976. On February 2, 1976, the committee submitted a proposal requesting the procurement of 24 terminals for student use. On April 28, 1976, this proposal was approved.

During the Spring and Summer of 1976, the faculty continued to prepare materials for student use. Utilization of the eight authoring terminals was high, averaging about sixty hours per terminal per week. PLATO continued to generate new interest, and by the beginning of the Fall semester there were sixteen departments planning to use the student terminals. However, the project was held back again due to the long lead time needed to order terminals and the care which had to be taken in negotiating a fair services contract for the university. In September the project grew to a total of 12 terminals to support both development of programs and student use of PLATO during the Fall semester of 1976. It was not until March 15, 1977, midway into the Spring semester of 1977, that the project reached the desired level of 24 student terminals and 8 authoring terminals.

During the summer and fall of 1977, faculty members began to use PLATO in larger portions of their classes. In addition, the PLATO Project generated new interest in departments which had not previously used PLATO. The number of departments involved increased to a total of twenty-eight, and the average utilization of the thirty-two terminals exceeded sixty hours per terminal per week. In order to serve the dual purpose of reducing the level of frustration in getting to a PLATO terminal by lowering the average number of hours each terminal was used per week, and also to provide some growing room for the departments which had just begun using PLATO, it was decided to increase the number of terminals from thirty-two to fifty in preparation for the spring semester of 1978. Increasing the project to a level of fifty terminals brought the University to a decision point regarding the future of the Delaware PLATO Project, because cost analyses had shown that once the project grew to above forty-eight terminals it would become more economical for the University to purchase its own PLATO system than to lease services by means of long-distance communications lines. Based on the steady growth which the project had enjoyed since its beginning in March of 1975, and based on the encouraging results from controlled evaluations and studies of student opinions regarding the usefulness of PLATO in higher education, the University of Delaware purchased its own PLATO system from the Control Data Corporation.

The University of Delaware Computing Center did an excellent job in preparing for the installation of the machine. A large area in the newly constructed Computing Center was designated for the PLATO system. Power generators were installed, a chilled water system was engineered, and the necessary electrical lines and pipes were put into place for the machine. The system was delivered at the University of Delaware Computing Center on January 31, 1978. After the machine was assembled, powered up, and run through a long series of performance tests and acceptance tests, it was officially accepted on St. Patrick's Day, March 17, 1978.

The Delaware PLATO system uses the latest line of computer hardware offered by the Control Data Corporation. Based on a Cyber 173 mainframe, it was initially configured to serve a load of 100 simultaneous PLATO users, with one central processor, ten peripheral processors, 98,000 60-bit words of central memory, 500,000 words of ECS-II (extended core storage), four dual-density disk drives, two tape drives, and two remote job entry stations.

During the 1978-79 academic year, the number of PLATO terminals on the Delaware campus was increased from 50 to 75, and the Project's outside user base also continued to grow, resulting in the need for enlarging the central system. On October 15, 1978, 32,000 60-bit words of central memory, 500,000 words of ECS-II, and four dual-density disk drives were added to the system resulting in a doubling of its capacity.

The Delaware PLATO system is linked into a worldwide PLATO network which allows Delaware authors to exchange materials and ideas with other users on systems in Minnesota, Illinois, Quebec, and Brussels. Figure 1 shows the hardware configuration of the Delaware PLATO system.

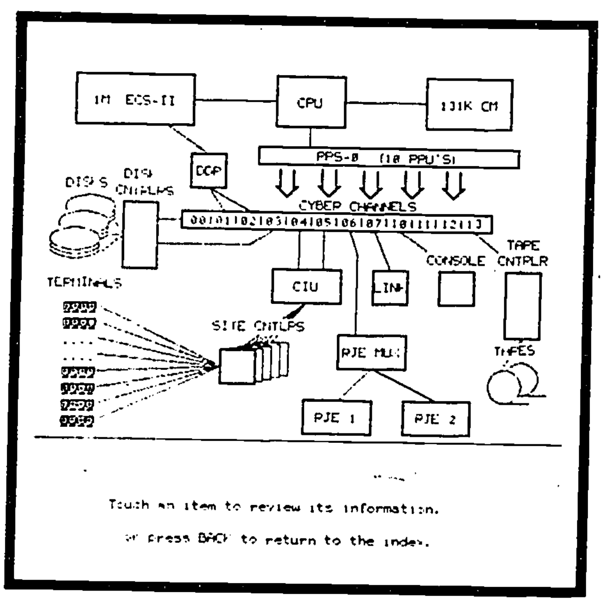


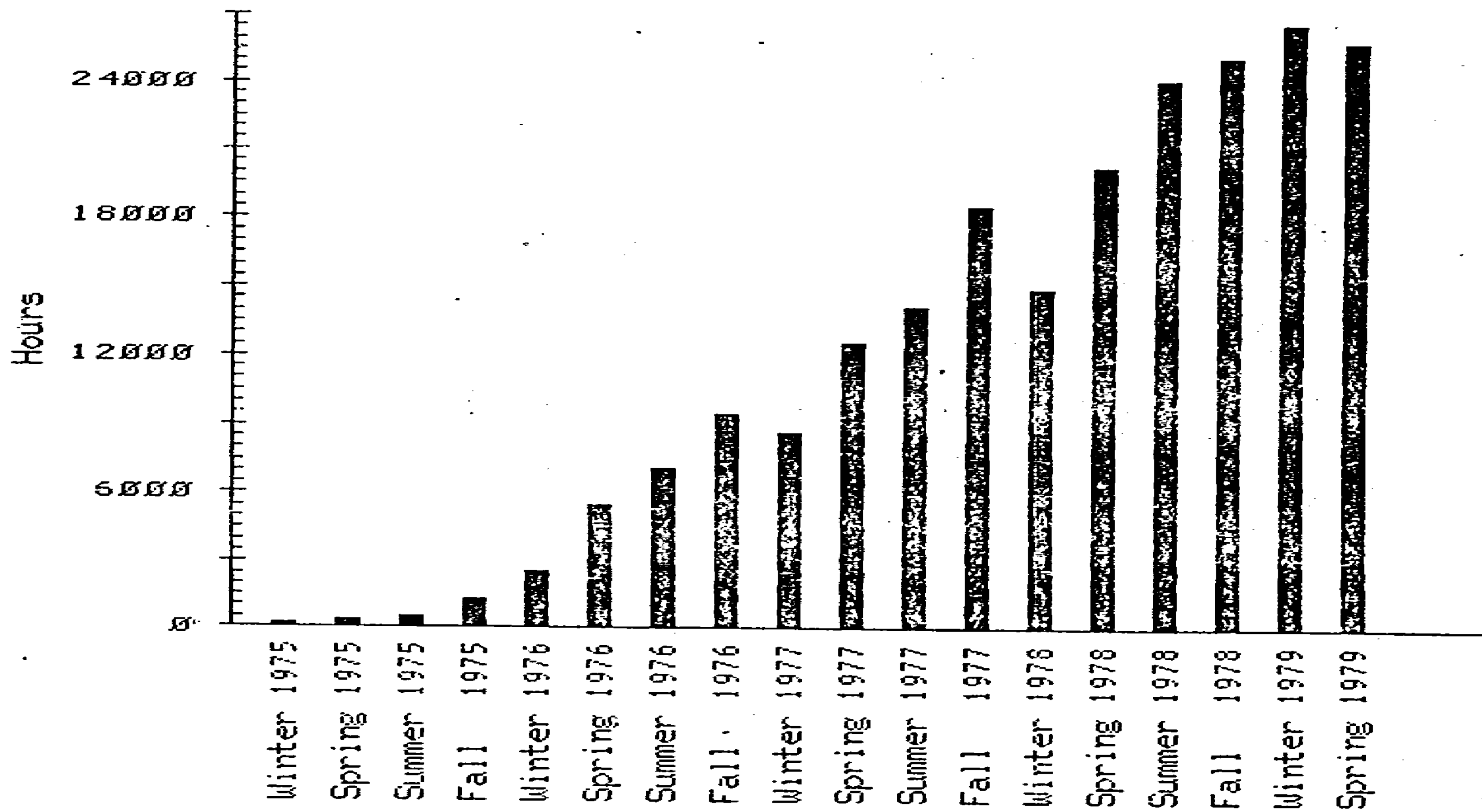
Figure 1. Hardware Configuration of the Delaware PLATO System by Brand Fortner. Copyright © 1978 by the University of Delaware PLATO Project.

-Utilization-

From the beginning of the project there has been a steady rise in the utilization of PLATO at the University of Delaware. Figure 2 shows the growth in terms of hours of terminal usage per quarter. The sharpest rise in utilization occurred during the first two quarters of 1976, when serious development of new programs began. The average utilization tripled during the 1976-77 academic year, when large-scale use by students began. It was at that time that the average utilization rose to over eighty hours per terminal per week. Additional interest shown in PLATO during the 1977-78 academic year produced a level of utilization which was almost twice that of 1976-77. During 1978-79, the level of utilization was fifty percent higher than that of 1977-78. It is interesting to note that the use of PLATO greatly increased during the winter quarter over previous years due to the increased development of PLATO lessons by faculty members in between semesters, and also due to the training sessions held for outside users.

Figure 2.

UNIVERSITY OF DELAWARE QUARTERLY USAGE



The *Third Summative Report of the Delaware PLATO Project* contained a list of sixty courses in which PLATO was used during the 1977-78 academic year. Table 1 of this report shows how the number of courses grew to a total of 102 during the 1978-79 academic year. Column 1 gives the course symbol and number from the University's course catalog. Column 2 contains the descriptive title for the course. Column 3 gives the number of credits. Column 4 shows how many students used PLATO in the course. Column 5 gives the average number of hours each student used PLATO. The last four columns indicate whether the course used PLATO in the summer session, the first semester, the winter session, or the second semester. 4,300 students in 102 courses used PLATO during 1978-79. They accumulated a total number of 22,578 hours spent at PLATO terminals.

Table 1

Courses Using PLATO During 1978-79

Course Symbol and Number	Descriptive Title	Number of Credit Hours	Number of Students	Average Terminal Hours per Student	Time of Utilization			
					Summer	Fall	Winter	Spring
ACC 207	Accounting I	3	58	8.5				X
ACC 208	Accounting II	3	126	6.9	X	X	X	X
ACC 415	Advanced Accounting	3	89	2.5				X
ACC 551	Financial Accounting	3	93	24.6		X		X
AGE 101	Introduction to Agricultural Engineering Technology	3	41	5.5		X		
ALL 267	Technical and Scientific Terminology	1-2	38	15.3				X
ANT 101	Introduction to Social and Cultural Anthropology	3	58	1.4				X
APS 101	Introduction to Animal Science	4	15	4.8		X		
APS 133	Anatomy and Physiology	4	97	7.3		X		
APS 134	Anatomy and Physiology of Domestic Animals	4	100	5.3				X
APS 300	Animal & Plant Genetics	3	2	.5				X
APS 310	Animal & Plant Genetics PLATO	1	25	4.5				X
ART 121	The Design Process	3	24	3.9		X		
ART 200	Typography	3	70	15.0	X	X		
ART 210	Basic Illustration	3	34	2.7				X
ART 303	Visual Design and Communication	3	37	9.8		X		

Table 1 (Continued)

Courses Using PLATO During 1978-79

Course Symbol and Number	Descriptive Title	Number of Credit Hours	Number of Students	Average Terminal Hours per Student	Time of Utilization			
					Summer	Fall	Winter	Spring
BIO 313	Lab for Genetic & Evolutionary Biology	1	134	6.0		X		
BIO 313	Honors: Lab for Genetic and Evolutionary Biology	1	16	4.7				X
C 100	Chemistry & Human Environment	3	44	3.9		X		
C 104	General Chemistry	4	15	1.0				X
C 111	General Chemistry	3	154	6.0		X		
C 213	Elementary Organic Chemistry	4	50	4.2			X	X
CHE 231	Introduction to Chemical Engineering Analysis	3	71	2.2				X
CHE 345	Chemical Engineering Lab I	3	44	.5				X
CS 105	General Computer Science	3	40	2.0			X	
CS 300	Introduction to Scientific Computation	3	39	2.7				X
CS 401	Foundations of Computer Science I	3	22	5.3				X
E 011	English Essentials	3	46	5.9		X		
EC 101	Introduction to Economics I	3	5	1.1		X		
EC 102	Introduction to Economics II	3	20	1.8				X
EDC 367	Writing in Elementary Grades	3	12	1.0			X	

Table 1 (Continued)

Courses Using PLATO During 1978-79

Course Symbol and Number	Descriptive Title	Number of Credit Hours	Number of Students	Average Terminal Hours per Student	Time of Utilization			
					Summer	Fall	Winter	Spring
EDC 372	Elementary School Arithmetic	3	106	1.3		X		X
EDC 559	Field Workshop: Math Lab I	3	9	1.0	X			
EDC 624	Analysis of Reading Retardation	3	23	2.7	X			
EDF 310	Human Growth and Development II	3	31	.5		X		
EDF 365	Educational Measurement and Evaluation	3	3	1.5				X
EDF 410	Educational Psychology	3	17	2.0		X		
EDF 461	Measurement Theory & Technique: Classroom Teachers	3	63	2.0			X	X
EDF 660	Educational Measurement	3	17	4.7				X
EDF 665	Elementary Statistics	3	6	4.0				X
EDF 667	Computer-Based Instruction	3	9	1.5		X		
EDF 667	Models of Educational Accountability	3	15	2.5	X			
EDP 567	PLATO Program Design	3	9	35.7		X		
EDP 653	Occupational and Educational Information	3	2*	41.8		X		
EDP 665	Using Tests in Counseling	3	7	5.6				X

*Includes multiples.

Table 1 (Continued)

Courses Using PLATO During 1978-79

Course Symbol and Number	Descriptive Title	Number of Credit Hours	Number of Students	Average Terminal Hours per Student	Time of Utilization			
					Summer	Fall	Winter	Spring
EDP 867	Management Application of Research	3	10	2.0		X		
EDP 888	Human Relations for Administrators	3	14	.8		X		
EG 125	Introduction to Engineering	3	20	1.7		X		
FR 102	Elementary French II	3	141	3.2		X		X
FR 111	Intermediate French	**						
FR 201	French Reading and Comprehension I	**						
FSN 459	Topics in Food Science	2	12	2.0				X
IFS 465	Early Identification: Young Disabled Learners	3	12	2.0	X			
IFS 640	Curriculum Analysis	3	5	2.0		X		
LAT 101	Elementary Latin I	3	84	8.0		X	X	
LAT 102	Elementary Latin II	3	23	7.5				X
M 115	Pre-Calculus	3	14	1.1				X
M 167	Pre-Calculus	3	12	5.9		X		
M 241	Honors Calculus I	3	130	8.9		X		X
M 242	Honors Calculus II	3	6*	2.5*		X		X
MIL 405	Military Management II	2	11	.4			X	
MU 105	Fundamentals of Music	3	188	5.4		X		X

* Some statistics for this class included in M 241.
** Statistics for these courses included in FR 102.

Table 1 (Continued)

Courses Using PLATO During 1978-79

Course Symbol and Number	Descriptive Title	Number of Credit Hours	Number of Students	Average Terminal Hours per Student	Time of Utilization			
					Summer	Fall	Winter	Spring
MU 106	Fundamentals of Music	3	12	6.1				X
MU 167	Jazz Harmony	3	23	3.0	X		X	
MU 185	Music Reading and Ear Training	2	68	23.8		X		X
MU 186	Music Reading and Ear Training	2	34	44.4		X		X
MU 285	Advanced Music Reading and Ear Training	2	16	5		X		
MU 286	Advanced Music Reading and Ear Training	2	17	6.6				X
N 301	Nursing: Adult Physical Health & Illness I	10	182	5.1		X		X
N 840	Medical Surgical Nursing I	4	9	1.3		X		
PE 120	Volleyball	1	51	1.4			X	X
PE 144	Skills/Techniques/Tennis/Volleyball	1	31	2.3				X
PE 324	Measurement and Evaluation	3	57	2.3			X	X
PE 364	Coaching Volleyball	1	17	1.0				X
PE 426	Biomechanics	3	70	6.8		X	X	X
PE 612	Mechanical Analysis of Sport Skills	3	8	.9		X		
PE 810	Biomechanics	3	11	1.5				X
PSY 201	General Psychology	3	760	1.5		X		X

Table 1 (Continued)

Courses Using PLATO During 1978-79

Course Symbol and Number	Descriptive Title	Number of Credit Hours	Number of Students	Average Terminal Hours per Student	Time of Utilization			
					Summer	Fall	Winter	Spring
PSY 201	Honors: General Psychology	3	7	1.0				X
PSY 312	Learning and Motivation	3	67	1.3		X		X
PSY 320	Memory and Mnemonics	3	20	3.0			X	
PSY 340	Cognition	3	8	6.5	X			
PSY 367	Visual Thinking	3	18	11.2			X	
PSY 611	Clinical Psychology	3	20	1.0	X			
PSY 867	Computer Applications	3	5	1.5		X		
SOC 210	Population Problems	3	40	2.7				X
TDC 211	Clothing 1a: Basic Processes	3	67	1.8		X		X
TDC 216	Clothing 1b: Advanced Processes	3	53	2.1		X		X
TDC 317	Tailoring	3	11	1.8			X	

Table 1 (Continued)

Courses Using PLATO During 1978-79
Non-University Courses

PLATO Group	Descriptive Title	Number of Students	Average Terminal Hours per Student	Time of Utilization			
				Summer	Fall	Winter	Spring
careers	Career Search	16*	123.3		X		X
chal 301	Credit by exam for Nursing 301	5	2.9				X
chal 406	Credit by exam for Nursing 406	4	4.0				X
chalexam	Preparation for the two credit by exam nursing courses	10	2.6				X
martuza	Research	46	1.3		X		
nsp	New Student Program	3*	100.0	X			
security	Officers Training	50	1.0		X		
ubmath	Upward Bound Math	3	1.5	X			
UDCE	Career Search	10*	105.0		X		X
udhs	PLATO Programming for High School Students	6	27.9	X			
udread	Reading Study Center	45	8.5	X			
udtutor	English as a Second Language	52	1.6	X			
uenglish	Upward Bound English	43	3.0	X			

* Includes multiples.

-Organization-

There are two main components in the organization of the Delaware PLATO Project. The first is its division according to academic departments requesting the use of PLATO services. The second is the approach taken by its staff in order to provide those services. In each department there is a faculty member identified as "PLATO project leader." The project leader serves as an intermediary between the PLATO staff and the rest of the faculty in the department. The project leader coordinates all PLATO activities for the department, including evaluation. All final decisions regarding the content of PLATO lessons are made by the project leader. Most project leaders use a peer review process whereby they obtain help from their colleagues in making these decisions. The energy, enthusiasm and dedication of the faculty has been a very important factor in the implementation of PLATO at the University. Table 2 contains a list of the PLATO project leaders.

Table 2

PLATO Project Leaders at the University of Delaware

Projects	Project Leaders
Accounting	Angelo Di Antonio
Agriculture	Paul Sammelwitz
Anthropology	Juan Villamarin
Art	Raymond Nichols
Biology	David Sheppard
Chemical Engineering	Robert Pigford and Stanley Sandler
Chemistry	John Burmeister
Civil Engineering	Eugene Chesson
Communications	George Borden
Continuing Education	Jon Heggan
Counseling	Richard Sharf
Ecomonics	James O'Neill
Education - Instruction	Robert Uffelman
Education - Research	Victor Martuza and Richard Venezky
Freshman Honors Program	Donald Harward
Health Education	Paul Ferguson
Human Resources	Frances Mayhew
Institutional Research	Carol Pemberton
Languages	Gerald Culley
Mathematics	Ronald Wenger
Military Science	George Bailey
Music - Aural Skills	Fred Hofstetter
Music - Written Theory	Michael Arenson
Nursing	Mary Anne Early and Don Mackay
Physical Education	David Barlow and James Kent
Physics	Cheng-Ming Fou
Psychology - Instruction	John McLaughlin
Psychology - Research	James Hoffman
Security	Stephen Swain
Sociology	Vivian Klaff
Computer Information and Sciences	Hatim Khalil
Theatre	Brian Hansen
Upward Bound	William Morris
Writing Center	Louis Arena

As requests for the use of PLATO have increased, the University has developed a highly trained staff to support the project. At the beginning of the project the staff consisted of three graduate assistants. When the faculty's request for expansion to a level of eight terminals was approved in the summer of 1975, a senior applications programmer/analyst became the first professional staff member of the project, and the number of student assistants was increased to eight. During the summer of 1976, in preparation for large-scale use of PLATO, a second professional programmer/analyst was hired, and the number of student assistants was increased from eight to twelve. During the winter of 1976-77, six of the student assistants demonstrated that they had met the qualifications for junior staff positions, and they were promoted to junior PLATO applications programmer/analysts.

During the 1977-78 academic year four more student assistants demonstrated that they had met the qualifications for junior staff positions, and they were similarly promoted to junior PLATO applications programmer/analysts. In addition, three new professional analysts were hired from outside the University, two at the junior level, and one at the middle level. Two systems programmers were hired in order to coordinate system programming, operations, and communications for the new machine. A second secretary was hired to handle the increased load of paper work in the project. Finally, funds sufficient to hire one full-time operator were allocated to the University of Delaware Computing Center, which is operating the new PLATO machine.

During 1977-78 it also became evident that the two senior staff members of the Delaware PLATO Project, namely, James H. Wilson and Bonnie A. Seiler, had been taking on more and more of a supervisory role. In addition to overseeing the work of several junior staff members, they each had a major managerial component of the project. Bonnie Seiler is in charge of lesson design, evaluation, and scheduling, and Jim Wilson manages the operations side of the project. Recognizing the increased level of responsibility of these two staff members, two new managerial positions were created, and Bonnie and Jim were promoted to these positions effective July 1, 1978.

During the 1978-79 academic year, a Senior Electronics Specialist was hired in order to coordinate maintenance for the growing number of PLATO terminals on campus, and a PLATO User Services Coordinator was hired to manage the project's growing outside user base. Table 3 (page 20) shows a complete list of the staff of the Delaware PLATO Project. The numbers given in column three are used to identify each staff member in the project's task assignment matrix (cf. Figure 19, page 19) which is discussed on the next page.

The number of tasks needed to support program development, experimentation, student use, and evaluation for the many departments using PLATO requires that each staff member of the PLATO Project carry out multiple assignments. Figure 2 contains the task assignment chart of the Delaware PLATO Project. It shows how staff members have assignments at two different levels, namely, program development and supporting services. In program development each staff member is assigned to write programs for one or more departments. In addition, each staff member assumes one or more additional roles under supporting services which include operations, site management, library cataloging, TUTOR training, scheduling, lesson design and evaluation.

Operational duties include the running of the Delaware PLATO system; the management of files such as instructional programs, utility routines, and work spaces in the computer memory; maintenance of terminals and peripheral equipment; data storage and transfer from PLATO to the University's computers and vice versa; printing of graphic displays and data files as requested by the faculty; maintenance of PLATO data communications and hardware; diagnosis of needed improvements in PLATO software; and research and development of new and existing equipment which would enhance PLATO services.

Each established PLATO site is watched over by a PLATO staff member who insures that the physical environment is conducive to student learning and to safe operation of the equipment. The site director also insures that the terminals are not using more than their proper allocations of computer resources. To date PLATO sites have been established in the Education Building, in Smith Hall, at 46 E. Delaware Avenue (PLATO staff building), in Music, in Art, in the Freshman Honors Program, in Physical Education, in the College of Nursing, in the Computing Center, and in the Psychology Research Laboratory.

The PLATO Library consists of five main parts. First, printed materials, which include all available publications dealing with PLATO and significant publications by users of other systems; second, audio disks, which store up to twenty-two minutes of pre-recorded audio materials for use with PLATO's random access audio device; third, microfiche slides, which contain up to 256 slide images which can be rear-projected onto the screen of the PLATO terminals; fourth, 35mm color slides of PLATO displays, facilities, and related materials which are used in demonstrations and other presentations; and fifth, lesson catalogs, which categorize on-line all PLATO lesson materials available on the Delaware PLATO system.

A comprehensive TUTOR training program is maintained in order that staff members can increase their programming abilities, and so that prospective new authors of PLATO lessons can learn the authoring language. Now that microprocessors are becoming an important component in the PLATO system, a committee has been established which is studying available microprocessor systems, establishing a training program for use in the University and in the state, and designing a communications system whereby microprocessors can use the PLATO system to exchange electronic mail, get new versions of programs, and report back to the central system concerning student performance. Code review and lesson review sessions are held regularly in order to maintain the high quality of lesson development which has become a standard in the Delaware PLATO Project. Seminars are held regarding techniques of educational design and evaluation, and a catalogue of test instruments is kept with examples of their applications. Several staff members share the responsibility of providing consultation to users in the PLATO classrooms.

Figure 3

TASK ASSIGNMENT CHART

PROGRAM DEVELOPMENT

COMPONENT NUMBER ONE — M6

- Accounting — C9,24,25,28,36,40
- Art — C19,26,51
- Chemistry — 49
- Communications — C20
- Computer Science — C17
- Economics — C9,29
- Institutional Research — C10
- Languages — C21,13,45
- Music-Oral Skills — C16,37
- Music-Written Theory — C16,22
- Physical Education — 42
- Psychology-Research — C15,52,55
- Physics — C21
- Theatre — C20,30

COMPONENT NUMBER TWO — M7

- Agriculture — C12,50
- Anthropology — C14,29
- Biology — C14,23
- Chemical Engineering — C21,55,56,58
- Civil Engineering — C15,46
- Continuing Education — C15
- Counseling — C15
- Education-Instruction — C18
- Education-Research — C12
- Health Education — C14,58
- Honors — C13
- Human Resources — C12
- Mathematics — C9,33
- Military Science — C12,35
- Nursing — C14
- Psychology-Instruction — C18,47
- Security — C18,54
- Sociology — C15,46
- Upward Bound — C20,34
- Writing Center — C20,38,41

SUPPORTING SERVICES

M6 — OPERATIONS

- Communications — 11
- Data Storage and Transfer — 11
- Hardware Research — 5,11,15,35,44,48
- Maintenance — 5,39
- Operator Training — 10
- PLATO Software — 10
- Printing — 10,11,12,15
- Resource Management — 6

PLATO LIBRARY

- Audio Disks — 20,34
- Lesson Catalogs — 8,12
- Microfiche — 16
- Printed Materials — 4
- Slides — 19

CLUSTER SUPERVISORS

- 009 Willard — 18
- 040 Smith — 21
- 46 E. Delaware Avenue — 17
- Art — 19
- Computing Center — 11
- Freshman Honors Program — 13
- Music — 16
- Nursing — 14
- Physical Education — 42
- Psychology-Research — 15

M6,M7 — USER SUPPORT SERVICES

- Classroom Assistants — M7,18,21,43
- Consultants — M6,M7,9,19,20
- Customer Services — M6,8
- Miscellaneous Programming — M6,M7,12,27,32,47
- Seminars and Workshops — M7,6,8,9,19,20
- Tests and Measurements — M7

M = manager in charge
C = coordinator of project

Numbers refer to column 3 of Table 3.

39 40

Table 3

Staff of the Delaware PLATO Project

Position	Name	Number
Director	Fred T. Hofstetter	1
Assistant to the Director	Marianna K. Preston	2
Senior Secretary	Joan F. Harris	3
Secretary	Charlotte Coletta	4
Senior Electronics Specialist	Robert Stradling	5
Manager	James H. Wilson	6
Manager	Bonnie A. Seiler	7
User Services Coordinator	Deborah A. Braendle	8
Programmer/Analyst	Keith Slaughter	9
Systems Programmer	Brand Fortner	10
Systems Programmer	Charles Wickham	11
Junior Analyst	Dave Anderer	12
Junior Analyst	Christine Brooks	13
Junior Analyst	Monica Fortner	14
Junior Analyst	Mark Laubach	15
Junior Analyst	William Lynch	16
Junior Analyst	Joe Maia	17
Junior Analyst	Judith Sandler	18
Junior Analyst	James Trueblood	19
Junior Analyst	Jessica Weissman	20
Junior Analyst	Dan Williams	21
Trainee Staff*	Patricia Bayalis	22
Trainee Staff	Kathy Bergey	23
Trainee Staff	George Betz	24
Trainee Staff	Louisa Bizoe	25
Trainee Staff	Mark Baum	26
Trainee Staff	Lawrence Carson	27
Trainee Staff	William Childs	28
Trainee Staff	Charles Collings	29
Trainee Staff	Jeffrey Davis	30
Trainee Staff	Tuan Duong	31
Trainee Staff	David Graper	32
Trainee Staff	Jay Green	33
Trainee Staff	Michele Heineman	34
Trainee Staff	Michael Houghton	35
Trainee Staff	Hu'ng Hang	36
Trainee Staff	Russ Kozerski	37
Trainee Staff	L. Everett Langhans	38
Trainee Staff	Doug Latimer	39
Trainee Staff	Carol Leefeldt	40
Trainee Staff	Jean Maia	41
Trainee Staff	Stuart Markham	42
Trainee Staff	Janet Niland	43
Trainee Staff	Bill Resnicow	44
Trainee Staff	Walt Smith	45
Trainee Staff	Jeffrey Snyder	46
Trainee Staff	Rae Stabosz	47
Trainee Staff	Daniel Tripp	48
Trainee Staff	David Tweed	49
Trainee Staff	Sue Waeber	50
Trainee Staff	Ben Williams	51
- - - - - - - -	- - - - - - - -	- - -
Trainee Staff	Mike Frank	52
Trainee Staff	Doug Harrell	53
Trainee Staff	Robert Krejci	54
Trainee Staff	Bob Lamb	55
Trainee Staff	Scott McMillan	56
Trainee Staff	Richard Payne	57
Trainee Staff	Jay Tuthill	58

* Trainee Staff are miscellaneous wage earners. Eight of these are work-study students. Trainee Staff listed below the dotted line are funded by departments other than PLATO.

-Instructor and Author Training-

Since the beginning of the Project, a series of weekly seminars has been offered four times a year in order to give members of the University and its surrounding community an opportunity to learn about various aspects of the PLATO system. There is a short orientation seminar for those who want a brief overview, a sequence of two courses in TUTOR programming, a course in lesson design, a lesson review seminar, and a research and development seminar. These seminars are offered free of charge for no credit to members of the University of Delaware. The introductory seminars have three weekly meetings, and the other seminars have ten weekly meetings.

Due to the success which these seminars have demonstrated in producing competent PLATO authors, and in response to the need for a national training program for PLATO authors, the Delaware PLATO Project has reorganized the training curriculum into a special program of intensive workshops for those seeking PLATO training from outside the University. Participants can elect a one-week or two-week period of training. One-week registration allows participants to choose three modules from the training curriculum. Two-week registration allows participants to study five modules. A brochure giving more information regarding this training program is available from the office of the Delaware PLATO Project. Table 4 shows a list of modules in the training curriculum.

Table 4

Training Curriculum for Users and Authors

1. Introduction to the PLATO System. General purposes and uses of the PLATO System are presented. Instructional materials are demonstrated to illustrate PLATO's special features, such as the touch-sensitive screen, the music box, the random-access audio device, and the speech synthesizer. This module will help participants establish guidelines for the use of PLATO in their respective fields.

2. Orientation for Instructors. Guidelines for integrating PLATO materials into the respective participant's learning environment are detailed. Topics include viewing PLATO's library of instructional materials, organizing PLATO materials into a curriculum, setting up student rosters, collecting student-usage data, and using PLATO's communication features. This module provides a valuable opportunity to learn how to individualize student needs.

3. Beginning TUTOR Programming. For those with little or no background in computer usage, this module offers the fundamentals of TUTOR, which is PLATO's programming language; included is guided practice at a PLATO terminal.

4. Advanced TUTOR Programming. For those with some previous knowledge of TUTOR, this module covers advanced topics in PLATO programming, tailored to participants' individual programming need.

5. PLATO Lesson Design. This module presents guidelines for designing computer-based educational materials on PLATO. Emphasis is placed on the advantages and disadvantages of developing different types of lessons, plus work on basic display techniques, answer handling, and individualizing instruction.

6. PLATO Lesson Review and Critique. This module, designed to help authors improve the instructional materials they are developing, involves informal review and critique of one another's lessons by participants, and the sharing of design techniques.

7. TUTOR Programming Review and Critique. This workshop includes informal review and critique of TUTOR programming techniques used by participants. Lessons are reviewed for readability, documentation, and efficiency. This module provides participants with an excellent opportunity to improve their authoring skills.

8. Site Management Training. Designed for those who manage a PLATO site, this workshop emphasizes how to use PLATO "site director options" to run an efficient PLATO site. Topics covered include PLATO hardware components, orientation to system resources such as ECS (Extended Core Storage, computer memory), disk space, computer time, and how to allocate resources among users.

9. PLATO Computer-Managed Instruction (CMI). Designed to teach participants to use the PLATO Learning Management (PLM) system, this workshop demonstrates PLATO's system for computer-managed instruction. It utilizes instructor-specified objectives, test items, mastery criteria and multimedia instructional materials. Topics include the use of PLM to individualize instructional programs, to create competency-based courses and to set up study/review packages.

Since the beginning of the project a growing number of teachers from Delaware's public schools have become interested in using PLATO in the classroom. In response to their requests for an opportunity to learn more about computer-based education, a Summer Institute in Computer-based Education was held during July of 1976. Jointly funded by the University and the Delaware School Auxiliary Association, the institute offered instruction on PLATO and on Project DELTA, a mini-computer based system with terminals in many of Delaware's high schools. In addition, all participants attended a seminar to discuss issues raised in the new book by Hunter et al., Learning Alternatives in U.S. Education: Where Student and Computer Meet (Englewood Cliffs: Educational Technology Publications, 1975).

Special presentations were made by participating faculty from several disciplines. These included art, presented by Ray Nichols of the University's Art Department; physics, by Richard Herr of Physics; lesson design, by Bonnie Seiler of the PLATO staff; computer-assisted testing, by Robert Uffelman of Education; music, by Fred Hofstetter of Music; computer-managed instruction and vocational-technical training, by John Matthews and Ed Boas of Education; administrative computing, by John Falcone of the Computing Center; MENTOR, by Hank Hufnagel of the Computing Center; WANG minicomputers, by Derryl Pelley of the Mathematics Department at Glasgow High School; chemistry, by Henry Blount of the Chemistry Department; DELTA, by Teresa Green of the University's DELTA Project; and PLATO, by Jim Wilson of the PLATO staff. Many of the participants in the institute have gone on to develop, test, and implement computer programs in their respective schools.

A second Summer Institute in Computer-Based Education was held from July 24 through August 11, 1978, under a $30,000 grant from the National Science Foundation. Under the original plan of this grant, 48 teachers would have been able to participate in the institute. However, in response to a brochure which was sent out to science teachers in the tri-state area, 216 teachers requested seats in the institute, showing the desire and need for training in computer-based education, and leading to a doubling in size of the institute through funds generously contributed by the Delaware School Auxiliary Association. In addition to the activities included in the 1976 institute, the 1978 institute also included a section on mathematics by Professor Ron Wenger, and one on social science by Vivian Klaff.

In order to serve the training needs of those teachers rejected because of over enrollment in the 1978 institute, the National Science Foundation has provided a $50,000 grant for the summer of 1979. In addition, the Delaware School Auxiliary Association has provided funds for a second institute which will serve computer-based training needs for teachers of agriculture, business, biology, and economics.

-Lesson Review-

New users usually begin their orientation to PLATO by reviewing some of the more than 2500 hours of lesson materials that already exist on the PLATO system. The ever-increasing PLATO lesson library is organized into twenty-five subject matter catalogs and is accessible from any PLATO terminal. In addition, comprehensive written guides to lesson materials are available in the PLATO library, located at 46 E. Delaware Avenue.

Potential users may review PLATO lessons in their field in order to consider them for use by their students and/or to provide ideas for new lessons of their own. Sampling lessons written for subjects outside the teaching areas of the reviewer can also lead to ideas for applications in the reviewer's own subject.

Another early step in becoming acquainted with the features of the PLATO system involves trying various terminal accessories such as the random access audio device, which presents pre-recorded messages; the four-voice music box; the Votrax digitized speech device; and the random access slide projector.

In order to facilitate the review of lessons by faculty, staff, students, and visitors, a special "demonstration" sign-on has been created which gives all users immediate and easy access to the lessons on PLATO. Instructions for using this sign-on are as follows. First, when PLATO asks for your name, type "demo" as shown in Figure 4 and press the NEXT key; second, when PLATO asks for your course, type "demo" as shown in Figure 5 and while holding down the SHIFT key press the STOP key. PLATO will then display a fifteen-page index which accesses most of the instructional materials on PLATO. This index is shown in Figure 6. Reviewers can try a lesson by typing the appropriate letter from the index.

Four PLATO lessons were written specifically to orient new users to the Delaware PLATO System. They included: "How to Use PLATO," which teaches the new user how to operate the terminal; "Seminars Offered about PLATO," which describes the seminar series offered four times a year by the PLATO staff; "Information about the Delaware PLATO Project," which displays tables and graphs on monthly terminal use, projected costs, and departmental involvement; and "Delaware PLATO System Hardware Configuration," which describes the computer system, communication equipment, and terminals. These four lessons are accessible from the demonstration index.

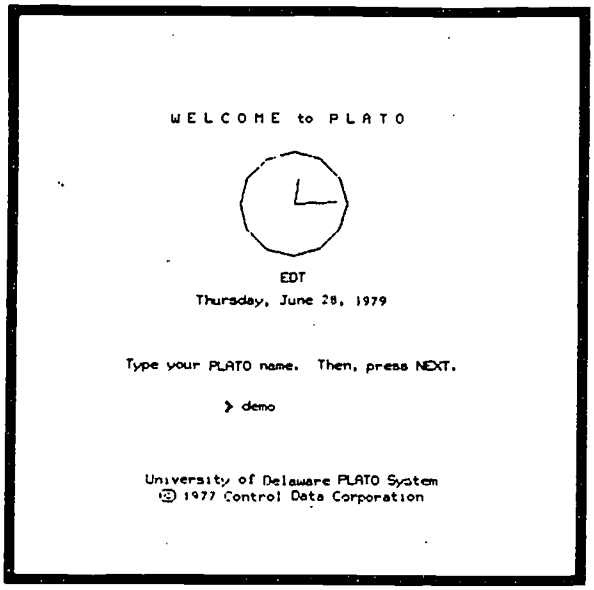


Figure 4. Signing on for Lesson Review: The Name.

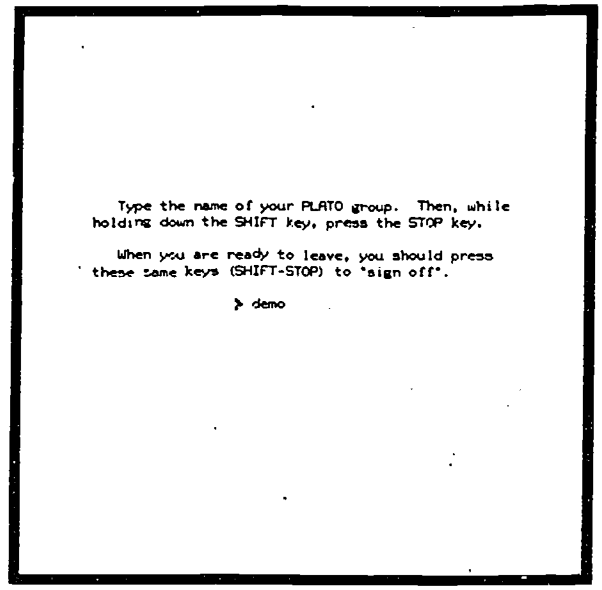


Figure 5. Signing on for Lesson Review: The Course.

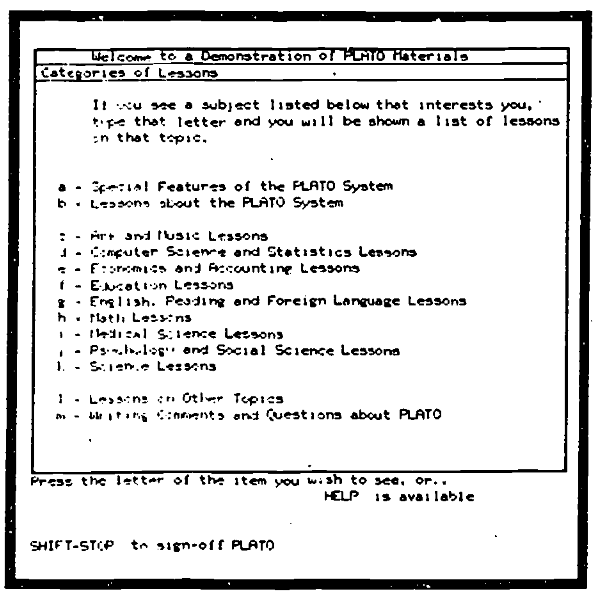


Figure 6 (a). Index of Programs for Lesson Review.

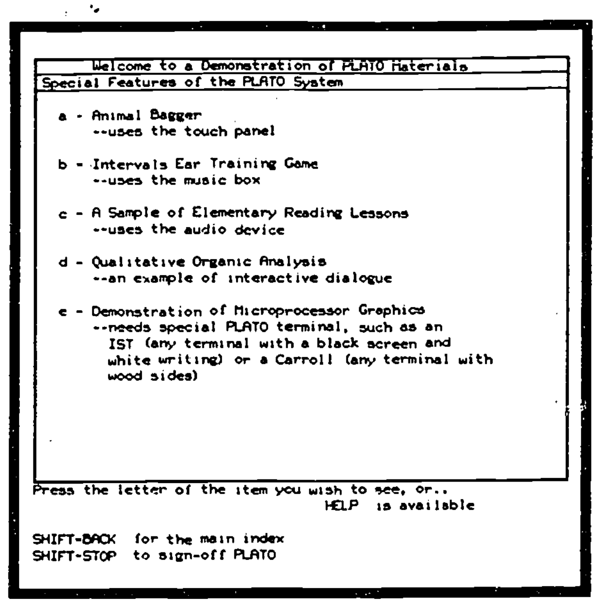


Figure 6 (b). Index of Programs for Lesson Review.

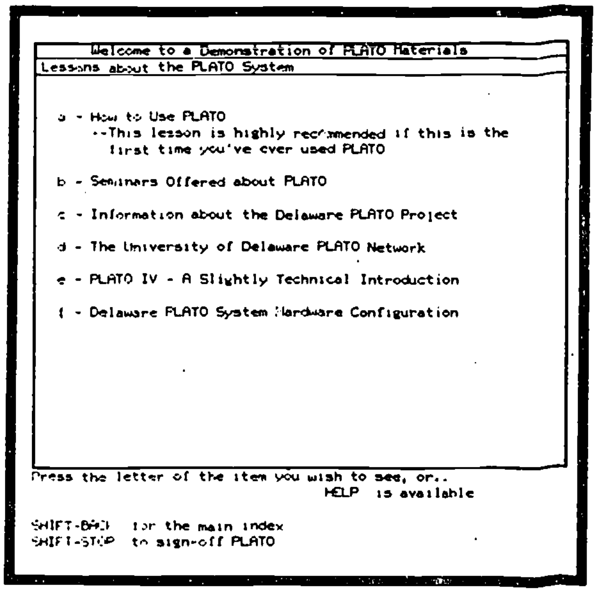


Figure 6 (c). Index of Programs for Lesson Review.

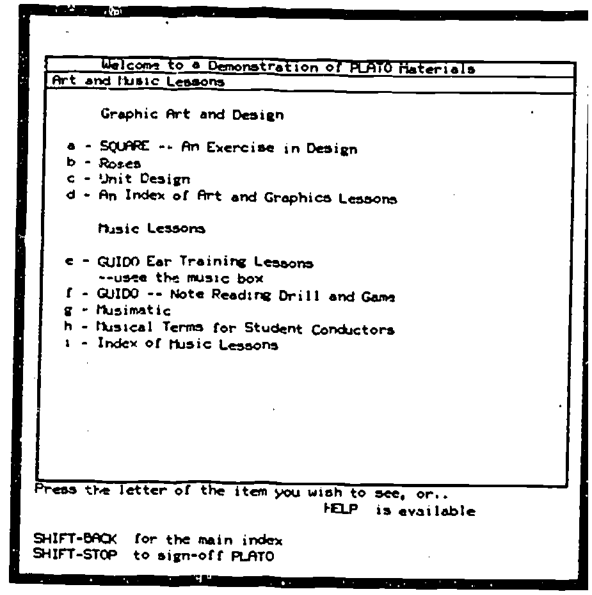


Figure 6 (d). Index of Programs for Lesson Review.

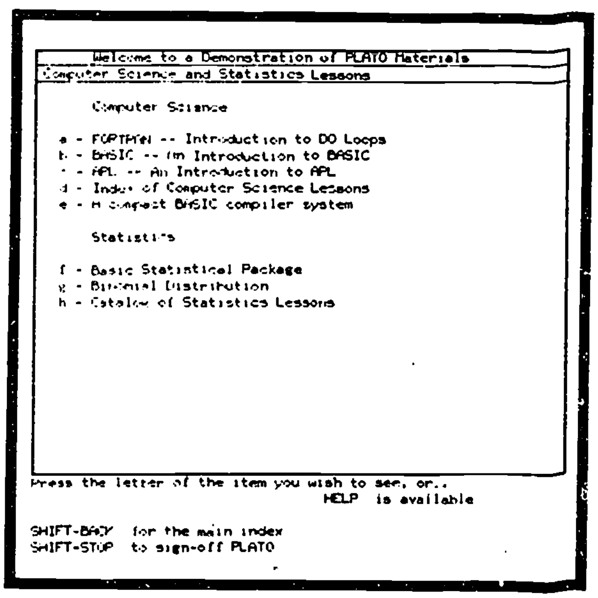


Figure 6 (e). Index of Programs for Lesson Review.

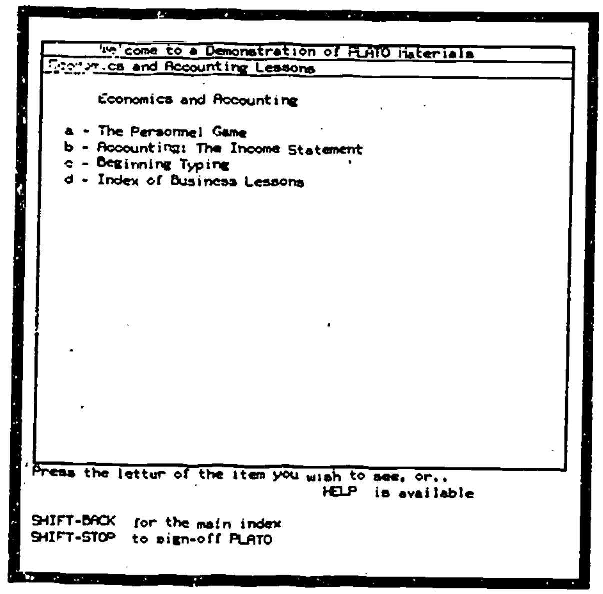


Figure 6 (f). Index of Programs for Lesson Review.

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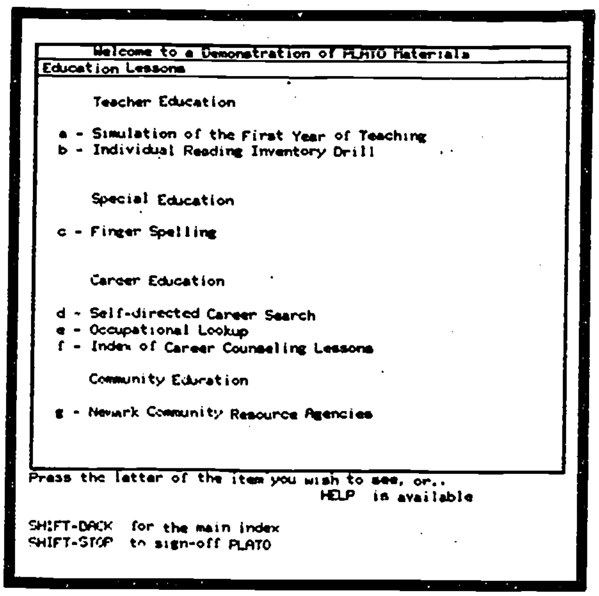

Figure 6 (g). Index of Programs for Lesson Review.

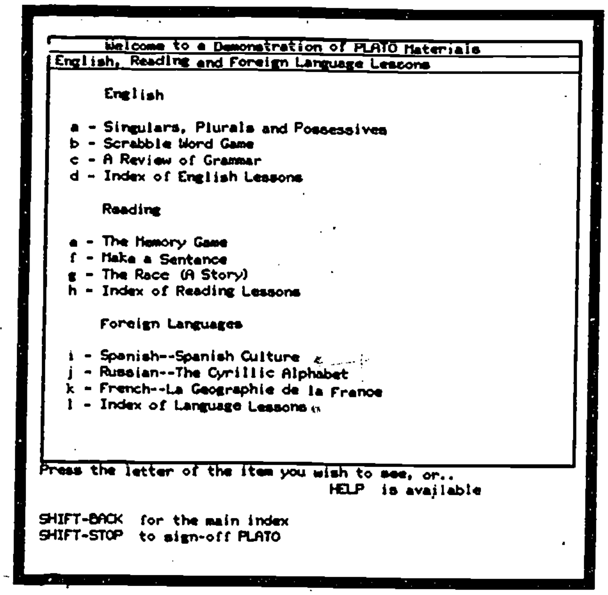

Figure 6 (h). Index of Programs for Lesson Review.

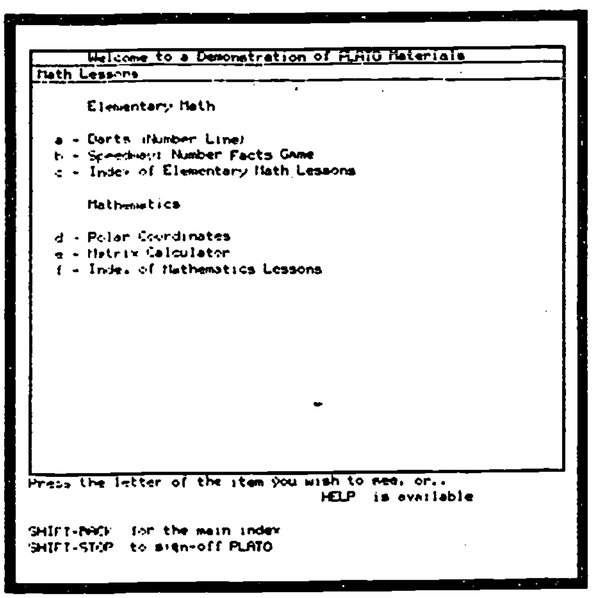

Figure 6 (i). Index of Programs for Lesson Review.

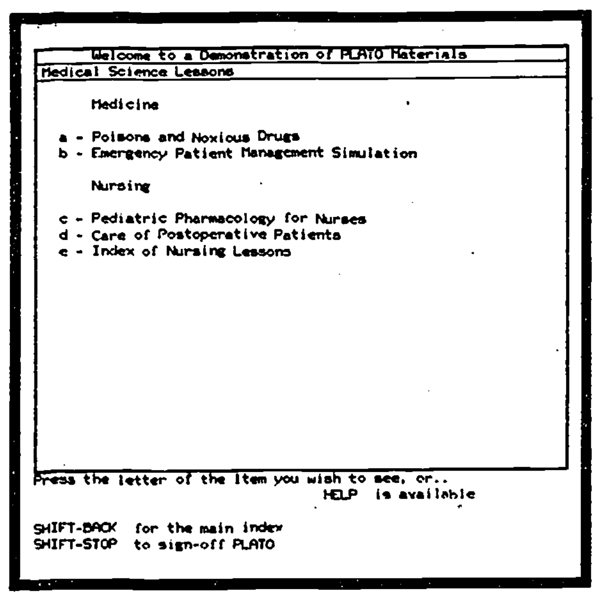

Figure 6 (j). Index of Programs for Lesson Review.

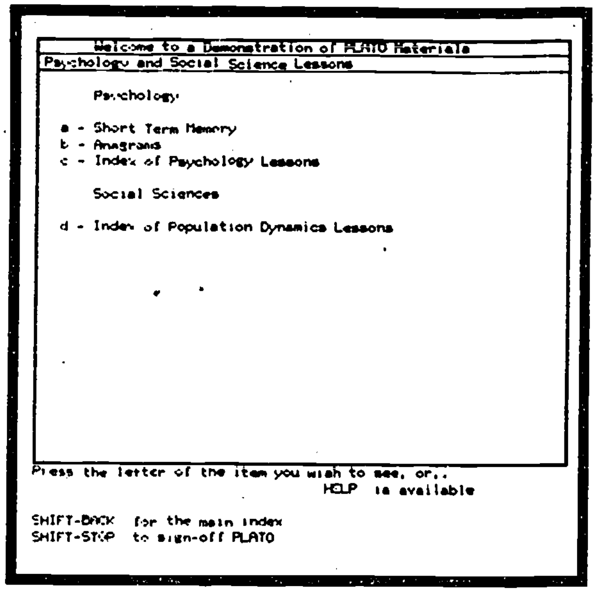

Figure 6(k). Index of Programs for Lesson Review.

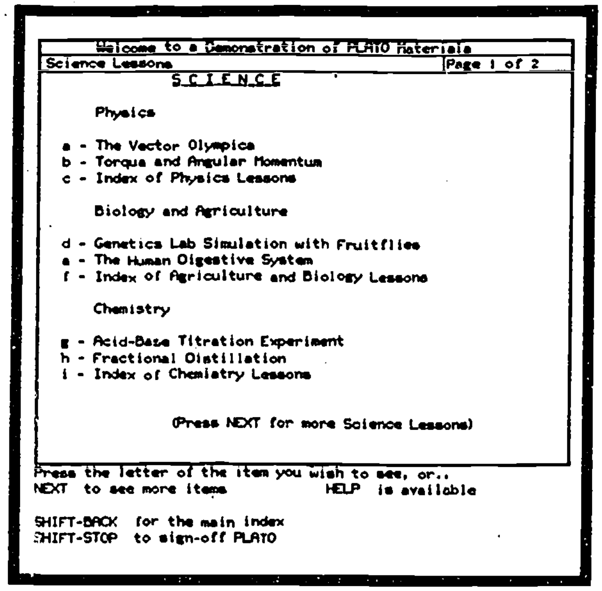

Figure 6(l). Index of Programs for Lesson Review.

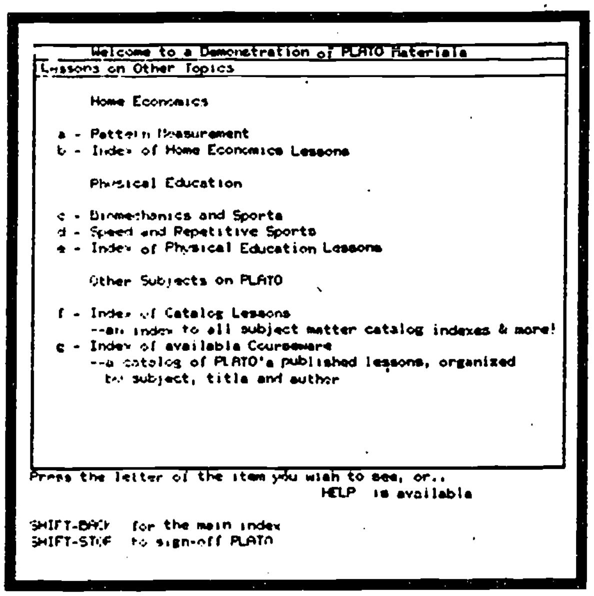

Figure 6(m). Index of Programs for Lesson Review.

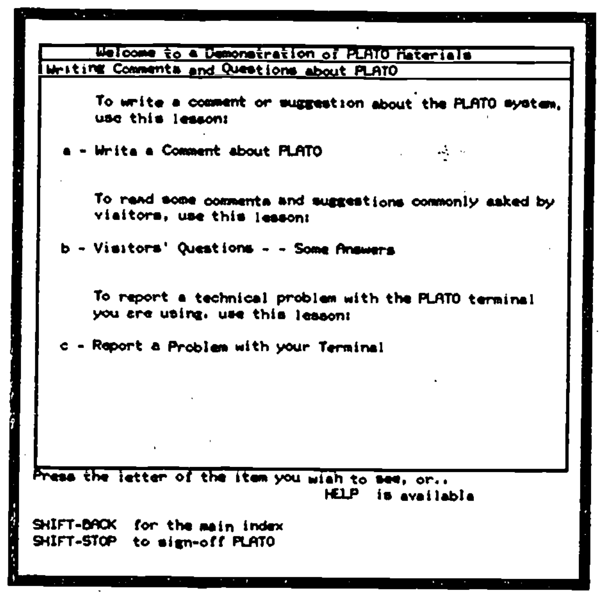

Figure 6(n). Index of Programs for Lesson Review.

-Participation in ADCIS-

The Delaware PLATO Project is an active participant in the Association for the Development of Computer-based Instructional Systems (ADCIS). ADCIS is the principal national forum for the scholarly exchange of ideas regarding computer-based education, and the project regularly delivers progress reports at the association's annual meetings. Papers have also been presented at ADCIS special interest group meetings for health sciences, implementation, PLATO elementary-secondary schools, and music. The music interest group was founded by our University's Music Department by means of the PLATO Project. The Delaware PLATO Project is also fostering the development of special interest groups for art, reading, and human resources.

A big event in the history of the Delaware PLATO Project was hosting the 1977 ADCIS National Convention at the Hotel DuPont, February 20-24, 1977. Jointly funded by the Delaware School Auxiliary Association, the Wemyss Foundation, ADCIS, and the University of Delaware, the convention attracted the largest attendance in its ten-year history. The participation of 32 vendors made the exhibit area a most comprehensive showing of computer-based educational technology. A special feature was the pre-session held for teachers on Monday, February 21, in cooperation with the State Department of Public Instruction. Entitled "Introduction to Educational Computing" the pre-session was attended by more than 300 Delaware teachers. During the main portion of the convention, several presentations were made by members of the PLATO staff and of the faculty. These are published in the 1977 ADCIS Proceedings, and they are available upon request in the PLATO office.

At the 1978 ADCIS Convention which was held in Dallas, Texas from March 1 through March 4, 1978, all three members of the PLATO senior staff were elected officers. Bonnie Seiler was elected Newsletter Editor for the PLATO Users Group, Jim Wilson was elected System Representative in the PLATO Users Group, and Fred Hofstetter was re-elected to a third consecutive term as President of the National Consortium for Computer-Based Music Instruction and holds an ex officio seat on the ADCIS Steering Committee. At the 1979 ADCIS Convention which was held in San Diego, California, from February 26 through March 1, 1979, Bonnie Seiler was reelected newsletter editor for the PLATO Users Group, James Wilson was reelected System Representative in the PLATO Users Group, and Fred Hofstetter was elected Conference Secretary and was also elected to serve on the Editorial board of the Journal of Computer-Based Instruction.

Several members of the PLATO staff and of the faculty have made formal presentations at ADCIS conventions. These are listed in Table 5. Copies of the presentations are published in ADCIS Proceedings, available in the Delaware PLATO Library.

Table [illegible]

Presentations by Delaware Faculty and Staff
at National ADCIS Conventions

Name	Title of Presentation	Year
Michael A. Arenson	"The Development of a Competency-Based Education Program in Music Theory"	1979
David A. Barlow, A. Stuart Markham, Jr., and James G. Richards	"PLATO Facilitation of Precision Analysis in Biomechanics"	1979
Edward Boas, Jr.	"An Analysis of Instructional Delivery Systems in Vocational Education Comparing Computer-Managed Instruction, Teacher-Delivered Module"	1979
John Brown	"Mathematics Applications of Computer Technology"	1977
John Eisenberg	"Overview of the PLATO Modern Hebrew Project"	1977
Nevin Frantz	"A Computer Managed Instructional System for Vocational Technical Education"	1977
Fred T. Hofstetter	"GUIDO: An Interactive Computer-Based System for Drill and Practice in Ear-Training	1976
Fred T. Hofstetter	"Computer-Based Recognition of Perceptual Patterns in Harmonic Dictation Exercises"	1978
Fred T. Hofstetter	"Controlled Evaluation of a Competency-Based Approach to Teaching Aural Interval Identification"	1979
Hank Hufnagel	"MENTOR - A PLATO-like system of CAI"	1977
Rosemary Killam	"Data Retention and Analysis: Experience and Recommendations"	1977
James Morrison	"Computing Applications in Business Education"	1977
James Morrison	"Innovative Classroom Applications of Computer Technology"	1979
Raymond Nichols and James H. Wilson	"The Computer Display as a Medium in the Teaching of Aesthetics in Visual Design"	1977
Raymond Nichols	"The PLATO Display in the Teaching of Optical Letterspacing"	1979
Bonnie A. Seiler	"Computer Assistance in the Social Processes of Learning"	1977
Richard Shart	"A Computer-Based Career Guidance System"	1977
James H. Wilson	"The Effects of Drill Structure on Learning in Phonetics Lessons"	1978
Rita Wagstaff	"Media Selection: Alternative Delivery Systems"	1978
Charles Wickham and Raymond Nichols	"PLATO in the Teaching of Foundation Visual Design"	1979
Robert Uffelman	"Computer-Assisted Testing at the Education Resource Center"	1978

CHAPTER II. APPLICATIONS

This chapter contains a summary of activities in the departments using PLATO at the University of Delaware. Sample lessons have been described with accompanying photographs in order to give the reader a general idea of the kinds of applications being pursued in the project. Study of these descriptions gives not only an overview of the wide range of activities which are being supported in the PLATO system, but it also provides a source of ideas from which new applications can arise.

-Accounting-

Approximately 350 students enrolled in five courses in the Accounting Department used PLATO during the 1978-79 academic year. During the spring semester of 1979, a controlled experiment was conducted in Managerial Accounting. Seventeen sections of this course were offered in the Accounting Department, and one section of this course was required to complete appropriate PLATO accounting lessons developed by Dr. James McKeown at the University of Illinois. The same instructor who taught the PLATO section also taught one other section of the course. In all there were 563 students in the course, thirty-eight of whom were in the PLATO section. The lessons available on PLATO covered material on the first examination in the course. On the examination for that section, the average score of the PLATO students was more than eight points higher than the average score of the other sixteen sections, and a t-test comparison showed that this difference is significant beyond the 0.01 level. It is interesting to note that the non-PLATO section taught by the same instructor who taught the PLATO section did not score significantly higher than the course average. Examples of two accounting lessons are explained below.

Figure 7 shows how PLATO teaches students to make an income statement. An explanation and a sample income statement are followed by an exercise in which the student must move the accounts and balances given on the left side of the page over to the right side of the page. PLATO checks the student responses for the correct order, column, and balance.

Figure 8 demonstrates the usefulness of having PLATO teach the student how to make worksheets. First, each student makes adjustments to a given trial balance at the end of an accounting period. Then an adjusted trial balance is used to prepare an income statement and a balance sheet. Students using the worksheet lesson receive immediate feedback in response to their answers.

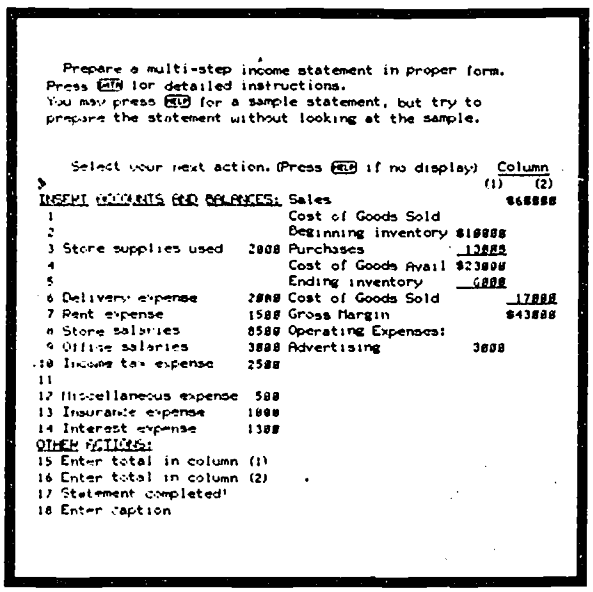

Figure 7. Income Statement, by James C. McKeown. Copyright © 1978 by the Board of Trustees of the University of Illinois.

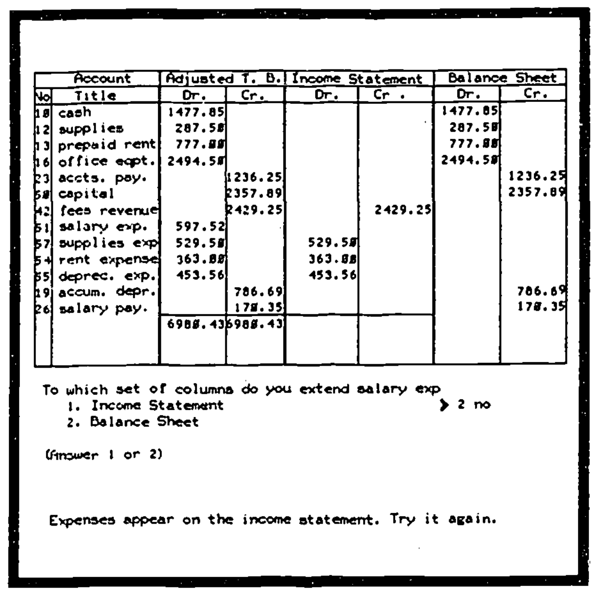

Figure 8. Worksheets, by James C. McKeown. Copyright © 1978 by the Board of Trustees of the University of Illinois.

Faculty members from the departments of Animal Science and Plant Science are using PLATO to provide students with simulated laboratory experiments and field experience which would be very costly to provide by other means. Most of the programs were originally developed by the College of Veterinary Medicine and by the Community College Biology Group at the University of Illinois. The successful implementation of these programs at the University of Delaware shows how through "courseware sharing" one institution can take advantage of PLATO programs written elsewhere.

In animal science, beginning students are using PLATO to study veterinary terminology, principles of digestion, muscular movement, mechanics of breathing, neuron structures and functions, spinal reflex loops, eye anatomy, and elementary psychophysiology of audition. Advanced undergraduate study mitotic cell division, probability and heredity, drosophilia genetics, natural selection, mitosis, gene mapping in diploid organisms, blood typing, population dynamics, pedigrees, karyotyping, and DNA, RNA, and protein synthesis. Graduate students concentrate on meiosis and the anatomy and physiology of reproduction.

In plant science, undergraduates run PLATO programs in cellular structure and function, water relations, diffusion, osmosis, genetics, and the spectrophotometer. Graduate students study plant pathology, enzyme experiments, respiration, biogeochemical cycles, enzyme hormone interactions, photosynthesis, seed germination, apical dominance, flowering and photoperiod fruiting and leaf senescence, gas chromatography, and gene mapping in diploid organisms.

The kind of experience which agriculture students obtain from PLATO is illustrated in the following three examples. Figure 9 shows a sample display from the neuron structure and function program. PLATO simulates neurons with various internal structures. The student stimulates the neurons by pressing keys at the terminal, and observes the effects of the stimulations as read by a recording voltmeter. The student can experiment with different rates and patterns of stimulation. PLATO keeps track of what the student does and provides the student with reports in the form of response graphs.

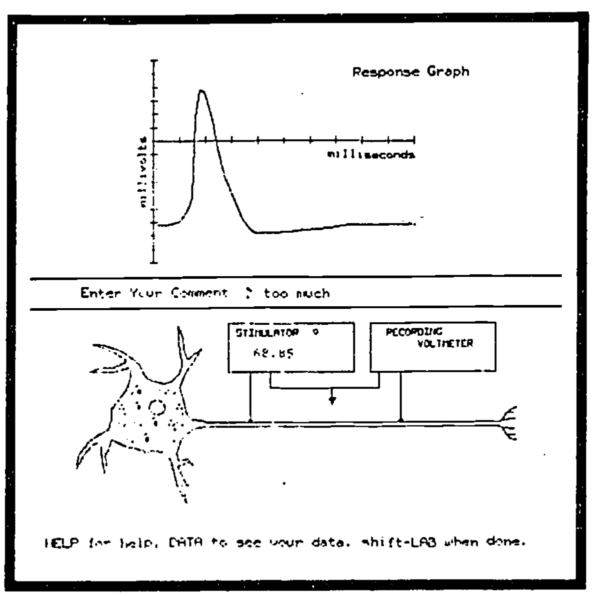

Figure 9. <u>Neuron Structure and Function</u>, by S. H. Boggs. Copyright © 1976 by the Board of Trustees of the University of Illinois.

Figure 10 shows the result of an apical dominance experiment. PLATO has given the student a plant with terminal and lateral buds intact. The student removes the apex, and is given a choice of replacing it with lanolin paste only or with lanolin paste plus one of five hormones. The student can experiment with choosing different hormones and observing their effects on the plant. In this case the student chose ethylene, and the plant branched.

Figure 11 shows how PLATO teaches the student how to run his own experiments. The student begins with the hypothesis that when two corn plants are crossed, the resulting generation will contain green plants and white plants in a ratio of 3:1. PLATO allows the student to cross two plants and observe the results, which in this case produced 100 green plants and 24 white plants. PLATO guides the student through a chi-square test of the hypothesis. When the student successfully completes the experiment, PLATO lets him go back and practice it again as often as he likes with an entirely new set of data each time.

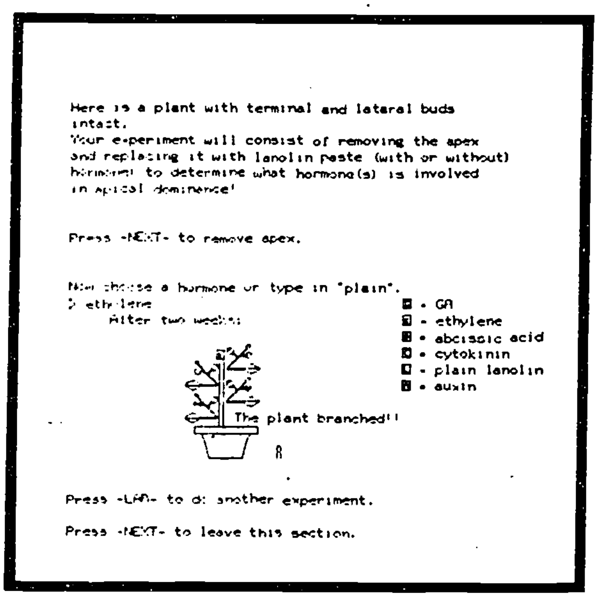

Figure 10. Plant Responses and Apical Dominance, by Mary Manteuffel and John Noell. Copyright © 1975 by the Board of Trustees of the University of Illinois.

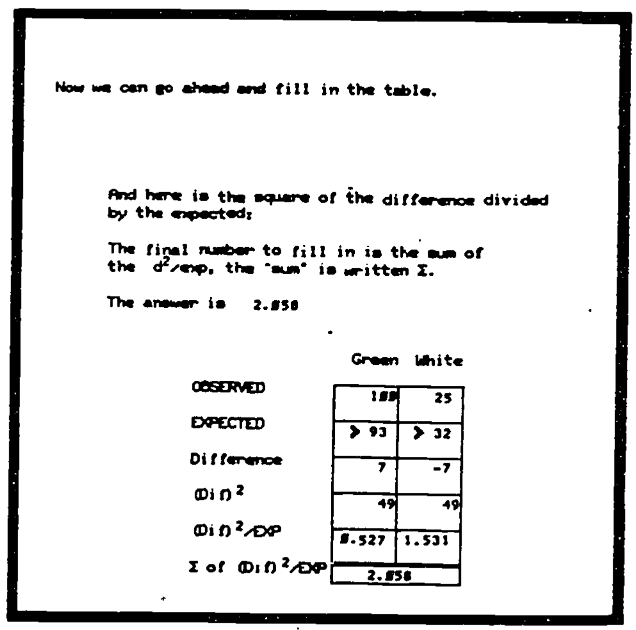

Figure 11. Genetics: Punnett Square, Chi Square, Mendelian Ratios, and Problems, by John Noell, Gary N. May, Alan Haney, and John Silvius. Copyright © 1976 by the Board of Trustees of the University of Illinois.

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During the 1977-78 academic year, the College of Agriculture completed development of its first Delaware PLATO lesson. Dealing with the human endocrine system, the new Delaware lesson presents the student with an outline of the human body. PLATO then asks the student what endocrine structures he would like to see. Figure 12 shows how the student has asked to see the kidneys, and PLATO has responded by drawing the kidneys in the proper locations. Later on in the lesson, the body of the outline is drawn again with all of the structures drawn in their proper locations, and the student is required to correctly identify each structure. Figure 13 shows how lessons were expanded during the 1978-79 academic year to include locations of endocrine structures in birds.

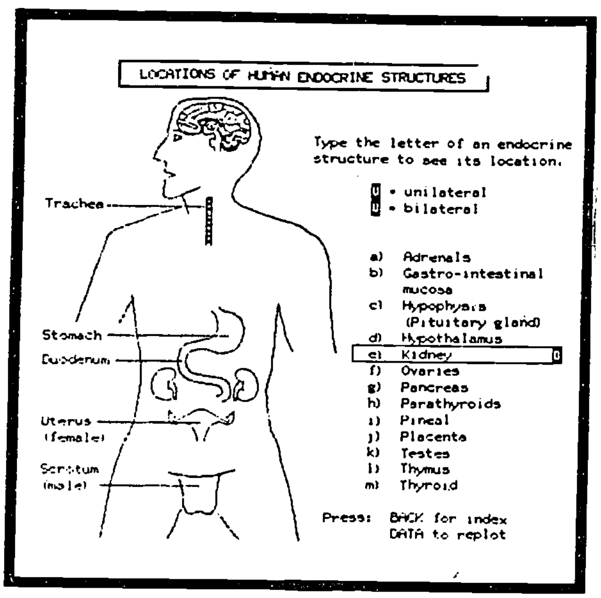


Figure 12. Endocrine System, by Paul Sammelwitz and Dan Tripp. Copyright © 1978 by the University of Delaware PLATO Project.

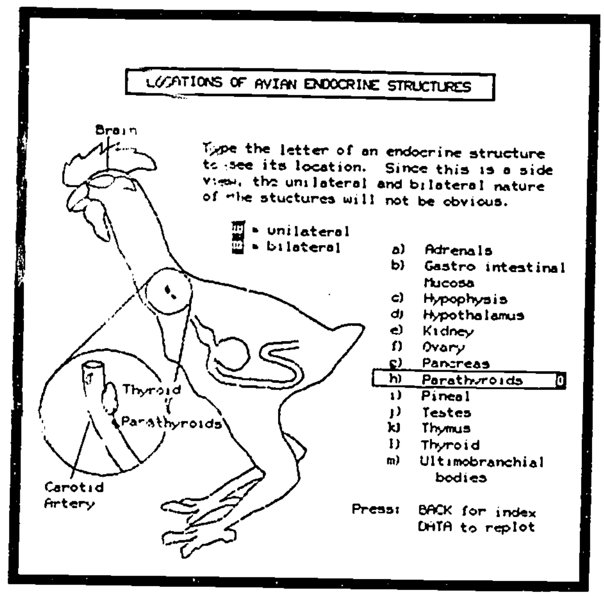


Figure 13. Endocrine System, by Paul Sammelwitz and Dan Tripp. Copyright © 1978,1979 by the University of Delaware PLATO Project.

-Anthropology-

The Anthropology Department is developing and using tutorials and drills in its introductory courses. Lessons are currently being written for biological anthropology and socio-cultural anthropology courses.

Biological anthropologists study cellular structure and genetic recombination from an evolutionary perspective. PLATO lessons about cellular structure and the genetic laws of inheritance, which emphasize this perspective, are being written to teach evolutionary theory. Figure 14 shows how a tutorial lesson on cellular structure presents and describes a mitochondrion. During subsequent parts of this lesson, the students are asked to identify different cell structures and their functions. Figure 15 shows how PLATO graphics are used to show students the spatial arrangements of atoms in the DNA molecule.

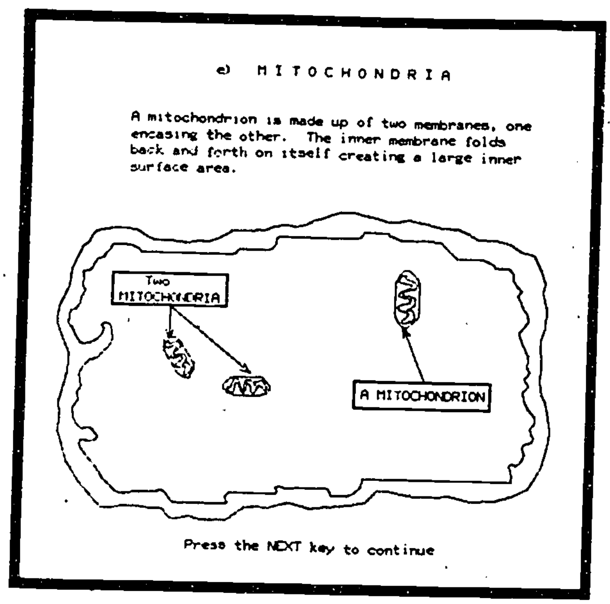


Figure 14. Tutorial from Cellular Structure, by Margaret Hamilton and Monica Fortner. Copyright © 1978 by the University of Delaware PLATO Project.

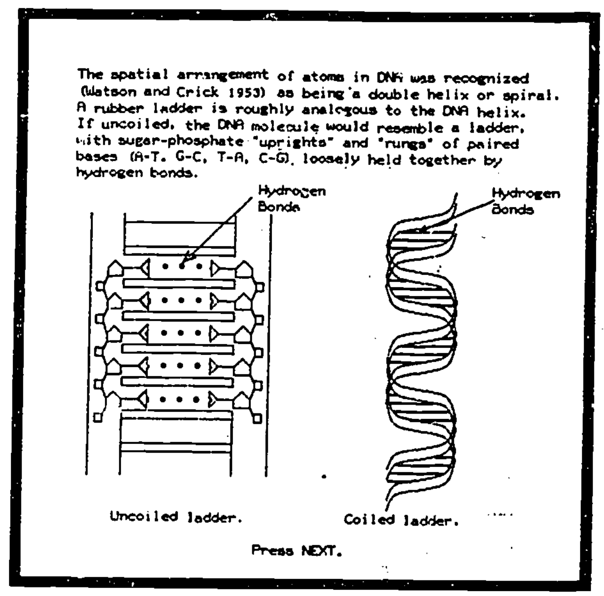


Figure 15. Tutorial from An Introduction to DNA for Anthropologists, by Jean Rounds, Margaret Hamilton, and Monica Fortner. Copyright © 1979 by the University of Delaware PLATO Project.

The art department is developing its own package of PLATO programs for the purpose of improving instruction in basic design and graphic design, including courses in typography, basic illustration, advertising design, and portfolio preparation. Using the highly sophisticated graphics features of PLATO, students are interactively able to create and alter designs on the terminal screen. Work which used to take fifteen hours to complete on paper can be done in three hours on PLATO, thereby giving students the opportunity to work many more problems than they could before. They are also developing a better aesthetic judgment, because PLATO makes it so easy for them to alter their designs. If they don't like part of a design, PLATO lets them change that part while retaining the remainder of the design. Thus students are encouraged to make what they like rather than like what they make.

The main applications of PLATO in art can best be explained by looking at how students use three programs, namely, "unit design," "grey scale practice in tonal recognition," and "optical letter spacing." In the "unit design" program, the student enters a shape into the computer by either turning on or turning off dots on a 96 x 96 dot matrix. Figure 16 shows how the student creates the image by selecting options like "move," "delete point," "store," and "draw line." Next, the student uses the basic shape to form a composite image by performing graphic transformations of the basic shape. Figure 17 shows how the student creates the composite image by rotating, mirroring, and inverting the positive/negative relationships of each element.

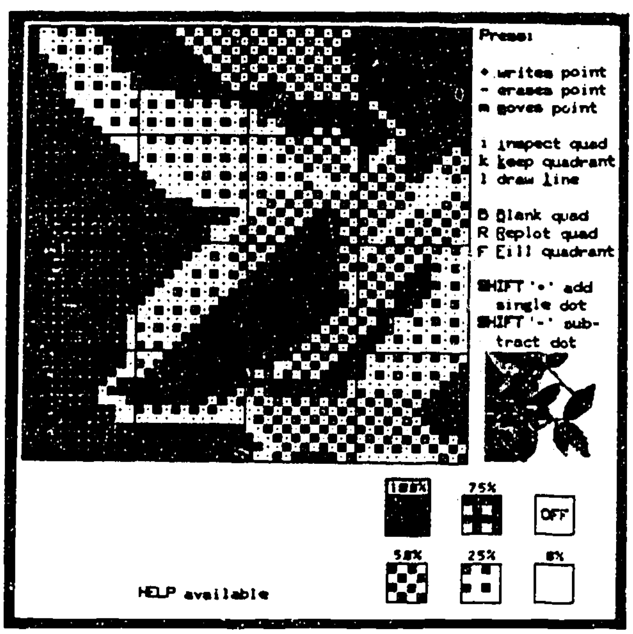


Figure 16. Unit Design by Ray Nichols; creating the basic image. Copyright © 1977 by the University of Delaware PLATO Project.

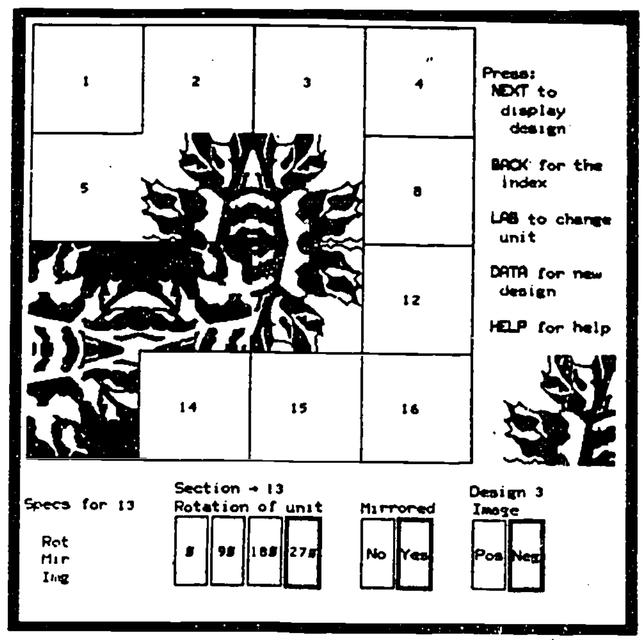


Figure 17. Unit Design by Ray Nichols; creating the composite. Copyright © 1977 by the University of Delaware PLATO Project.

Through successive tries at designing basic shapes and performing graphic transformations, the student learns how to create clever and intricate designs such as the one shown in Figure 18.

The grey scale program gives art students practice in recognizing the tonal values of the many shades of grey. PLATO presents the student with a grid of 20 x 30 squares. The student can then see the shade of grey for each square by telling PLATO the percentage of grey which should be in the square. Some students have become so adept at recognizing values of grey on PLATO that they can use the grey scale program to create facial images, such as the one shown in Figure 19.

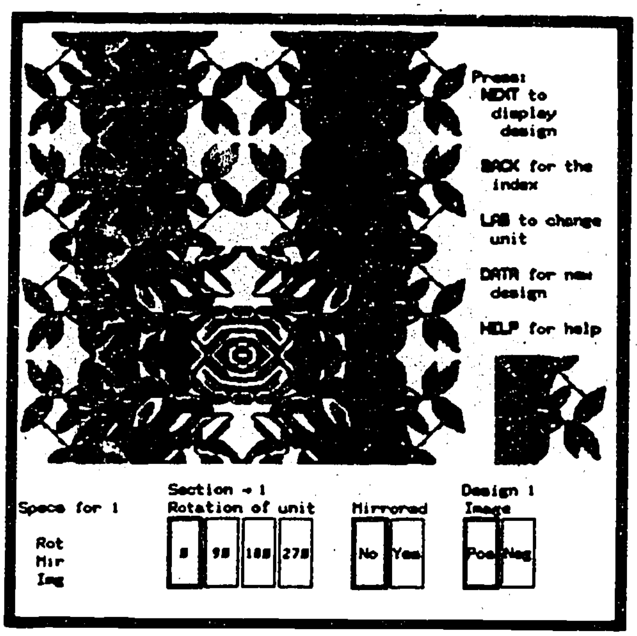


Figure 18. Unit Design, by Ray Nichols; the finished product. Copyright © 1977 by the University of Delaware PLATO Project.

Figure 19. Grey Scale, by Ray Nichols. Copyright © 1977 by the University of Delaware PLATO Project.

Since typography plays such an important role in advertising, it is extremely important for the art student to be able to space letters so that the printed word is both aesthetically pleasing and readable. The letter spacing program gives the students interactive practice in spacing letters without requiring them to go through the time-consuming process of drawing and inking a word every time they want to change the placement of a letter. Using PLATO, students can do many more assignments than were possible before, and the instructor is able to offer greater help to the students because he gets to see much more of their work. Students can work with words containing up to 9 letters from each of five typefaces: Helvetica, Baskerville, Garamond, Century Expanded, and Bodoni. Figure 20 shows a sample display from the letter spacing program. In this display the student is just about to move the "E" further over to the left.

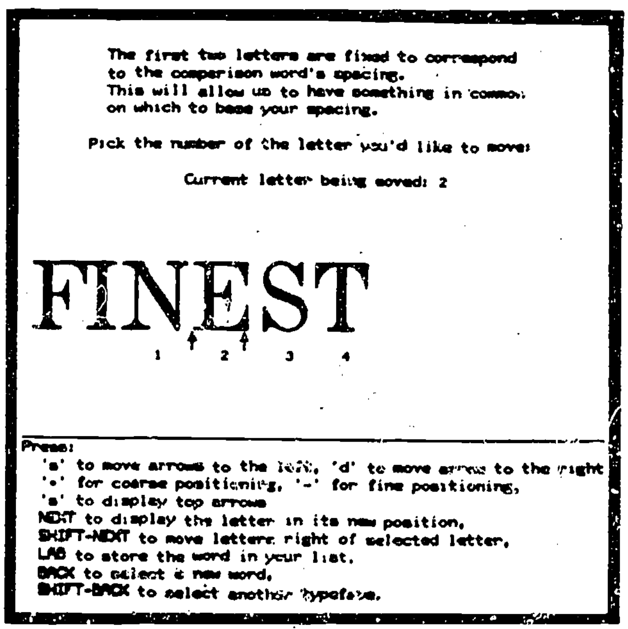


Figure 20. Letter Spacing by Ray Nichols. Copyright © 1977 by the University of Delaware PLATO Project.

One lesson newly developed during 1978-79 is called 'Logodesign' which was written to provide the graphic design student with a format for the development of designs which would be used for trademarks and corporate identity work. Figure 21 shows the basic drawing for such a design. The lesson allows the student to draw lines and circles in any configuration, setting the borders for a series of shapes which will eventually form the final design. After finishing the drawing, any of the shapes which are bordered by a line or a circle may be filled in. By indicating the desired areas to be filled PLATO will then execute the finished design. Figure 22 shows the finished design superimposed over the original drawing. The small dots spread over the drawing are the indicators that those specific shapes have been chosen for filling.

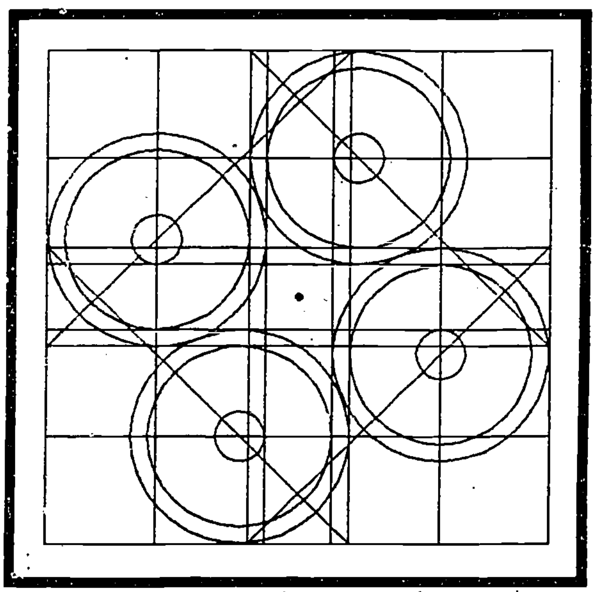


Figure 21. Logodesign, by Ray Nichols; creating the basic design. Copyright © 1979 by the University of Delaware PLATO Project.

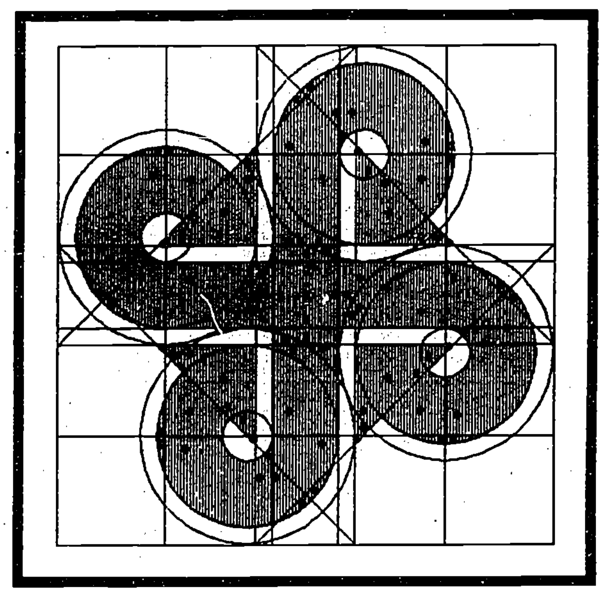


Figure 22. Logodesign, by Ray Nichols; the finished design. Copyright © 1979 by the University of Delaware PLATO Project.

The School of Life and Health Sciences is using PLATO to supplement laboratory experience in genetics. Many of the most valuable genetics exercises require the student to go through time-consuming and mechanically difficult procedures. In an actual laboratory situation students often overlook the important concepts under study in their efforts to complete complicated manual procedures within the time allotted. The flexible interactive nature of the PLATO genetics lessons permits students to design experiments, obtain data, graph and analyze results, and draw conclusions without having to go through time-consuming procedures which do not contribute to their knowledge. Using PLATO as a tool, unskilled persons can learn from complex and information-rich experimental designs, and they can obtain data from sources normally unavailable to beginning students.

Figure 23 shows part of a lesson in human genetics. Two generations of a family tree are shown. A chromosomal error in one of the parents has resulted in two severely affected daughters, one stillborn male and two fetal miscarriages. From this diagram students can choose to see the chromosome spread of any family member and thereby determine the origin and heritability of the defect. A clinical description of each afflicted individual is also available and adds realism to the student's role of genetic counselor.

Figure 24 shows the results of a classic experiment in bacterial genetics. Two strains of bacteria have been mated, and the transfer of each gene from one strain to the other has been measured as the timed increase of frequency of the gene in the population of recipient cells. This information enables students to locate the position of each gene on the bacterial chromosome. The sequence of genes from donor strain HfrH is seen to be thr-leu-azi-pro-lac-gal-trp.

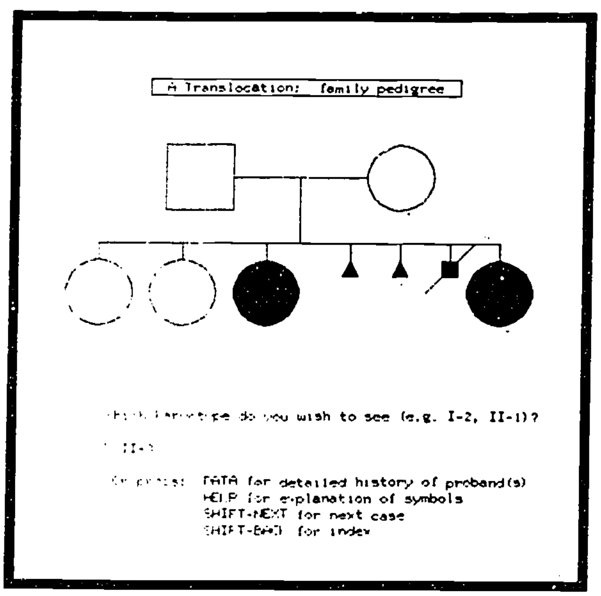


Figure 23. Human Karyotype Analysis, by Aart M. Olsen. Copyright © 1979 by the University of Delaware PLATO Project.

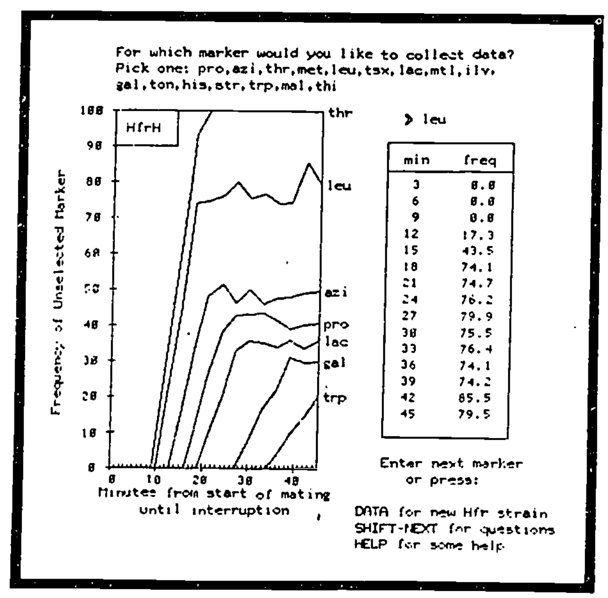


Figure 24. Gene Mapping in E.coli by Conjugation Analysis, by Aart M. Olsen. Copyright © 1979 by the University of Delaware PLATO Project.

Figure 25 shows the results of an experiment in developmental genetics. Wing length of mutant fruit flies depends on ambient temperature during a critical stage of larval development. In this lesson students themselves help design the experimental procedure which will unambiguously show which larval stage contains the temperature-sensitive gene.

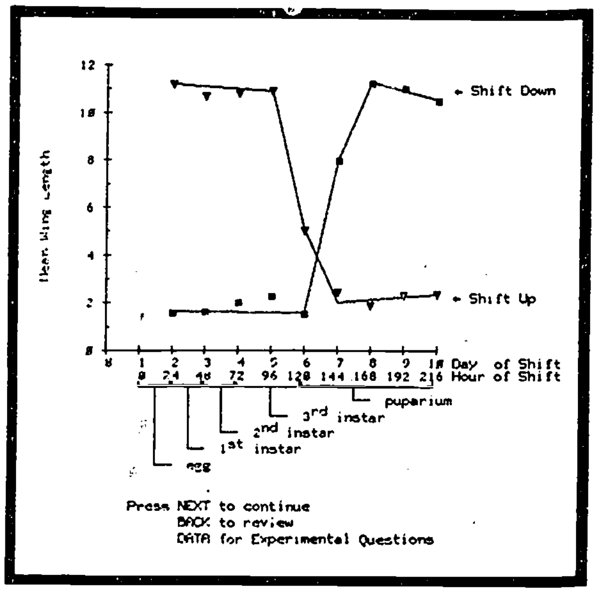


Figure 25. <u>A Temperature Sensitive Morphological Mutant of Drosophila Melanogaster</u>, by David E. Sheppard and Kathleen J. Bergey.

The large number of students electing to major in engineering makes it difficult for some students to get necessary personal assistance in engineering problem-solving. The Chemical Engineering Department is exploring the use of PLATO to provide additional problem-solving experience. A significant area of development in the Chemical Engineering Department has been the receipt of a two-year grant from the National Science Foundation, whereby the department will be able to increase the pace of its development of PLATO lessons.

The goals of the project include the development of PLATO lessons for several types of chemical engineering thermodynamics problems that have been especially troublesome to weaker students. The problems deal with ideal gases, adiabatic steam turbines, and real gas problems. In Figure 26 the student is asked to integrate the energy balance for the system selected. In this example, the student touched three boxes to select a variable (NU), a state (state 1), and a system (tire). Next, the student touched the second box in the equation at the top, which resulted in PLATO's writing "$N_1^t U_1^t$" in the second box. Once the student has completed the required equation, PLATO helps him learn to apply it. Other thermodynamics lessons are planned that will deal with important problem-solving concepts, such as the most effective use of the entropy balance and the reading of various thermodynamic properties charts.

In another lesson under development, the engineering student actively participates in the analysis and solution of simple mass balance problems. Figure 27 shows the diagram of a simple mixer which the student is to analyze in terms of mass balance. Using the material discussed in the lesson, he is asked specific questions that direct him toward an approach to solving the mixer.

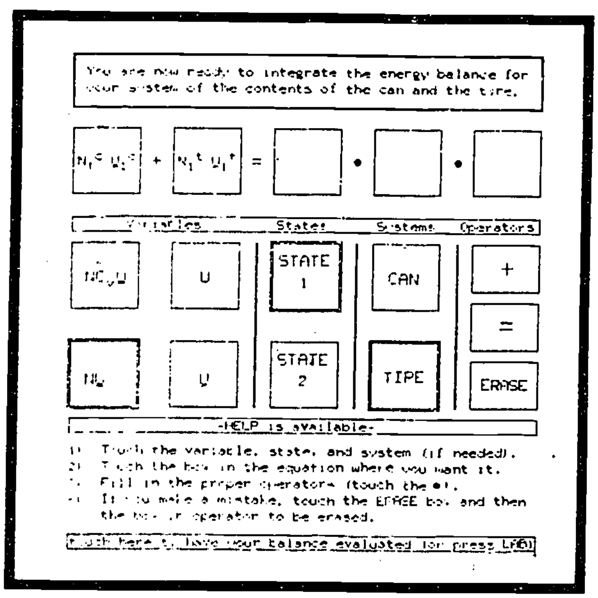


Figure 26. Expansion of An Ideal Gas, by Stanley Sandler and Doug Harrell. Copyright © 1978 by the University of Delaware PLATO Project.

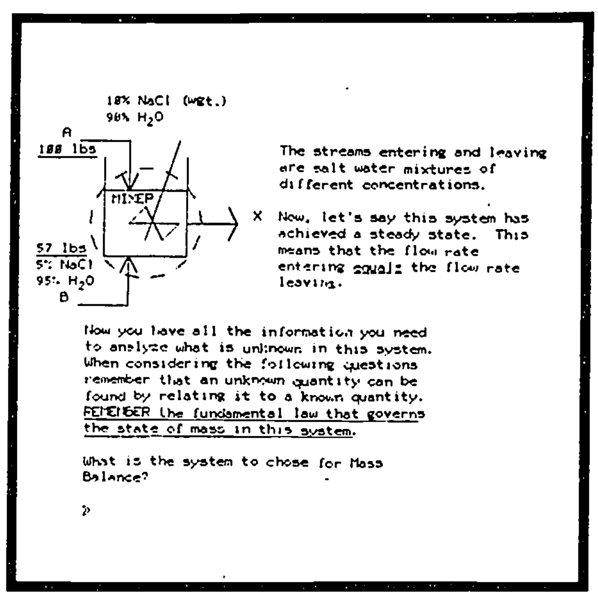


Figure 27. Introduction to Mass Balance, by Robert Pigford and Brian Russell. Copyright © 1978 by the University of Delaware PLATO Project.

Taking advantage of the large package of chemistry lessons written under NSF funding at the University of Illinois, the chemistry department has enjoyed instant success in helping students learn to determine chemical formulas from the composition by weight, to calculate the percentage composition from the known chemical formula, to determine quantitative relations in chemical equations, to make rapid identification of unknowns, and to perform multiple step organic syntheses for electrophilic aromatic substitution reactions. By using the computer to simulate chemical reactions, students get to work with many more samples than is possible in the traditional chemistry lab. PLATO gives the student the freedom to experiment with many methods of solving a given problem.

Figure 28 shows how experience in rapid identification of unknown organic compounds is provided by a lesson in which the student simply asks questions about the compound. The computer provides instantaneous answers, such as giving the boiling point or showing the NMR spectrum of the unknown compound. The vocabulary of the program is adequate to answer all of the experimentally useful questions about the compound under investigation. Figure 29 shows how PLATO teaches the standardization of an aqueous NaOH solution by simulating acid-base titrations. The student must perform every step in the simulation from filling the buret to observing the change of color at the end of the experiment. PLATO makes sure that the student follows correct laboratory procedures, helping out with suggestions when necessary.

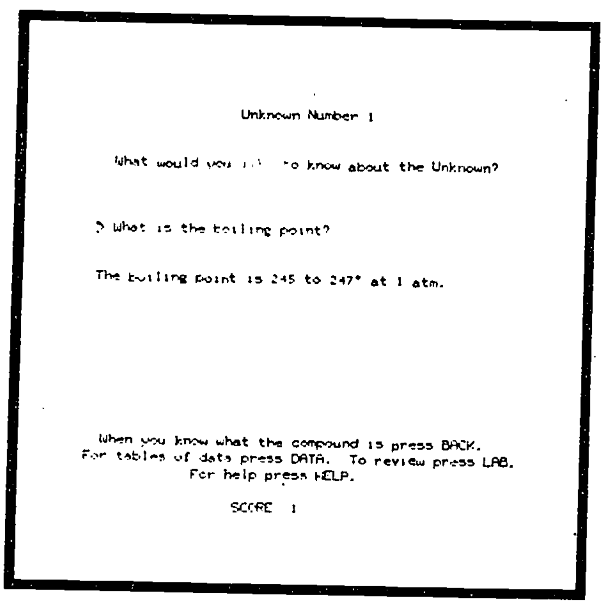


Figure 28. Qualitative Organic Analysis, by Stanley Smith. Copyright © 1972 by the Board of Trustees of the University of Illinois.

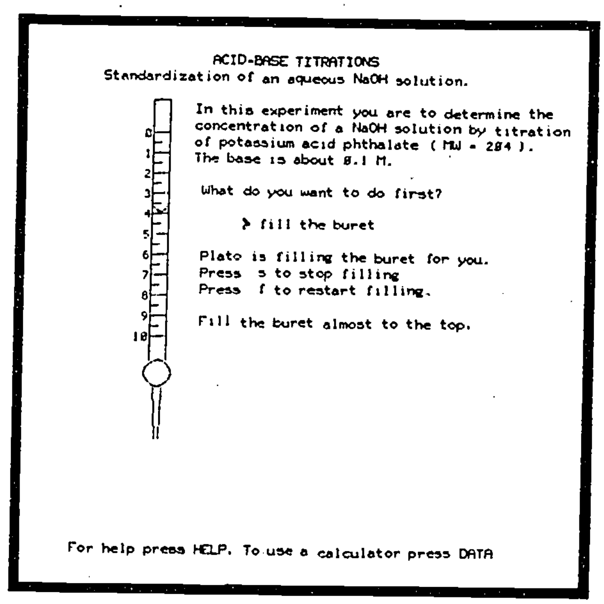


Figure 29. Acid-Base Titrations, by Stanley Smith. Copyright © 1976 by the Board of Trustees of the University of Illinois.

The faculty is investigating the value of PLATO as a tool in teaching topics in civil engineering. A lesson is being developed for use in the statics course, covering the topics of axial force, shear and moment. When completed, this lesson will teach students the concepts of internal force, definitions and methods of calculating internal axial force, and shear and moment, and it will provide drill and practice in calculating these forces.

Figure 30 shows a part of the lesson which explains the concept of internal force. Here the student is shown a rod which is used to suspend a clock from a ceiling. It is explained that internal forces inside the rod hold it together and enable it to support the weight of the clock.

In Figure 31 the student has just completed a section which explains the method of calculating axial force, shear and moment, and is now being asked to use this method to calculate these internal forces at point B. If the student answers correctly, he continues on to the next part of the lesson. If not, the student is given helpful hints, depending on the nature of his error, and then he must try again.

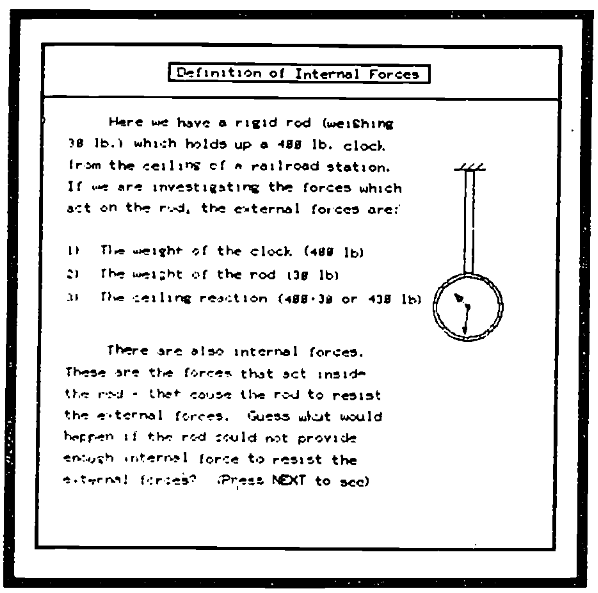


Figure 30. Internal Force, by Eugene Chesson and Jeff Snyder. Copyright © 1979 by the University of Delaware PLATO Project.

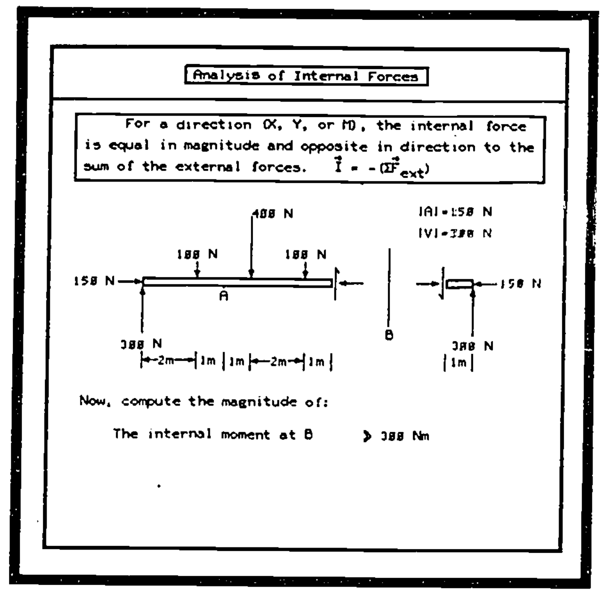


Figure 31. Internal Force, by Eugene Chesson and Jeff Snyder. Copyright © 1979 by the University of Delaware PLATO Project.

A general need of the communication major is skill in the use of at least one system of phonetic transcription. The most effective method of practice for the development of this skill is one involving transcription from oral dictation. Immediate feedback on accuracy significantly increases the rate of development. The Communication Department has found PLATO to be a good medium for providing this kind of practice. PLATO's random-access audio device is used to give the oral dictation. The use of PLATO to present dictation and judge student responses not only decreases the amount of class time that must be devoted to this activity for all students, but also offers an opportunity for those who need more practice time to get it without doing so at the expense of the students who do not.

Figures 32 and 33 show some of the strategies used in PLATO's phonetics programs. Figure 32 shows a talking robot program which students use to experiment with the physiology of phonetic production. This program allows the student to move the tongue, velum, and lips in various positions, and at any time the student can find out what sound would be produced. The computer shows the student not only the side view of the robot's head, but also the palatogram. Figure 33 illustrates another strategy in which PLATO gives the description of a consonant and them asks the student to type the corresponding consonant.

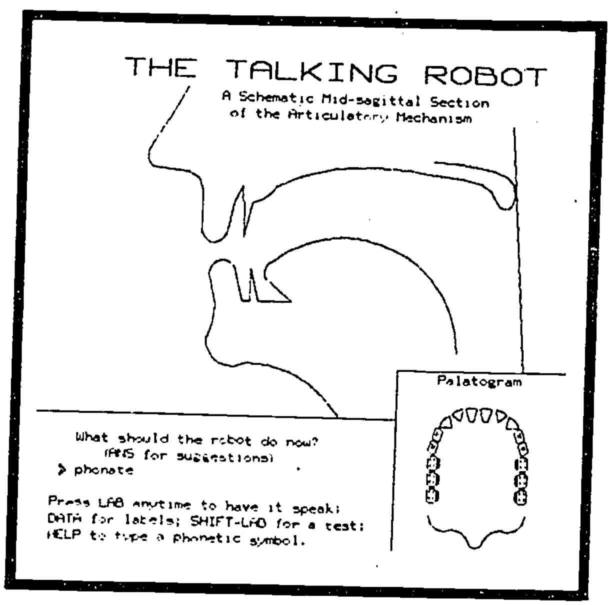


Figure 32. The Talking Robot: A Simulation of Speech Sound Production, by James H. Wilson and Elaine P. Paden. Copyright © 1975 by the Board of Trustees of the University of Illinois.

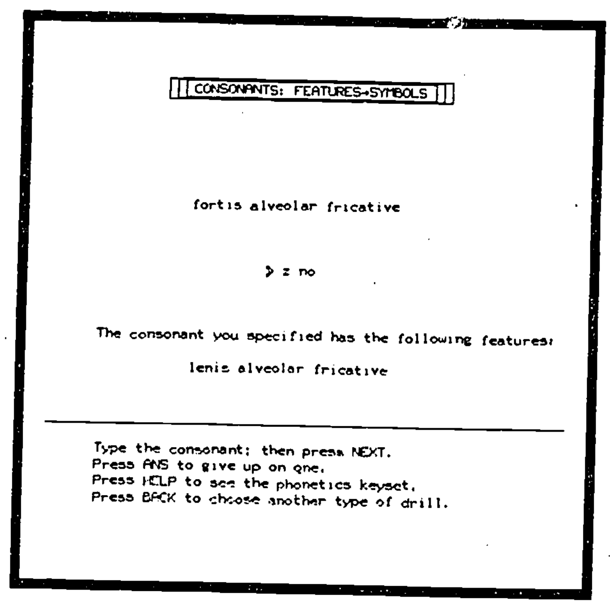


Figure 33. Organogenetic Feature Drills, by James H. Wilson and Elaine P. Paden. Copyright © 1975 by the Board of Trustees of the University of Illinois.

The Computer and Informational Sciences Department is developing a computer literacy package for the humanities on the PLATO system. This package will include lessons on the PASCAL AND BASIC programming languages, PASCAL and BASIC compilers, instruction on the use of a text-editing system, and a lesson on the development and the practice of applications of computers in the humanities. This will be a first step in the department's goal of providing courseware on computer literacy for disciplines on the campus. The text editor will make full use of not only the line-oriented text editing facilities already in the PLATO system, but also of cursor-editing techniques.

Existing lessons on the PLATO system range from advanced topics such as systems programming, numerical analysis, and information processing, to introductory lessons that teach what a computer is, basic computer terminology, and programming languages. Shown below are two lessons that teach FORTRAN programming. In Figure 34, the students are given an "old program," and they are asked to retype it as a "new program" by compressing the if-statements together using Boolean constructs. So far, the student has written the third and fourth lines of the old program as one statement in the third line of the new program, and he is in the process of making the fifth, sixth, and seventh lines of the old program the fourth line of the new program. Figure 35 shows how PLATO can simulate a FORTRAN compiler and help the students understand what the various statements do by allowing them to change their parameters and then observe their execution. In this example, the students are allowed to use four formating statements and two program execution statements. The students can edit the statements, enter data cards, initialize variables, and execute the program to find out the effects of their changes.

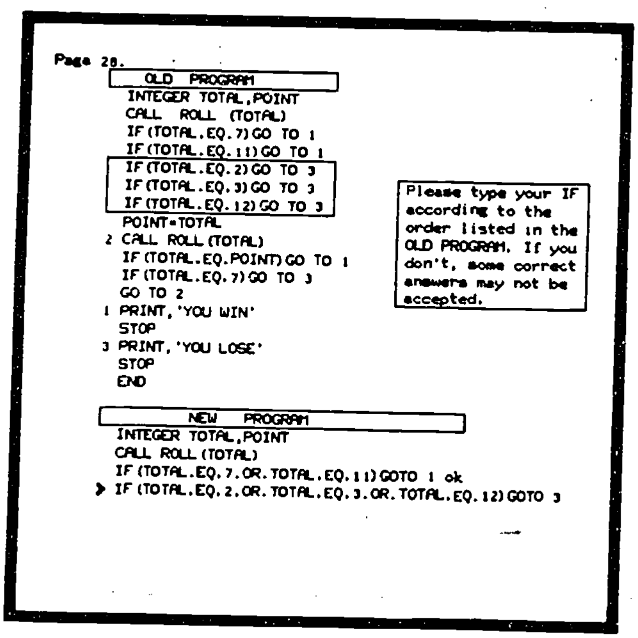


Figure 34. Experience with FORTRAN FORMAT Statements, by Rick Simkin and H. G. Friedman. Copyright © 1977 by the Board of Trustees of the University of Illinois.

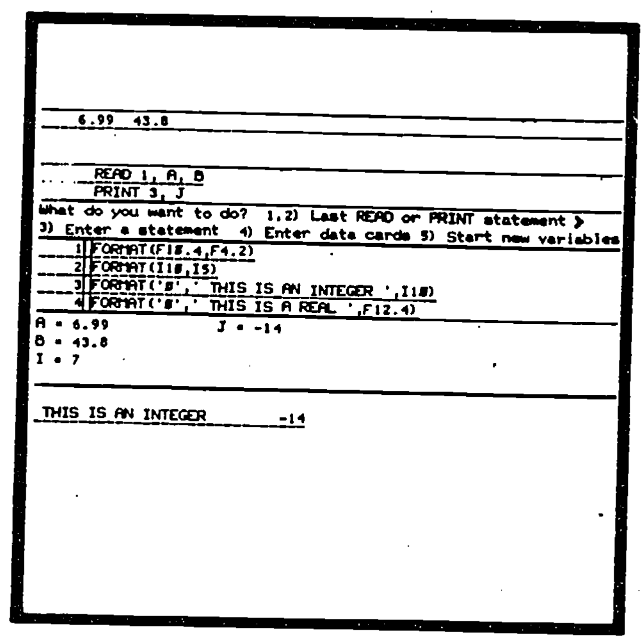


Figure 35. Understanding the FORTRAN IF Statement, by Greg Strass. Copyright © 1975 by the Board of Trustees of the University of Illinois.

During the 1978-79 academic year courseware was also developed which gives computer science majors experience in studying mathematical models of computers. The new lessons use simulation techniques in order to allow the students to design a machine and then simulate the execution of the machine. Figure 36 shows how a student enters the states, tape symbols, and state transitions for a turing machine. After the state transition table has been completed, the student can see the execution of the turing machine occur in real time on the PLATO screen, and the student can step through the process one statement at a time, or the student can see the entire execution carried out automatically. Figure 37 shows what the display looks like when the execution of the table in Figure 36 is halted.

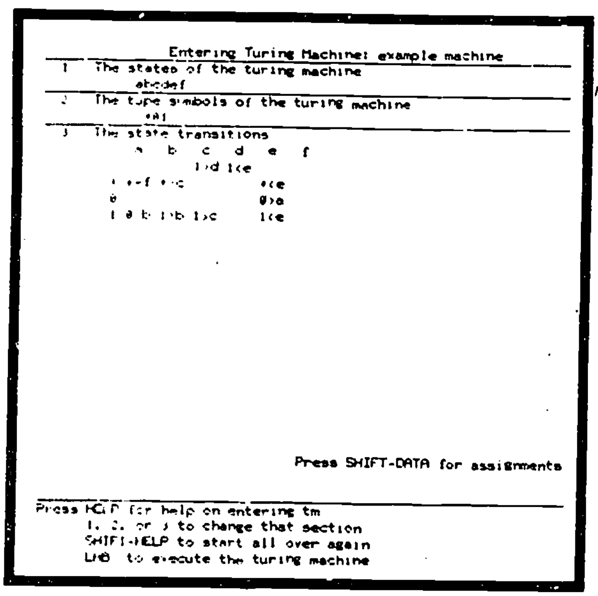


Figure 36. A Turing Machine Simulator, by Ralph Weischedel and Joseph P. Maia. Copyright © 1979 by the University of Delaware PLATO Project.

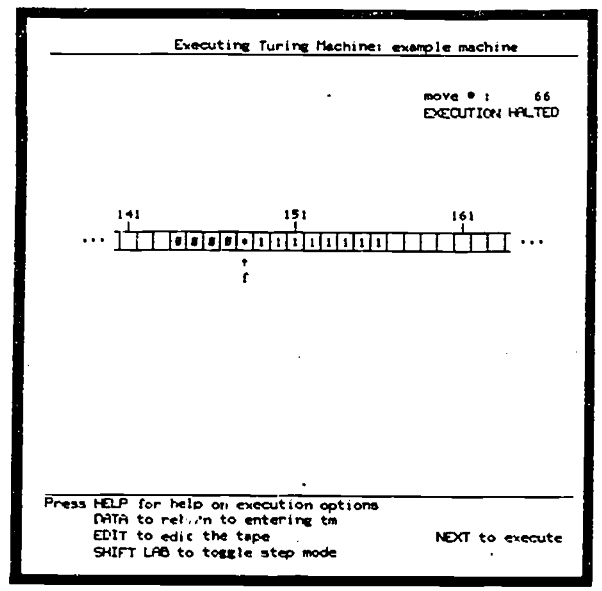


Figure 37. A Turing Machine Simulator, by Ralph Weischedel and Joseph P. Maia. Copyright © 1979 by the University of Delaware PLATO Project.

The Center for Counseling is using PLATO to develop a computer-based career guidance system which allows people to clarify their interests and abilities and helps them explore the characteristics of occupations. The Division of Continuing Education is providing funds to use the system in its adult counseling operations. The system consists of two parts. The first part consists of a computerized version of The Self Directed Search, an interest and ability inventory developed by John Holland (1974). The user spends fifteen to twenty minutes answering 228 items in the six scales of the inventory, namely, realistic, investigative, artistic, social, enterprising, and conventional. Figure 38 shows a sample display from the investigative scale. In this scale, the user indicates whether the activities printed on the screen are liked or disliked by touching the appropriate boxes. The boxes chosen by the user light up.

When the user completes The Self Directed Search, PLATO computes the scores for each of the six categories. After comparing these scores to a data bank of occupations, PLATO then allows the user to ask questions regarding the occupation. In Figure 39 PLATO has been asked to display the employment outlook for the occupation "guidance counselor." The computer memory contains current information on 317 occupations. PLATO allows users to look at any occupations they wish to examine, in an order determined by PLATO.

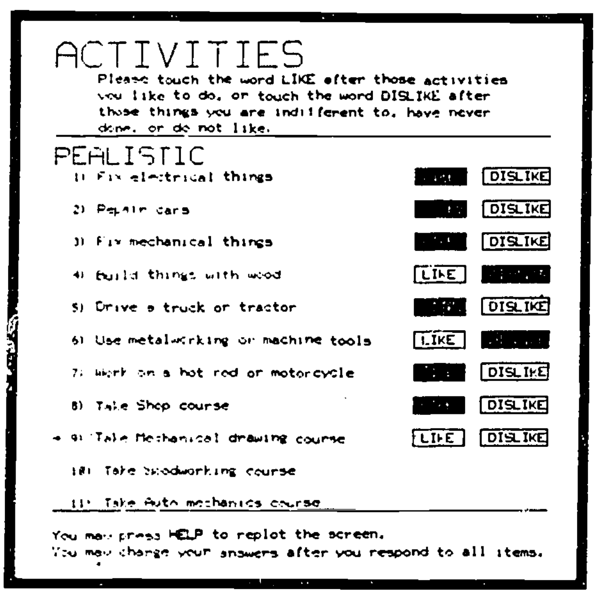


Figure 38. Interest Inventory from The Self Directed Search, by John L. Holland. Copyright © 1977 by Consulting Psychologist Press, Inc.

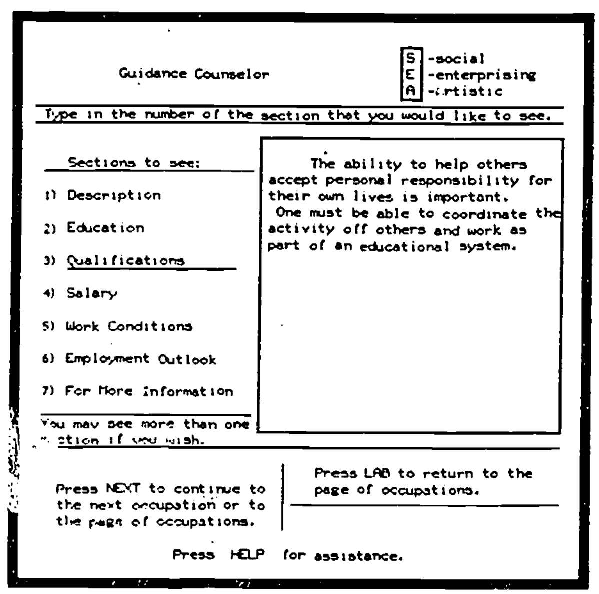


Figure 39. Occupational Search, by Richard Sharf. Copyright © 1977 by the University of Delaware PLATO Project.

This project differs from other computerized guidance projects in several ways. It begins with an assessment of the individual's interest and abilities using a well-validated inventory, rather than an exploration of a large data base of job information without any direction. Its data base includes occupations for college students and adults returning for further education. Access to the system has been made as simple as possible so that people who have never used a computer terminal can benefit from the system. PLATO is being used not only for the delivery of career guidance, but also for the creation of a data base of information on how people make career choices.

During the summer months, the Center for Counseling has given prospective new students the opportunity to explore occupations in the department's new PLATO package "The Occupation Arrow." "The Occupation Arrow," shown in Figure 40, allows users to type the title of any occupation they want information about. PLATO interprets what they have written and provides information about the occupation or about one like it. The seven categories of information available on each occupation are shown in Figure 41. If the occupational title that the user enters is too broad or vague, such as "engineer," the user is referred to an appropriate index of occupations, such as "careers in engineering."

Student response data about occupational information seeking is being generated and stored from this part of the career counseling package. Comparisons will be made between information seeking styles used in "Job Aids" and those used in "Career Search."

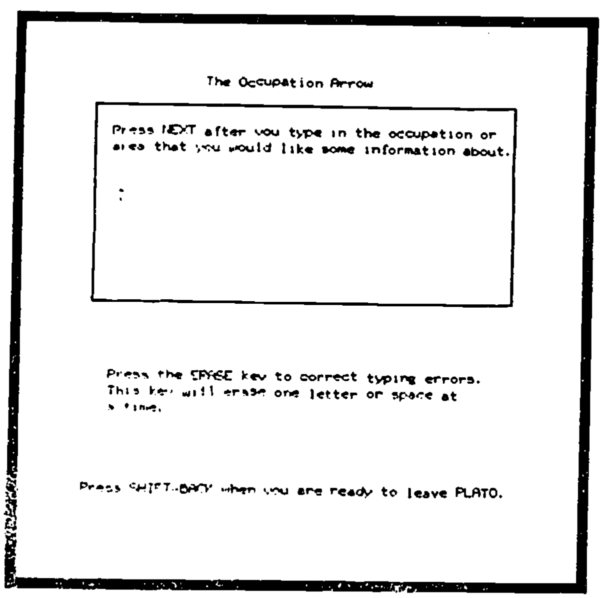


Figure 40. The Occupation Arrow, by Richard Sharf and Mark Laubach. Copyright © 1978 by the University of Delaware PLATO Project.

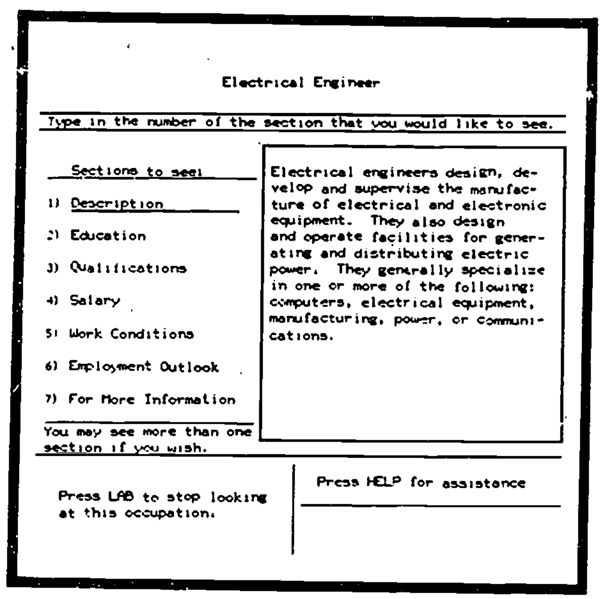


Figure 41. Sample Description from The Occupation Arrow, by Richard Sharf and Mark Laubach. Copyright © 1978 by the University of Delaware PLATO Project.

Economics students are using PLATO to complement their class work and to aid in understanding the concepts of both micro and macro economics. Students can change economic variables such as income employment and price level, and they can observe the effects of these changes in graphs drawn on the display screen. The students can repeat individual lessons as often as they like, and they can move on to more difficult exercises whenever they are ready. The economics package includes quizzes at the end of each lesson to insure that the students have mastered the concepts presented in the simulations.

Reading about how autonomous consumption, induced consumption, autonomous investment, induced investment, government spending and the tax rate affect the economy can be very confusing for the beginning student. PLATO presents these concepts in an individualized, self-paced format, making sure that the student understand them before moving on to more difficult material. Figure 42 shows how PLATO uses graphs to teach the ways in which individual firms can influence prices. Firms operating under monopoly, oligopoly, and monopolistic competition are presented. PLATO asks questions which both insure that the student is reading the graphs correctly and also understanding the basic concepts associated with each graph. Figure 43 shows how a display can be dynamically created while the students is working through a lesson. To make sure that the student understands the interaction of the cost curves, PLATO asks the student questions as the curves are drawn. When the student answers correctly, more of the curves are drawn.

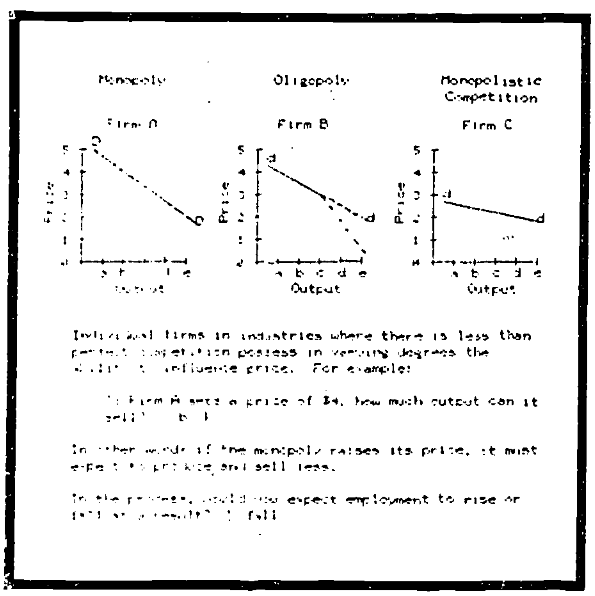


Figure 42 Imperfect Competition, by Donald W. Paden, James Wilson, and Michael D. Barr. Copyright © 1975 by the Board of Trustees of the University of Illinois.

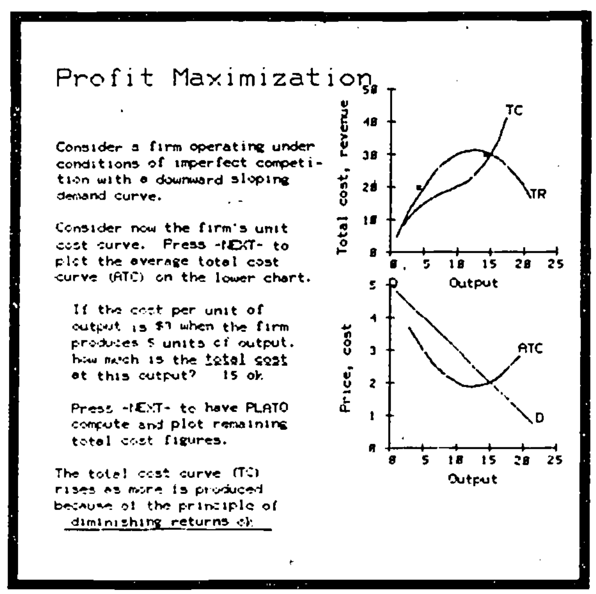


Figure 43. Imperfect Competition, by Donald W. Paden, James Wilson, and Michael D. Barr. Copyright © 1975 by the Board of Trustees of the University of Illinois.

The College of Education uses PLATO to give its students college level instruction in educational psychology, statistics, and analysis of reading retardation. Four instructional lessons have been written by College of Education faculty. First, "Factors in Reading Comprehension" was developed by Dr. Frank Murray for the University's psychological foundations course which, like many other behavioral science courses, often has students replicate appropriate psychological laboratory experiments. Dr. Murray has successfully placed one of these laboratory experiments on PLATO. The exercise, "Factors in Reading Comprehension," is a study of the effects of familiarity with terminology upon reading comprehension. PLATO presents the students with the opportunity to become familiar with certain nonsense words such as "mekog" and "latuk" before these words were embedded, along with other nonsense words, in a prose package typical of grade school instructional exercises. Figure 44 shows a sample display from a story about an inventor who made a machine to play baseball with his children. All of the machine parts are named with nonsense words. PLATO facilitates a high degree of experimental control by presenting each student with a different passage randomized on certain critical dimensions. In addition to participating in an improved laboratory experience, the students also learned about some of the instructional potential of the PLATO system. As a further bonus, the data from the exercise has some scientific merit since the improved design allowed a firmer demonstration of the instructional utility of familiarization effects.

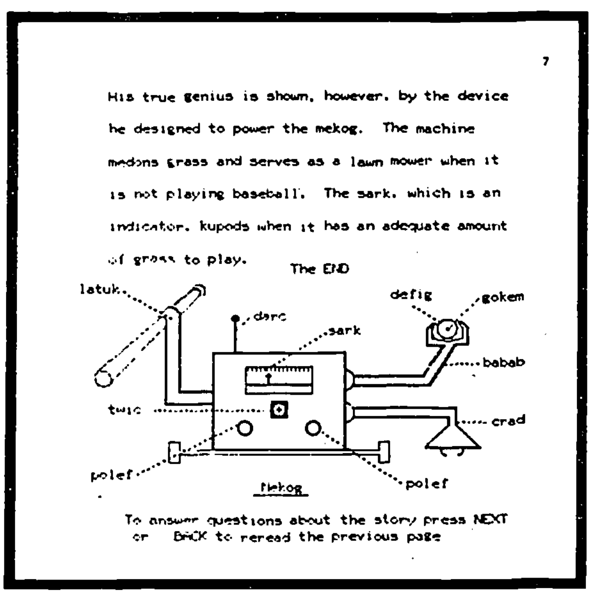


Figure 44. Factors in Reading Comprehension by Frank Murray and Judy Sandler. Copyright © 1978 by University of Delaware PLATO Project. 73

Second, "The Effect of Sampling Variability and Range Restriction of Pearson's Coefficient of Correlation" was developed by Dr. Victor Martuza to introduce education students to the causes and typical effects of sampling variability. After giving some preliminary instruction on the subject, the lesson presents the students with a population of two-dimensional data points and their summary statistics. By choosing the sizes of random samples and restricting the range from which such samples are taken, the students are able to build a collection of samples of various sizes and ranges. For each sample PLATO calculates the means, standard deviations, covariance, and correlation, and the students are able to judge for themselves the reliability of estimates of population characteristics based on their samples. Figure 45 shows a summary of the correlations obtained when 25 samples of 7, 25, 50 and 80 data points were randomly selected from a population of 100 points. The student has correctly answered a question about the effect of sample size on the sampling distribution of correlation.

Third, "FASTER - Fast Accurate Symbol Transcription for Evaluation of Elementary Reading" was designed by Dr. John Pikulski to increase the speed and accuracy with which graduate level reading clinicians record children's responses on an Informal Reading Inventory and a Word Recognition Test. Figure 46 shows how each response is presented in a box at the top of the screen. The clinician must touch the symbol that is used to transcribe the response. PLATO keeps records of how well each clinician does and ranks them in order of speed in a "Hall of Fame" list.

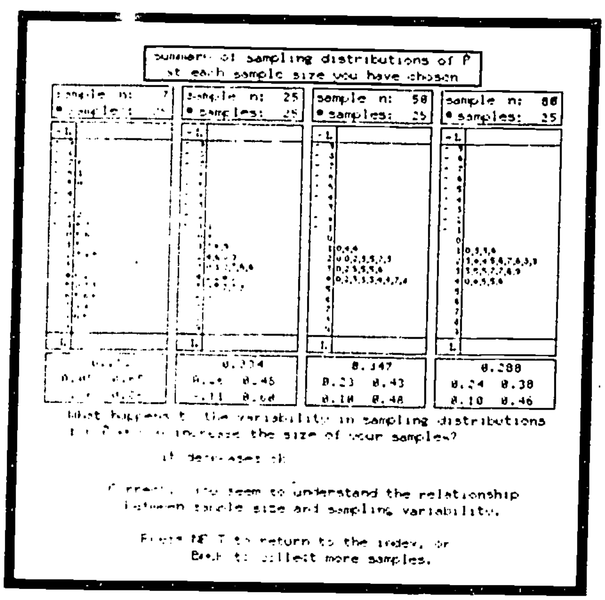


Figure 45. The Effects of Sampling Variability and Range Restriction on Pearson's Coefficient of Correlation, by Victor Martuza and James Trueblood. Copyright © 1978 by the University of Delaware PLATO Project.

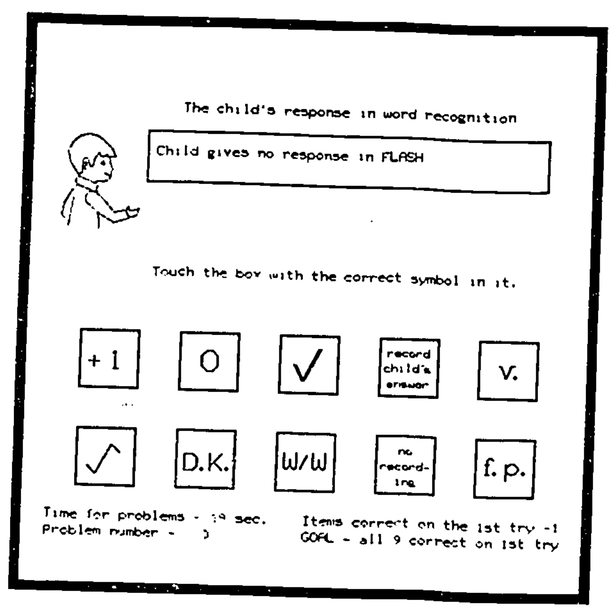


Figure 46. Fast Accurate Symbol Transcription for Evaluation of Elementary Reading, by John Pikulski and Deborah Braendle. Copyright © 1978 by the University of Delaware PLATO Project.

Fourth, the Reading Study Center has developed a package of remedial reading lessons designed to teach both "survival" words (words that an adult needs to be able to recognize in order to get through daily life, such as "telephone" and "stop") and words from the Dolch sight word list. The lessons follow a theme involving spies and secret passwords. The basic instructional lesson is called "SWAT" (Sight Word Attack Team). Lesson "SWAT" teaches words in groups of four. Major activities in the lesson include:

1) watching an animated "briefing" on the word--an amusing illustrated story containing the password in each sentence. Figure 47 shows a story on the word "stop" in which a car has stopped too late and has crashed into a bicycle that gets away undamaged.

2) selecting a password from among four foils to complete a "secret message." In Figure 48 the student is asked to touch the word "telephone."

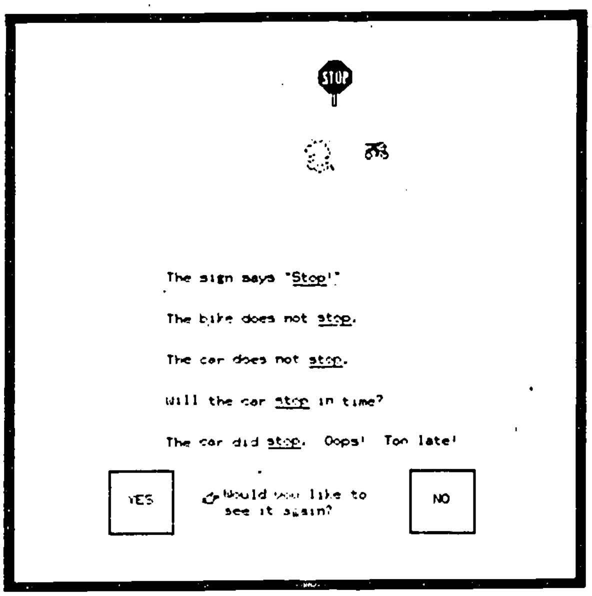


Figure 47. Animated Story from SWAT (Sight Word Attack Team), by Rosalie Bianco, Peter Pelosi, Jessica Weissman, and Bonnie Anderson Seiler. Copyright ©1978 by the University of Delaware PLATO Project.

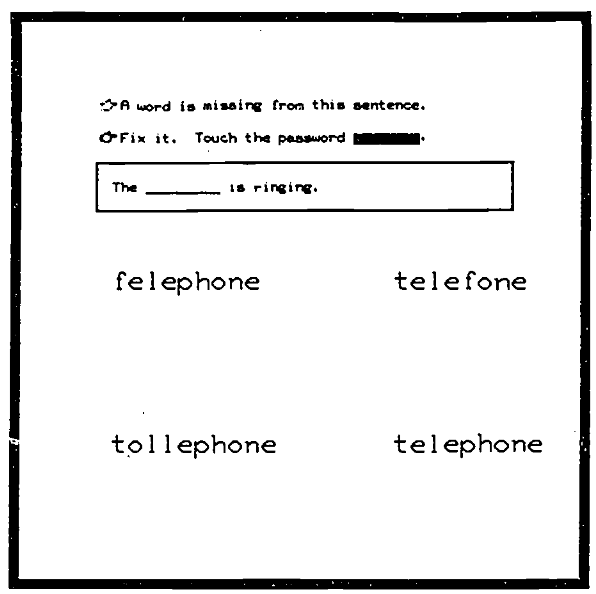


Figure 48. Touch the Password from SWAT (Sight Word Attack Team), by Rosalie Bianco, Peter Pelosi, Jessica Weissman, and Bonnie Anderson Seiler. Copyright © 1978 by the University of Delaware PLATO Project.

3) decoding a message through spelling the password by touching letters on the decoder machine. In Figure 49 the student is spelling the word "stop."

4) finding the password in a scramble of words. Figure 50 shows how the screen looks after the student touches four occurrences of the word "stop."

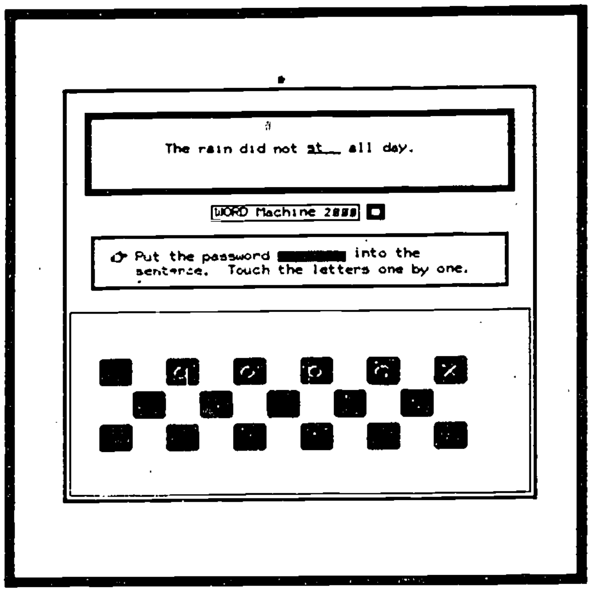


Figure 49. Spell the Password from SWAT (Sight Word Attack Team), by Rosalie Bianco, Peter Pelosi, Jessica Weissman, and Bonnie Anderson Seiler. Copyright © 1978 by the University of Delaware PLATO Project.

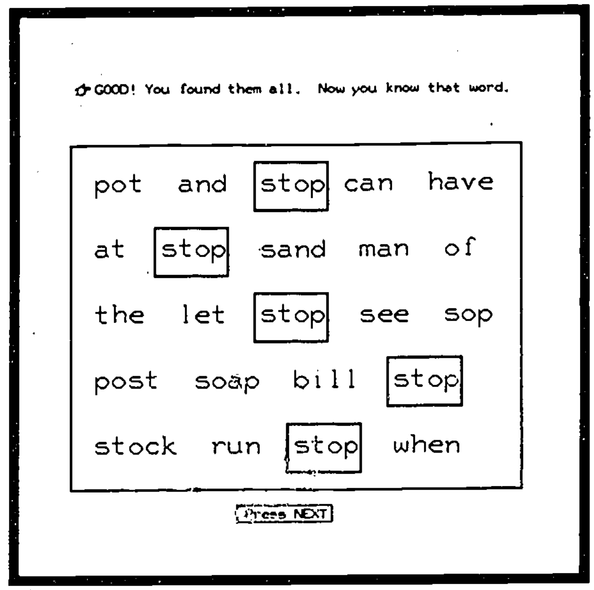


Figure 50. Finding the Passwords in SWAT (Sight Word Attack Team), by Rosalie Bianco, Peter Pelosi, Jessica Weissman, and Bonnie Anderson Seiler. Copyright © 1978 by the University of Delaware PLATO Project.

5) telling real spies from fake ones by deciding whether the sentence the spy is saying contains the password. In Figure 51 the student is being asked whether the spy is saying the password "bank."

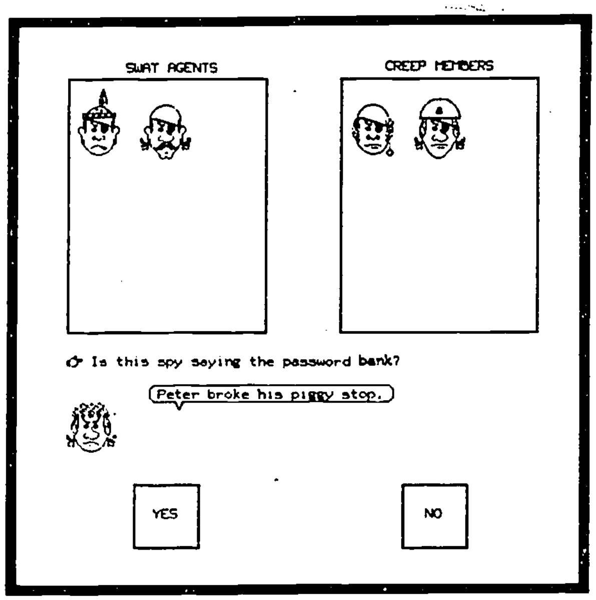


Figure 51. Identifying the Spy in SWAT (Sight Word Attack Team), by Rosalie Bianco, Peter Pelosi, Jessica Weissman, and Bonnie Anderson Seiler. Copyright © 1978 by the University of Delaware PLATO Project.

The reading center has also developed instructional games in which the students practice distinguishing the target words from each other. In "Make a Spy," for example, the students' reward for "guessing" the secret message is the chance to select parts of a spy disguise for themselves. The students like to fix sentence after sentence just for the opportunity to make their own funny spy faces. Like all other reading materials developed on PLATO, the SWAT package uses random access audio to deliver instructions and feedback to the student. However, where previously written lessons automatically initiate the delivery of audio, the SWAT lessons use a different strategy known as learner-controlled audio. With learner-controlled audio, all of the directions and feedback are written on the screen. The students initiate the messages by touching the screen when they are ready to listen. After the students have heard a message once, they are able to touch the messages in order to hear them again.

There are three advantages of learner-controlled audio over more conventional programming techniques. First, students are never surprised by messages which they are not ready to hear. Second, students can hear any message again if they need help. Third, since the messages are written on the screen, the students see them many times and become familiar with them. Eventually, the students learn how to read the messages by themselves.

The English Department has found PLATO to be a valuable tool for improving writing skills, especially for those students taking the three credit, pre-E110 course taught by the Writing Center staff which uses feedback from PLATO to individualize student programs both on the computers and in the small groups of four students per instructor taught at the Writing Center. Designed and put on PLATO by community college English teachers in Illinois, the lessons cover punctuation, sentence structure, spelling, paragraph structure, verbs, and verb form. They also include diagnostic programs which gather information on individual students' skills in several areas of usage and punctuation.

Figure 52 shows a simple drill in which the student is asked to identify parts of speech in a sentence. In this example the student was first asked to identify the pronoun in the sentence; the student correctly answered "their." The student was then asked to identify that pronoun's antecedent; the student correctly answered "children," and was appropriately congratulated. A special feature of this lesson is the interactive help which students receive when they answer incorrectly. In this example if the student had answered "are" instead of "their," PLATO would have responded that "are" is a verb, not a pronoun.

Figure 53 shows a more complex exercise in which the student is given a paragraph which contains misused words. The student is asked to identify and correct the misused words. When a misused word has been corrected, PLATO crosses it out and prints the correct word above it. In the example given the student has already corrected the words "they're" and "which" and "Irregardless," and is now changing "hisself" into "himself."

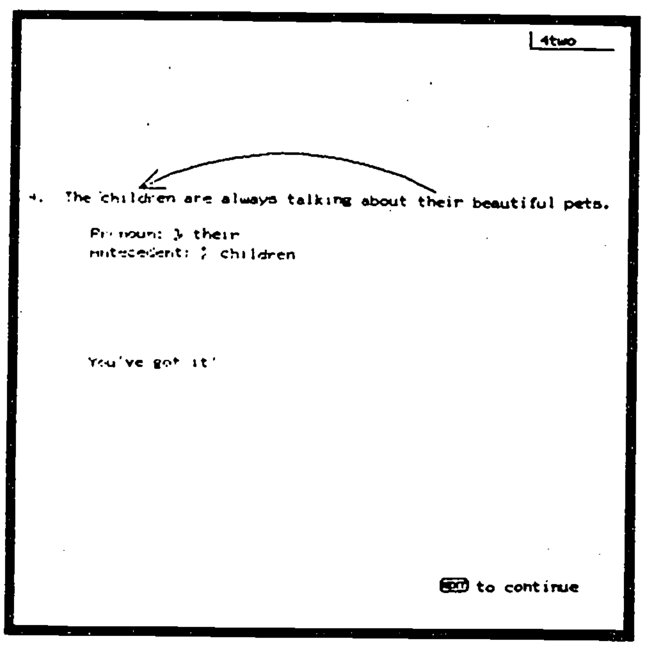


Figure 52. Pronoun Agreement, by Delores Lipscomb. Copyright © 1976 by the University of Illinois at Chicago Circle.

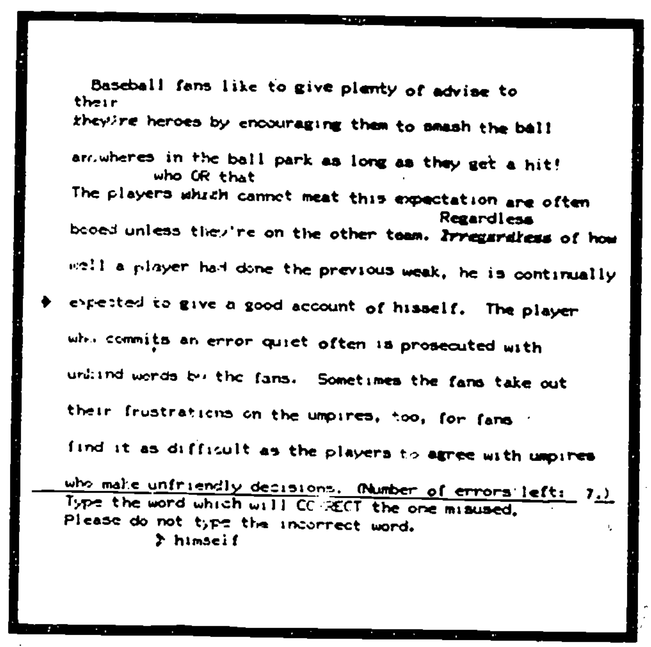


Figure 53. Paragraph Editing: Word Usage, by Errol M. Magidson and Mitsuru Yamada. Copyright © 1974 by the City College of Chicago.

During the 1978-79 academic year, the Writing Center began to develop a package of lessons designed to help students recognize and learn the differences among informal, classroom, and conversational English. This package is built around a test diagnostic of eight language features common to speakers of Black English vernacular. Some of the features are also present in the speech of foreign students of English, especially with those with a Hispanic background. Figure 54 shows a sample screen display from a lesson on the usage of "is" and "are." PLATO shows the student a sentence, and then asks the student to touch a box indicating whether that sentence is classroom English, conversational English, or informal English. When the student touches the correct box, PLATO puts the sentence into the proper place in the chart. Figure 55 shows how PLATO goes on to help the student learn how to pick out correct verb forms to turn positive sentences into negative sentences. PLATO shows a positive sentence and then asks the student to touch the box which contains the correct phrase for making a new classroom English negative sentence. When the student touches the correct box, PLATO displays the new sentence.

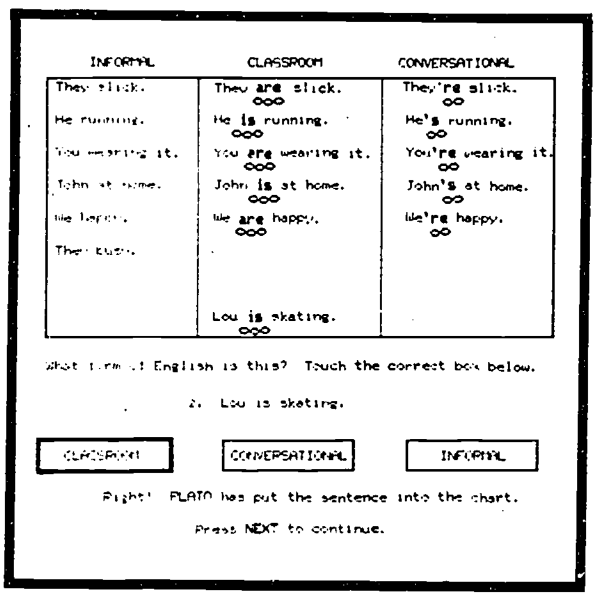


Figure 54. IS and ARE, the Missing Links, by Louis Arena, Marcia Peoples, and Jessica Weissman. Copyright © 1979 by the University of Delaware PLATO Project.

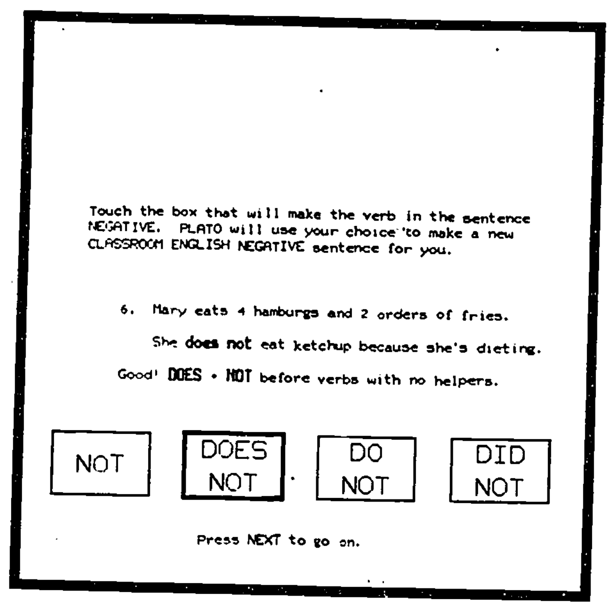


Figure 55. The Power of Negative Thinking, by Louis Arena, Sophie Homsey, and Jessica Weissman. Copyright © 1979 by the University of Delaware PLATO Project.

PLATO became part of the Freshman Honors Program in Dover during the Spring Semester of 1978. With four terminals installed on the Wesley campus, it became a very popular aspect of the program. Use among the students and staff took several forms. In addition to using PLATO in their classes, some of the students were interested in programming their own lessons. Fifteen honors students became lesson authors. They learned to do drawings, compose music, and make animations. One of the students wrote a game called Dive Bomber. The player is the commander of a ship which is being attacked by a dive bomber. The player is asked to give an estimate in meters of how far away the plane is. The object of the game is to shoot down the plane before it destroys the player's ship. Each time the player misses he is told how far he overshot or undershot, and from that information he can calculate the proper distance for the next shot.

Several Honors faculty became PLATO authors and designed lessons to be used by their students. One lesson designed for class plots a vector field $V = M(x,y)i + N(x,y)j$. The student is asked to give functions M and N. Any valid expressions in x and y may be used. Figure 56 shows how PLATO plots the corresponding vector field. Another faculty lesson was written in a game format to teach polar coordinates. In this game the student must aim the cannon of a tank at a target and fire the proper distance to score a hit. The student aims the tank by giving the polar coordinates (r,θ) of the target. If the target is hit, points are given to the student with the goal being to win 4000 points in 20 shots. Some targets are worth more than others, based on the difficulty of the coordinates and the size of the target. Figure 57 shows the result of hitting a target with coordinates (60,70).

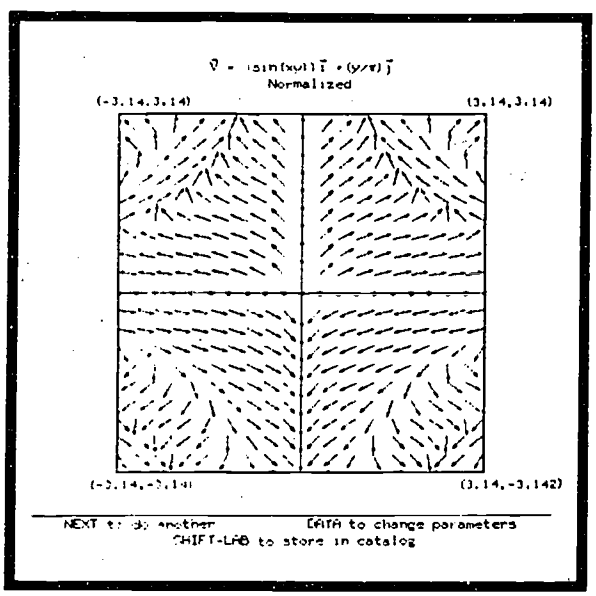


Figure 56. Vector Field Plotting, by Morris Brooks. Copyright © 1978 by the University of Delaware PLATO Project.

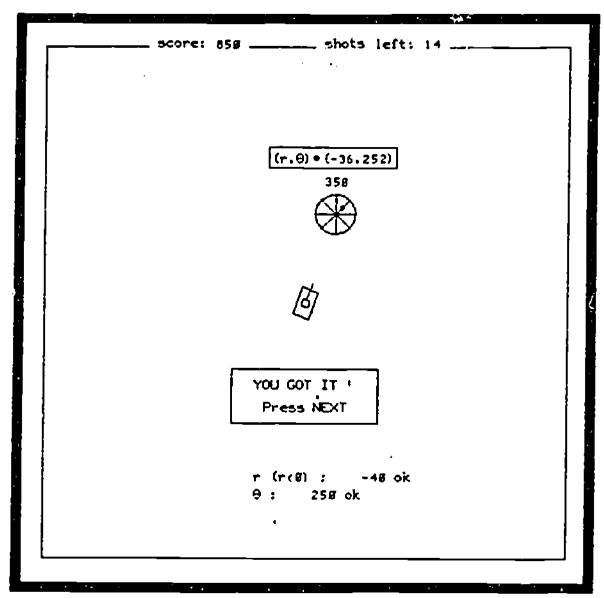


Figure 57. Polar Coordinate Game, by Alan Stickney. Copyright © 1978 by the University of Delaware PLATO Project.

During the 1978-79 academic year, Honors students began to receive academic credit for lessons which they researched, designed, and programmed using topics suggested by faculty members. Two examples are PLATO lessons in logic and differential equations. Figure 58 shows a sample display from the logic lesson. The user types in the premises and conclusions in standard logical notation. PLATO then analyzes the logical argument and tests its validity. PLATO then responds with the judgment on the validity of the argument. This lesson also reviews basic concepts in symbolic logic.

Figure 59 shows a sample display from the differential equations lesson which graphically illustrates the Cauchy-Euler method of numerically approximating the solution of an ordinary differential equation. The user is asked to supply a function of two variables $f(t,x)$ and initial conditions. PLATO responds by displaying the graph of the approximating solution. This lesson is useful in studying qualitative properties of differential equations for which it is difficult to obtain analytical solutions.

PLATO has also been used extensively in a mathematics curriculum developed by Professors Brooks and Stickney. Partially funded by an Improvement of Instruction grant, this curriculum includes the basic properties of the integral, differentiation, sigma notation, numerical approximation, and root finding. Students are able to use PLATO to see their test scores, semester averages, and relative standing in the class.

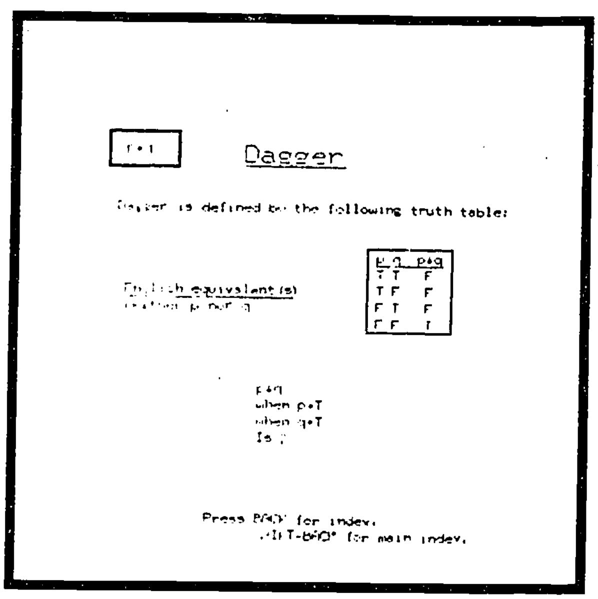


Figure 58. Logic, by Gerard C. Weatherby and Robert Scott. Copyright © 1978 by the University of Delaware PLATO Project.

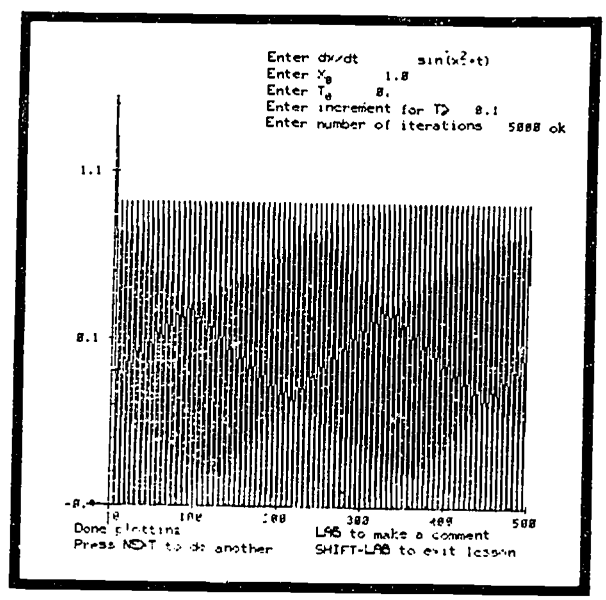


Figure 59. The Cauchy-Euler Method of Approximating Differential Equations, by Tanner Andrews and Stan Samsky. Copyright © 1979 by the University of Delaware PLATO Project.

Faculty members in the areas of clothing construction, home economics, foods, interior decoration, retailing, and flat pattern have become interested in the teaching and research potential of the PLATO system. Prior to the start of their project the only home economics lesson on the system dealt with nutrition. At the present time they are developing lessons in measurement, pattern measurement, ease requirement, alteration practice, fitting, determining pattern size and figure type, and determining needed alterations.

One of the criteria in lesson development has been to make full use of the special features of PLATO. The touch panel is used in practicing pattern alteration. In this lesson the student is presented with a line drawing of a pattern piece. The student touches the pattern piece to indicate the location of the alterations to be made, as shown in Figure 60. PLATO then performs the alteration and informs the student of any errors that have been made.

Video projection will be used to teach students how to determine needed alterations. Ill-fitted garments will be projected on the screen, and the student will be asked to identify and correct the problem. ᵀf the student answers correctly, the correct fit will be shown. ents may also work on alterations for their own fitting problems. igure 61 shows the measurement chart students fill in to determine what alterations they need.

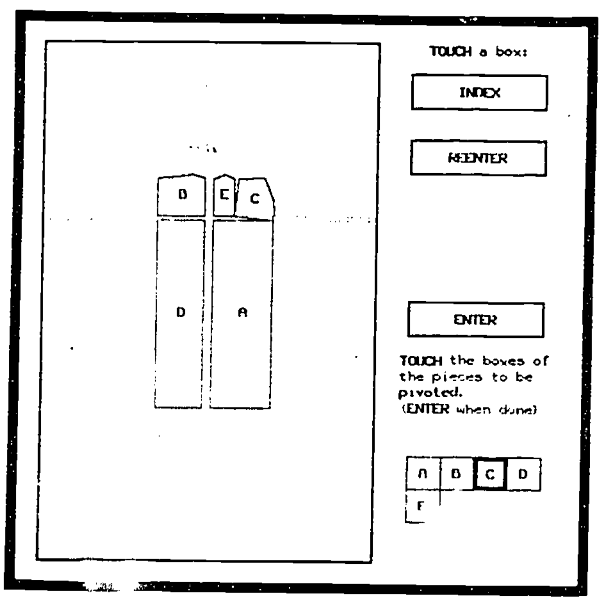
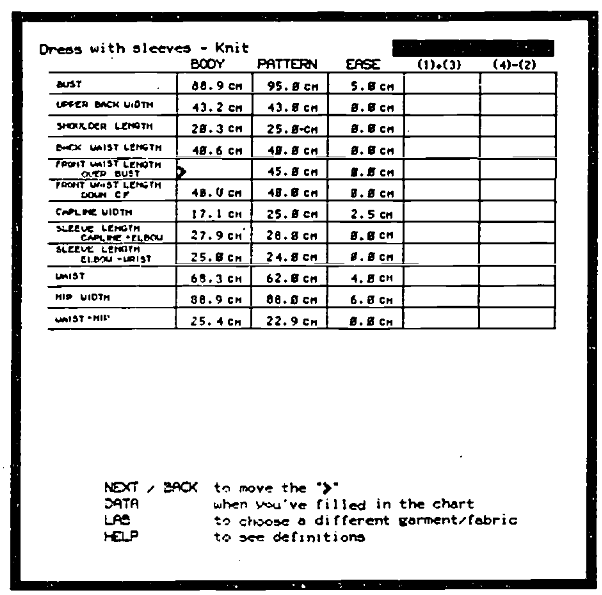


Figure 60. Alteration Laboratory, by Frances W. Mayhew, Dorothy Elias, Frances K. Smith and D. G. Anderer. Copyright © 1976, 1977, 1978, 1979 by the University of Delaware PLATO Project.



Dress with sleeves - Knit

	BODY	PATTERN	EASE	(1)+(3)	(4)-(2)
BUST	88.9 cm	95.0 cm	5.0 cm		
UPPER BACK WIDTH	43.2 cm	43.0 cm	0.0 cm		
SHOULDER LENGTH	20.3 cm	25.0 cm	0.0 cm		
BACK WAIST LENGTH	40.6 cm	40.0 cm	0.0 cm		
FRONT WAIST LENGTH OVER BUST	>	45.0 cm	0.0 cm		
FRONT WAIST LENGTH DOWN CF	40.0 cm	40.0 cm	0.0 cm		
CAPLINE WIDTH	17.1 cm	25.0 cm	2.5 cm		
SLEEVE LENGTH CAPLINE - ELBOW	27.9 cm	28.0 cm	0.0 cm		
SLEEVE LENGTH ELBOW - WRIST	25.0 cm	24.0 cm	0.0 cm		
WAIST	68.3 cm	62.0 cm	4.0 cm		
HIP WIDTH	88.9 cm	88.0 cm	6.0 cm		
WAIST - HIP	25.4 cm	22.9 cm	0.0 cm		

NEXT / BACK to move the ">"
DATA when you've filled in the chart
LAB to choose a different garment/fabric
HELP to see definitions

Figure 61. Determining Pattern Alterations, by D. G. Anderer, Dorothy Elias, and Frances K. Smith. Copyright © 1976, 1977, 1978, 1979 by the University of Delaware PLATO Project.

The University of Delaware's institutional research unit is using PLATO to produce line and bar graphs for its reports. Data for these graphs are entered into PLATO by means of the terminal keyset, and PLATO graphs the data on the display screen. The PLATO Project's Versatec copier is then used to transfer the screen displays into hardcopy, and these copies become part of the institutional research unit's reports. Once stored, the data can be used again in subsequent years, and it will serve as a data base for doing more detailed research and reports. When completed, this project will greatly simplify the production of graphs for institutional research, which up until now has had to rely on hand-drawn graphics. The possibility of using a Hewlett-Packard four-color plotter is also being explored. It is also planned to link the PLATO programs to other data bases in the University's administrative computer system.

Examples of the output from this project are seen in Figure 62 which shows the Fall undergraduate enrollment on the Newark campus by college and division, and in Figure 63 which shows the Fall undergraduate major enrollment in the physical science departments of the College of Arts and Sciences.

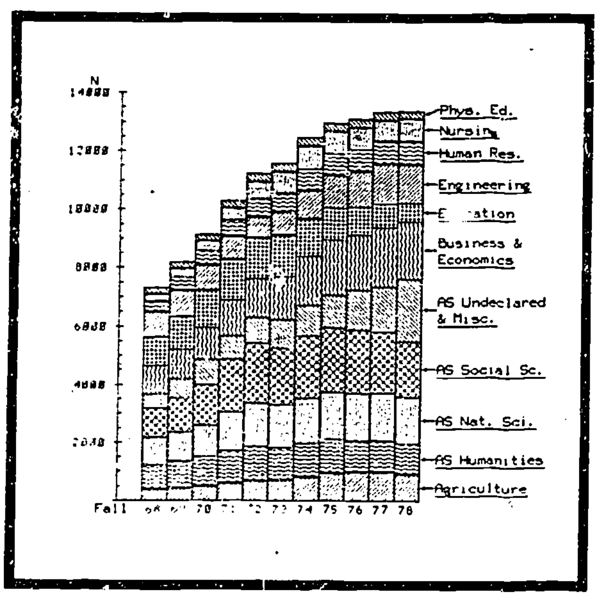


Figure 62. Sample Screen Display from the Institutional Research Graphics Program, by Carol Pemberton and Brand Fortner. Copyright © 1979 by the University of Delaware PLATO Project.

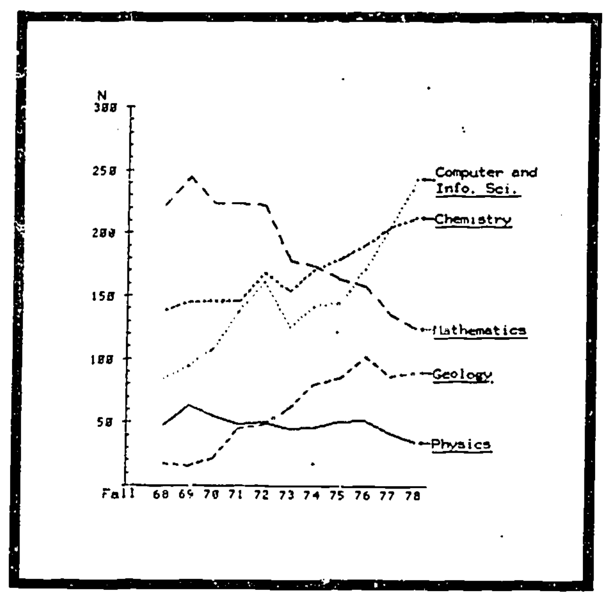


Figure 63. Sample Screen Display from the Institutional Research Graphics Program, by Carol Pemberton and Brand Fortner. Copyright © 1979 by the University of Delaware PLATO Project.

Languages faculty members have worked very hard to successfully improve instruction in Latin, Spanish, French, German, and ancient Greek.

One lesson of benefit in learning almost any foreign language is a substitution drill driver being developed by Dan Williams. Its outstanding feature is an editor that guides teachers through the steps of creating their own curricula of drills without having to learn programming or to provide a programmer. The teacher can insert drills in almost any alphabetic language.

Figure 64 shows a drill being written by a teacher of ancient Greek. PLATO has separated the teacher's sentence into a column of words so that the teacher can indicate what the student should do with the sentence. The teacher has underlined the third word, to show that the student will be asked to substitute a different word, and is now putting boxes around the words that the student should change grammatically as a result of the substitution.

The completed drill, as a student sees it, is shown in Figure 65. The model sentence is shown, with an underlined word and the word (in brackets) that the student should substitute. The student has typed the resulting sentence but has made three mistakes. The lesson shows that the first word ends with the wrong kind of letter "s," and that the second word has been given a smooth breathing mark instead of a rough one. The x's under the fifth word mean that it is also incorrect.

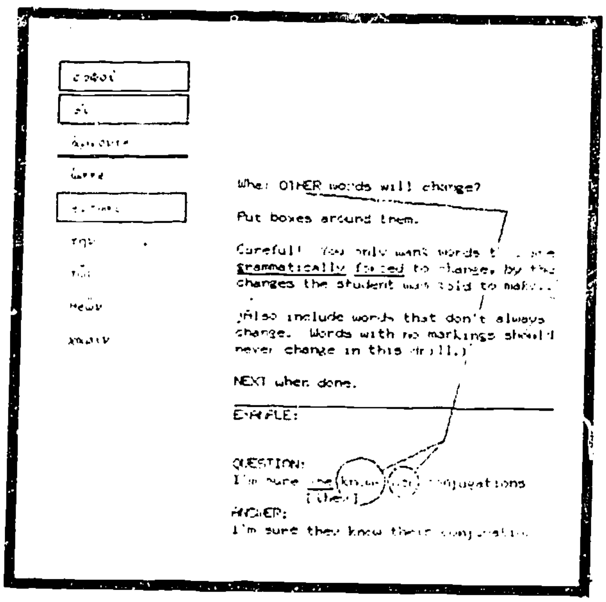


Figure 64. Substitution Drill Editor, by Dan Williams. Copyright © 1977, 1978 by the University of Delaware PLATO Project.

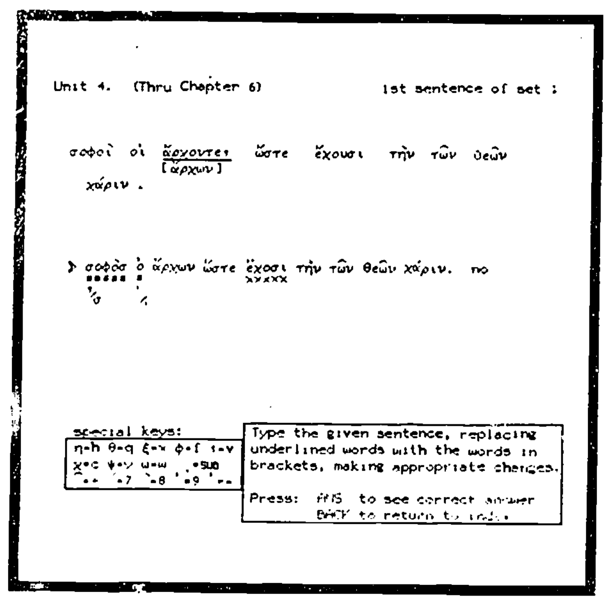


Figure 65. Substitution Drill, by Dan Williams. Copyright © 1977, 1978 by the University of Delaware PLATO Project.

Professor Culley has completed the development of a Latin verb-form drill called "The Verb Factory." The main feature of this lesson is the interactive help which PLATO gives in helping the students get the right answer. In Figure 66, PLATO has asked the student to write in Latin the phrase "You (singular) are well." The student has responded by answering "valetis," and PLATO has judged the answer incorrect, stating that the stem, vowel, tense, and mood are okay, but the personal ending is wrong. If the student encounters severe difficulty in getting the right answer, PLATO takes him through a check list of grammatical components to help him isolate where his problem is, and the Verb Factory manufactures the correct verb form, one part at a time.

The Verb Factory also contains a Latin verb speed-game called the "Cursus Honorum." The Cursus Honorum allows the student to set switches in the Verb Factory by touching boxes on the display screen, thereby choosing the vocabulary and the verb forms for the computer drill. PLATO proceeds to generate the exercises according to the parameters set by the student. PLATO keeps score based on studant response time. In Figure 67 the student has been asked to write the third person plural present active indicative form of "iacere," and the student has correctly entered the answer "iaciunt." The student received 241.4 points for the speed with which he answered the exercise, giving him a total number of 1,325 points, which is displayed at the top of the screen along with the ranks which the student has achieved in the Cursus Honorum.

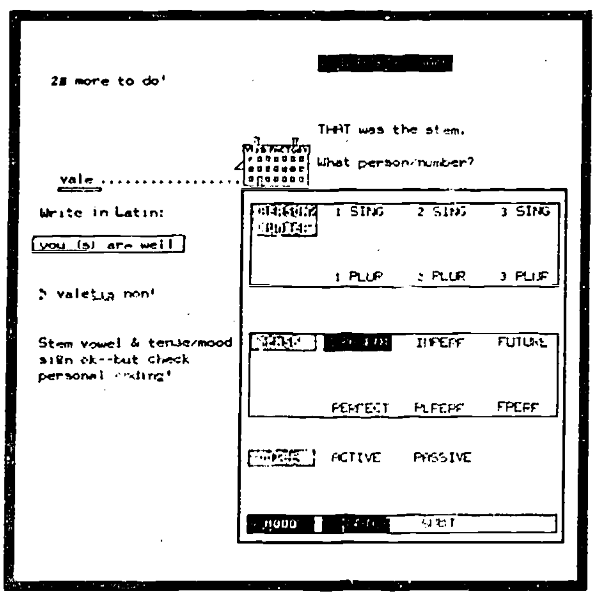


Figure 66. The Verb Factory, by Gerald R. Culley. Copyright ©1978 by the University of Delaware PLATO Project.

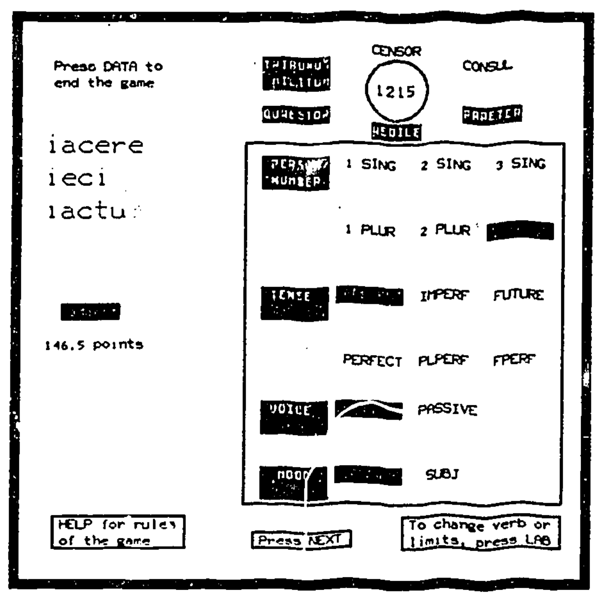


Figure 67. Cursus Honorum: A Latin Verb Game, by Gerald R. Culley. Copyright ©1978 by the University of Delaware PLATO Project.

Touché, a word-order lesson developed by Professor George Mulford, uses PLATO's touch panel to help students learn word order in a foreign language. Figure 68 shows how this lesson presents the students with all of the words of the sentence displayed in a scrambled manner in a vertical column. Students are asked to touch each word on the screen in the proper order, building the correct sentence word by word. As the students touch each word, it disappears and then reappears at the top of the screen, as long as the student continues to touch the words in the right order. Figure 69 shows the sentence almost complete. When the last word has been touched, an English translation appears at the bottom of the screen. If the student makes a mistake by touching a word out of order, the screen goes blank and the whole sentence reappears in a newly scrambled order. Using this simple procedure it has been possible to design exercises covering many of the difficulties encountered in the first two years of instruction in French. To correctly complete the sentences, the students must recognize parts of speech, verb agreements, different types of object structure, and the grammatical function of each noun or pronoun. An explanatory display preceding each exercise points out the rules governing the particular word order problem being drilled; the student can recall that display along with the completed correct sentence and its English translation at any time by touching the HELP box.

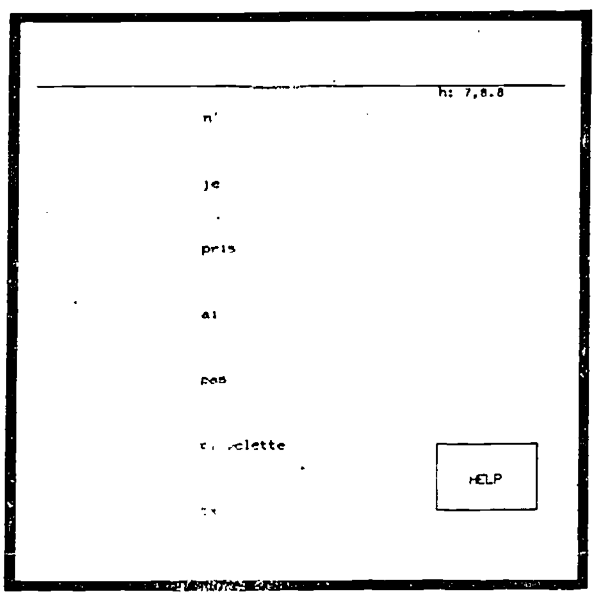


Figure 68. Touché: A French Word Order Touch Lesson, by George Mulford and Dan Williams. Copyright © 1978, 1979 by the University of Delaware PLATO Project.

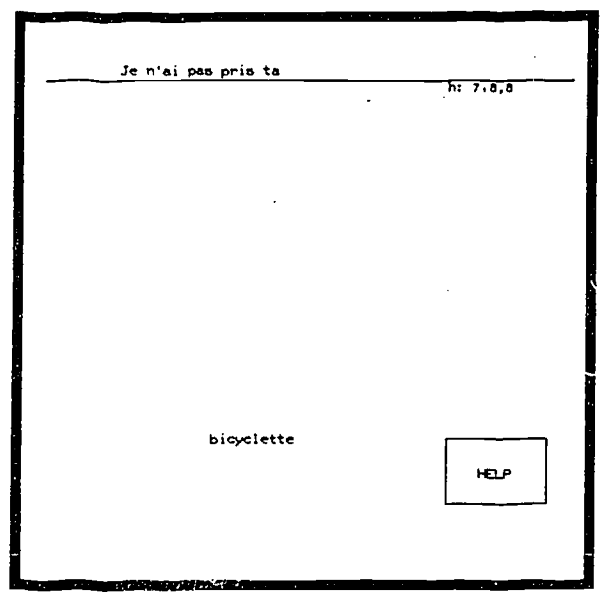


Figure 69. Touché: A French Word Order Touch Lesson, by George Mulford and Dan Williams. Copyright © 1978, 1979 by the University of Delaware PLATO Project.

The University of Delaware's entering freshman class is above the national average for college-bound seniors on both the SAT-Verbal and SAT-Math scores. Yet as these students review high-school mathematics topics in beginning college math courses, forty percent of them receive D or F grades or withdraw. As part of a continuing effort to meet this problem head-on, the Math Department introduced PLATO into its pre-calculus offerings during the Spring Semester of 1978. Students were encouraged to make use of PLATO lessons developed at the University of Illinois to improve their ability in manipulating algebraic expressions, solving linear and quadratic equations, utilizing trigonometric relationships, and graphing straight lines.

The mathematics lessons consist primarily of drill-and-practice exercises with tutorial introductions. Figure 70 shows a sample display from a lesson which allows students to practice the series of steps necessary to solve a complicated equation in one variable. Students may request that PLATO guide them through the necessary steps and perform all the calculations, or they may choose to specify all the steps and do the calculations themselves. In this case the student has worked two steps of a problem, and in answer to PLATO's question as to what should be done next, the student has responded "combine left." PLATO indicates that the student must first expand the term with parentheses.

Figure 71 shows a sample display from a lesson on the y-intercept. PLATO presents open linear equations for students to complete as they wish, and then the graphical representations of the finished equations are displayed. Three lines have been displayed corresponding to the numbers 4, 0 and -2, which the student has typed into the equation.

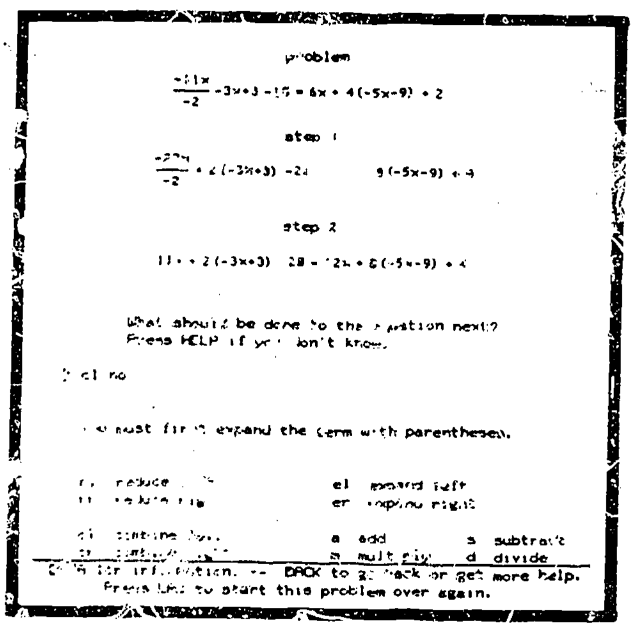


Figure 70. Equations with Fractions, by Mitsuru Yamada. Copyright © 1976 by the Community Colleges of Chicago.

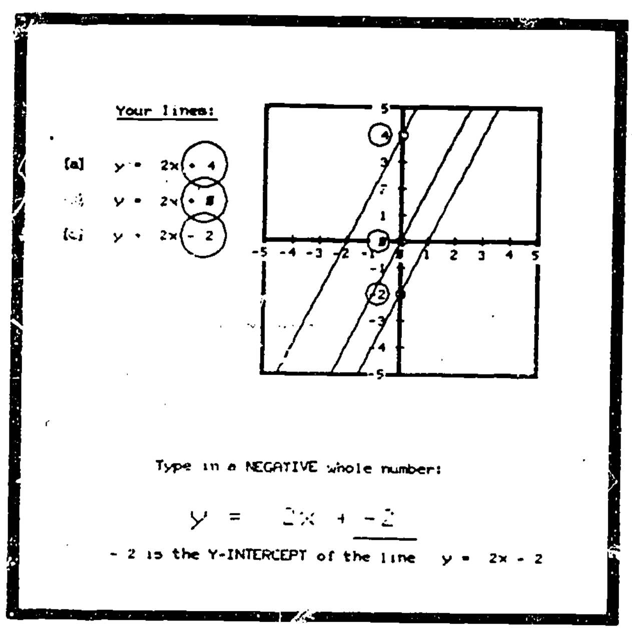


Figure 71. Intercept of a Straight Line, by Barbara Lederman. Copyright © 1976 by the Board of Trustees of the University of Illinois.

During the 1978-79 academic year, a diagnostic test was developed for the purpose of pointing out strengths and weaknesses of pre-calculus mathematics students. In the future, learning modules will be automatically prescribed for students on the basis of this test by the PLATO Learning Management system which will be used to deliver competency-based instruction in mathematics. Figure 72 shows a sample question from the diagnostic test. The instructions show how the student is able to enter the answer by simply touching the screen, and to change the answer before pressing the box marked RECORD which indicates that he has finished answering the question. This display also illustrates the use of graphics in test item presentation. Figure 73 shows yet another display from the diagnostic test in which graphs are used as answers in multiple-choice questions.

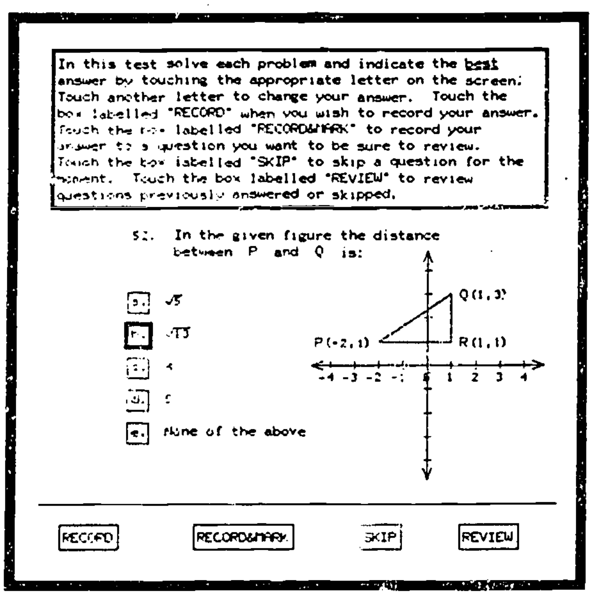


Figure 72. Pre-Calculus Diagnostic Test, by Ron Wenger and Keith Slaughter. Copyright © 1978, 1979 by the University of Delaware PLATO Project.

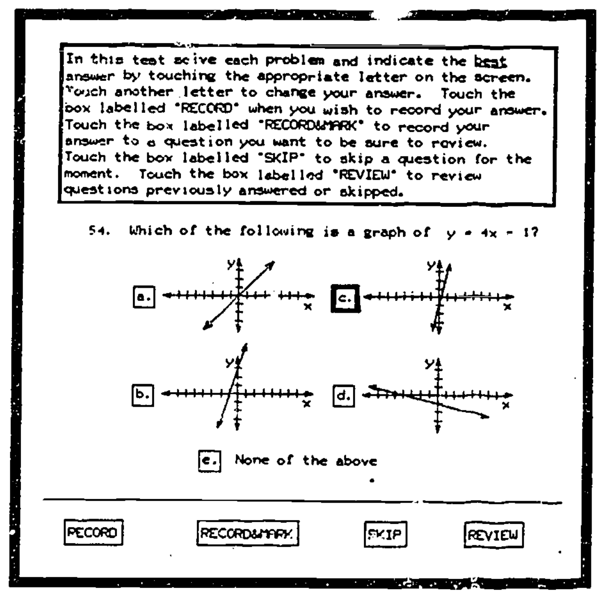


Figure 73. Pre-Calculus Diagnostic Test, by Ron Wenger and Keith Slaughter. Copyright © 1978, 1979 by the University of Delaware PLATO Project.

The Military Science Department is using PLATO in senior level courses which stress empirical analysis of data bases. The students have a wide variety of entry level skills. Some are able to handle fairly sophisticated statistical problems; others have never had a statistics course before. PLATO helps the less experienced students bring themselves up to the class standard.

Students are using two types of PLATO lessons. First, tutorials are helping them learn how to do statistics, such as the example shown in Figure 74, where the learner is asked to find the standard error of the mean. Second, PLATO's computational packages are helping the students perform statistical analyses of their own data.

The department is now developing a package to teach a particular problem-solving heuristic employing quantitative analysis. Known as "The Yellow Brick Road," it will enable students to work assigned military science problems or to solve their own problems. In Figure 75, the student is presented with data in order to determine whether it is cheaper to move an armored battalion by road or by rail. The program will connect to PLATO's existing instructional and computational statistical packages.

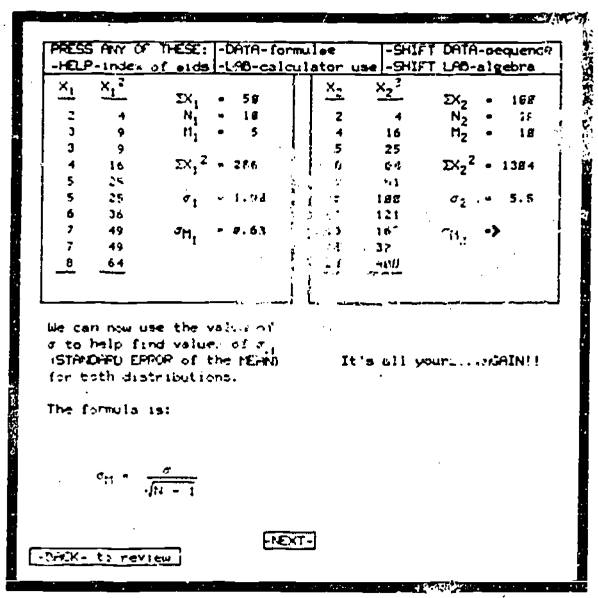


Figure 74. An Introduction to t-test, by William H. Sanders. Copyright © 1974 by the Board of Trustees of the University of Illinois.

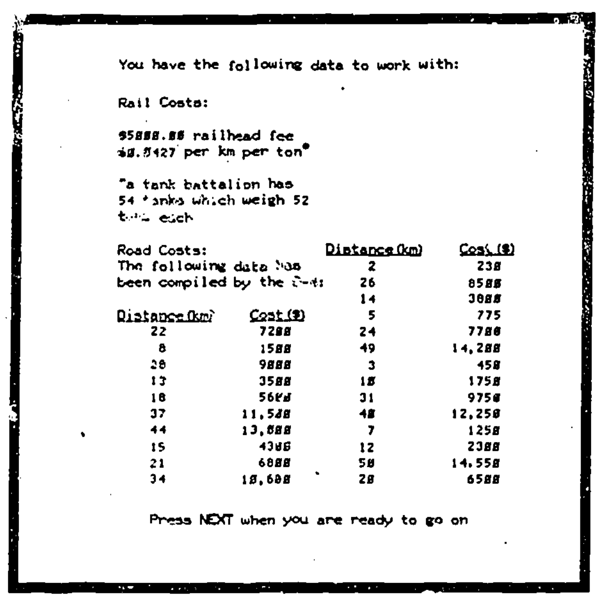


Figure 75. The Yellow Brick Road, by Lt. Col. George Bailey and Capt. Tom Reinhardt. Copyright © 1978 by the University of Delaware PLATO Project.

The music department has developed a package of ear-training programs called "GUIDO." Guido d'Arezzo is the eleventh century musician and music educator who invented the staff and established the principles of solmization. The ear-training programs are named after him, using his first name as an acronym for Graded Units fc · Interactive Dictation Operations. The entire first year of ear-training materials has been organized according to levels of difficulty into graded units which form the basis of a competency-based curriculum including drill and practice in intervals, melodies, chords, harmonies, and rhythms. Ear-training students spend an average of two hours each week at GUIDO learning stations which consist of a PLATO terminal and a digital synthesizer designed and developed by Sherwin Gooch at the University of Illinois.

The basic design of the GUIDO programs consists of a three-part process whereby PLATO first displays an answer form on the terminal screen, second, plays a musical example using the digital synthesizer, and third asks questions about the students' perception of the example. PLATO keeps track of how well the students are doing and issues weekly progress reports to the instructors.

Figure 76 shows a sample display from the intervals program. By studying this display the basic features of the GUIDO system can be understood. At the top are two rows of boxes which contain the names of musical intervals. When the student wants to hear an interval, all he has to do is touch one of the boxes. When he does, the box lights up and the interval designated by the box is played by the computer-controlled synthesizer. Conversely, when the student is going through one of GUIDO's formal units, the computer plays an interval, and the student responds by touching the box which contains the interval he thinks was played.

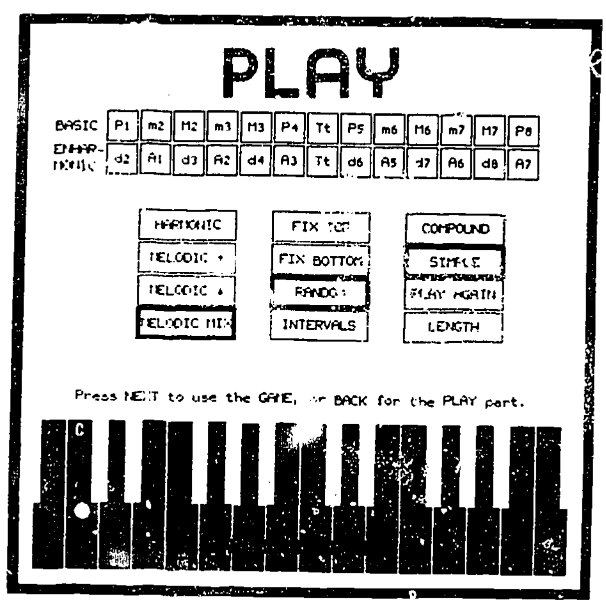


Figure 76. GUIDO Intervals Program,
by Fred T. Hofstetter and William H. Lynch.
Copyright © 1977 by the Delaware PLATO Project.

Underneath the interval names are three columns of teacher or student control boxes. These boxes are used to control the way in which dictation is given. The teacher can preset them for the student, or the teacher can allow the students to set them at will. The first column of boxes allows for the intervals to be played as harmonic, melodic up, melodic down, or melodic intervals up and down. The second column gives the option of being able to fix the top or bottom note of the intervals, or to have them selected at random. The box marked "intervals" allows the student to eliminate intervals from the boxes at the top of the screen, so that only some of the intervals will be played. In the third column of boxes the student can select compound or simple intervals, can have an interval played again, and can change the length of time the intervals last. Finally, there is a keyboard at the bottom of the screen. When intervals are played in formal units one of the notes of each interval is shown on the keyboard, and the student is asked to touch the other note played in the interval. In this way, students are quizzed on the spelling as well as on the aural recognition of intervals.

During the Spring of 1978, the Music Theory Department received a grant from the University's Center for Teaching Effectiveness to support the reorganization of the core music curriculum around PLATO's computer-managed instruction system. According to this system learning objectives and test instruments are being developed for each individual learning module in the core music courses. The objectives, tests, and student learning aids are being typed into the computer-managed instruction system which will keep track of how well the students are doing on the tests. Making use of the information being entered into the system by the music theory faculty, PLATO will be able to advise the students as to what tests they should take and what learning techniques they should try if they should happen to fail a test. The use of the system will have several advantages for both the teachers and the students. The students will be able to go through the curriculum at their own individual learning rates, and PLATO will make sure that they do not get into difficult materials before they are ready. The faculty members will be freed from the large amount of record keeping and testing required in the course, and they will be able to replace many of their lectures and classroom drills with more creative activities.

Figure 77 shows a sample interaction between the student and the computer-managed instruction system. PLATO is telling the student that it is time to find out whether he can identify pitches in treble, bass, alto, and tenor clefs. The student is given the option of studying from the textbook first in order to learn pitch identification, or if he feels confident that he already knows the material, he can go ahead and take a drill on pitch identification. In a traditional classroom setting, the student would have been subjected to more instruction on clefs whether he already knew the material or not. In this case, if the student passes the test, he will not have to spend time listening to the presentation of material which he already knows. Figure 78 shows a display from a sample test administered by the computer-managed instruction system. Notes are randomly generated and displayed on a staff, and the student is asked to respond as quickly as possible by touching the answer box containing the appropriate pitch name. On this particular test, the student must answer nine out of ten questions correct with an average response time of less than three seconds per question.

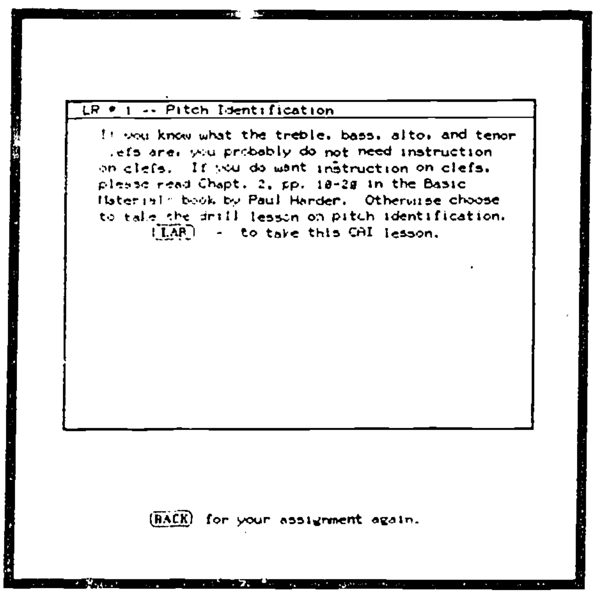


Figure 77. Pitch Identification Module from the Competency-Based Music Education Program, by Michael Arenson, Robert Hogenson, Fred Hofstetter, and Michael Zinn. Copyright © 1978 by the University of Delaware PLATO Project.

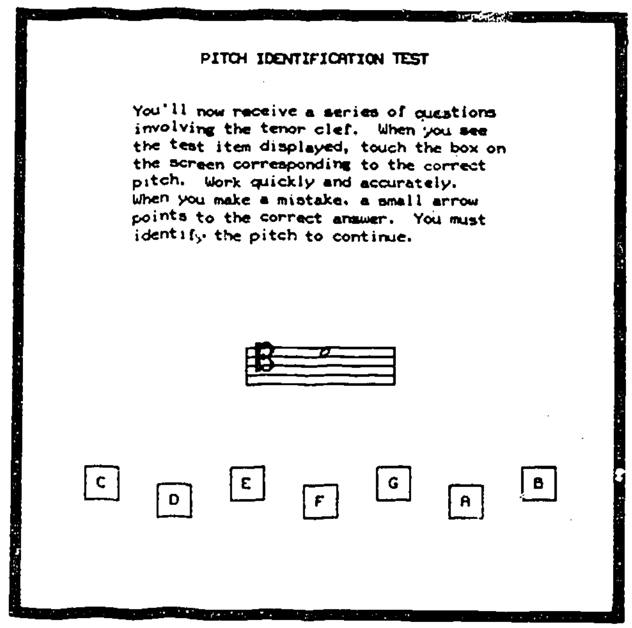


Figure 78. Pitch Identification Test, by Peter J. McCarthy and Deborah Braendle. Copyright © 1977 by the University of Delaware PLATO Project.

The College of Nursing is realizing the potential of PLATO to deliver instruction in courses dealing with adult physical health and illness, maternal and child health nursing, and adult acute physical illness. The College is using programs developed at the University of Illinois, Sheppard Air Force Base, the University of Oklahoma, and Parkland Community College. The College is also developing its own programs for educating and testing nurses in the care of clients and families with a variety of problems and the handling of emergency situations.

The nursing programs include tutorials, simulations, and tests. During the 1978-79 academic year, nursing faculty began to write competency tests whereby students wishing to obtain credit by examination can challenge nursing courses on PLATO. Some advantages of this capability for the students are that PLATO tests are more frequently available than the standard written tests, and they receive their scores within seconds after completing the tests. Faculty members no longer need to regularly prepare test questions since PLATO randomly selects questions from a large item pool. The faculty members are also freed from test grading duties. Figure 79 shows how the student answers a sample test question by touching or typing the appropriate letter from the choices available. At any time during the test the students can go back and answer any questions that have been skipped, and they can also review previous questions and change their answers if they so desire. The student options available during the review process are shown in the review index in Figure 80 .

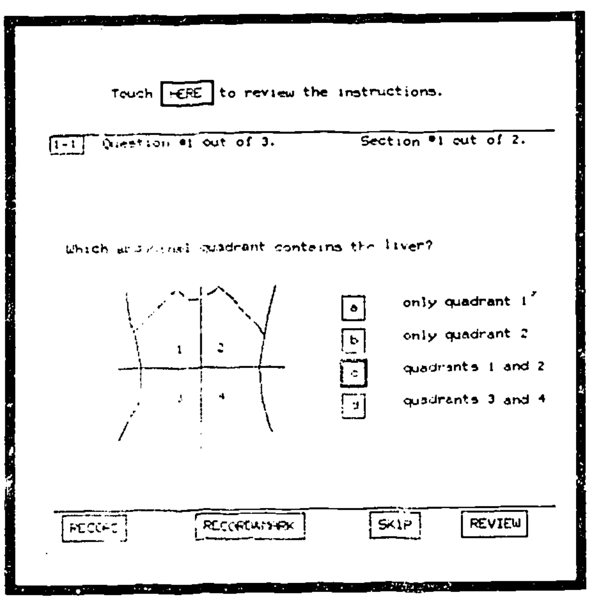


Figure 79. Sample Challenge Exam, by Mary Anne Early, I rothy Williams, Francis Kazmierczak, Monica Fortner, and Keith Slaughter. Copyright © 1978, 1979 by the University of Delaware PLATO Project.

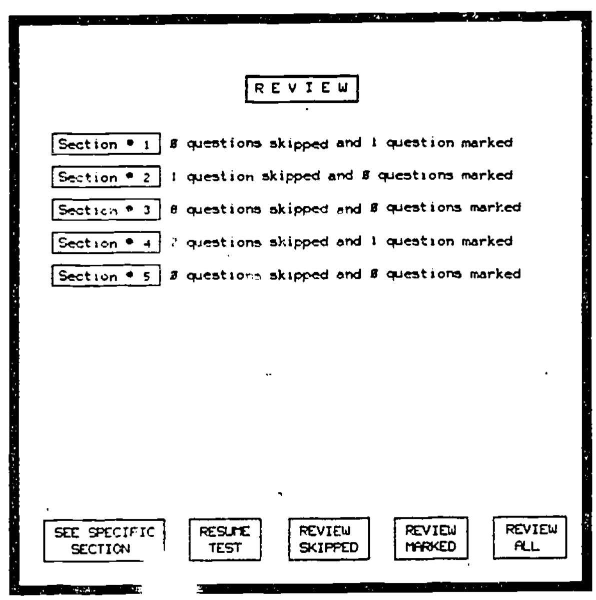


Figure 80 . Challenge Exam N301, by Mary Anne Early, Dorothy Williams, Francis Kazmierczak, Monica Fortner, and Keith Slaughter. Copyright © 1978, 1979 by the Delaware PLATO Project.

During the 1977-78 academic year, the Division of Physical Education completed the development of its first two PLATO lessons. The first lesson teaches volleyball strategies. Quantitative measures of student achievement had shown that physical education students were not grasping the fundamental volleyball strategies that were being taught in lecture classes. Thinking that this was due to the limited amount of experience which the students were able to get in practicing the strategies in actual volleyball games, it was decided to use PLATO to teach volleyball strategies in a simulated game environment. The volleyball lesson begins with a tutorial on each volleyball strategy. After the tutorial, PLATO sets up the volleyball court and tells the student what the opposition is about to do. Then the students position their players on the court by touching the display screen. When the student is finished setting up the players, PLATO judges the positioning and gives the student feedback on the set up. In Figure 81 , PLATO has asked the student to set up a defense against a CF spiker. The student has positioned the players, and PLATO's comments are shown at the bottom of the display.

The second lesson developed by the Division of Physical Education has led to significant improvement in student achievement, and at the same time, a large reduction in the amount of time taken to complete a project in film motion analysis program. Students come to PLATO with body coordinates of nineteen segmental endpoints which they have acquired through the filming of athletes. Figure 82 shows how PLATO uses the coordinates to provide the student with a graphical representation of the body, location of center of gravity positions, and kinematic compounds of both linear and angular velocities. In addition, PLATO calculates the angles for ea. vertex. The results of a controlled evaluation of this lesson are given in the evaluation section of this report (below, page 90).

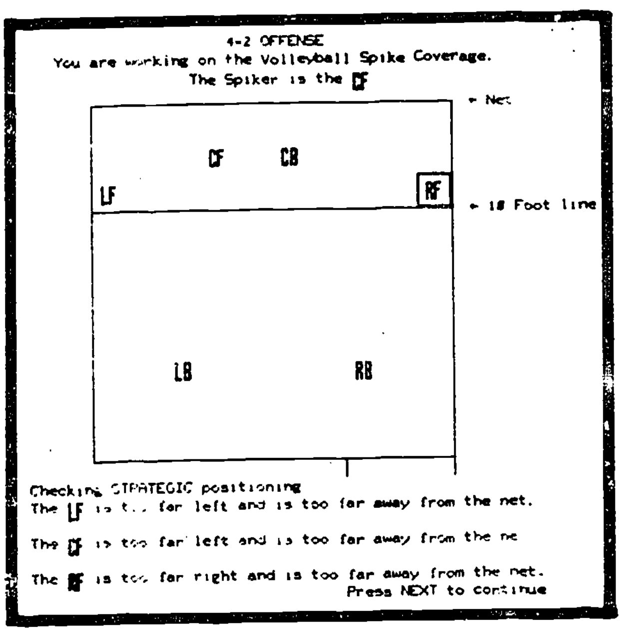


Figure 81 Volleyball Strategies, by Barbara Viera and A. Stuart Markham, Jr. Copyright © 1978 by the University of Delaware PLATO Project.

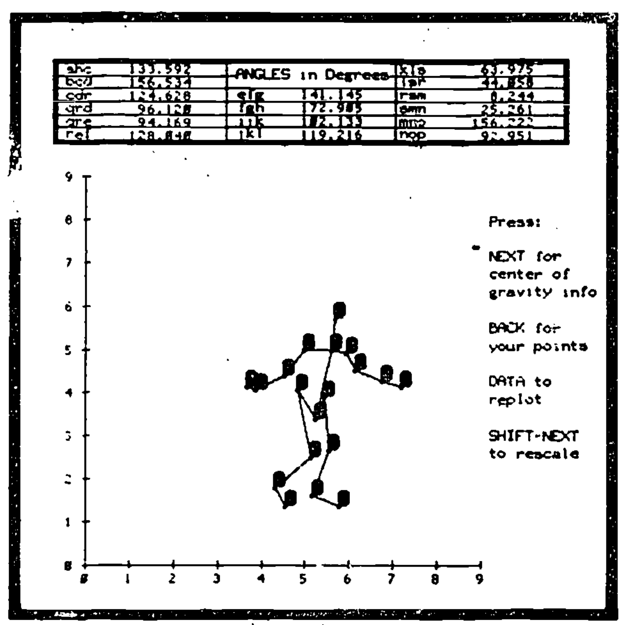


Figure 82 Film Motion Analysis, by David Barlow, James G. Richards, and A. Stuart Markham, Jr. Copyright © 1977 by the University of Delaware PLATO Project.

-Pre-College PLATO Activities in Delaware-

In addition to the PLATO lesson library for college level courses, many hundreds of hours of pre-college instructional materials exist in the areas of mathematics, English, science, music, human resources, and art. In cooperation with local school districts, five elementary, middle, and high school projects have been initiated to explore the potential of PLATO in a variety of learning situations, including remedial instruction and education for the gifted. In addition, the PLATO Project has sponsored programming courses for high school students and has given many hands-on demonstrations to groups from area schools.

Martin Luther King, Jr., Elementary School

Project CHALLENGE, a federally funded program for the education of academically gifted students in grades 4 - 6, made PLATO a part of its innovative curriculum during the 1979 academic year. A PLATO terminal, music box, interface, and PLATO services were purchased by the New Castle County School District with state grant money, federal money, and matching funds.

The students met with Mrs. Biesinger and Mrs. Harasika, the CHALLENGE teachers, one full day each week. Throughout this day, all students were scheduled to use PLATO for fifteen minutes unless some previous class assignments were not complete. Mrs. Biesinger reports that PLATO was an effective motivating force in getting students to complete their other assignments.

The two main goals that Mrs. Biesinger set for the use of PLATO in Project CHALLENGE were:

1. that PLATO be used to enrich subject areas being taught
2. that PLATO be used as a source of knowledge from which students could choose a subject that they wanted to learn either because it is not part of the curriculum or it is too advanced for the grade level being taught.

Students in the fourth and fifth grade classes had four pages of PLATO lessons available to them in subject areas including math, science, music, art, economics and psychology. Sixth grade students not only used existing materials, but they also designed some lessons of their own.

Both student and teacher reaction to PLATO was very favorable. Students found PLATO exciting; they especially enjoyed the game-like lessons in which their improvement was noted in a high score. The parents also showed much enthusiasm toward PLATO. One father took seminars from the PLATO staff at the University which enabled him to program the lesson his son designed in class.

During the summer of 1979, the University's Upward Bound program made individualized instruction via PLATO a regular part of its concentrated, on-campus program for academically promising urban high school students. Each student used PLATO in the Willard Hall classroom several times a week for English.

The objectives set for the PLATO program by Upward Bound's director, William Morris, included:

1. exposure to computers as a learning tool;
2. extensive individualized instruction via PLATO;
3. orientation and training of Upward Bound teachers and aides in the capabilities of computers for instruction, record keeping, and motivation.

Students were individually assigned to lessons by instructors in their regular classes. English topics included grammar, punctuation, spelling, and composition. Figure 83 shows how a student is asked to group words beginning with "re" according to the meaning which "re" has in them.

The English instructors also used PLATO to add a new excitement to communicating; using PLATO's notes sending and receiving capabilities (notesfiles), students wrote notes on-line to their instructors and classmates. This increased students' motivational momentum and also gave them an opportunity to generate their own sentences and creatively test their newly acquired language knowledge in grammar, punctuation, and spelling. Observers of the program were especially impressed by the students' intense concentration while working with PLATO.

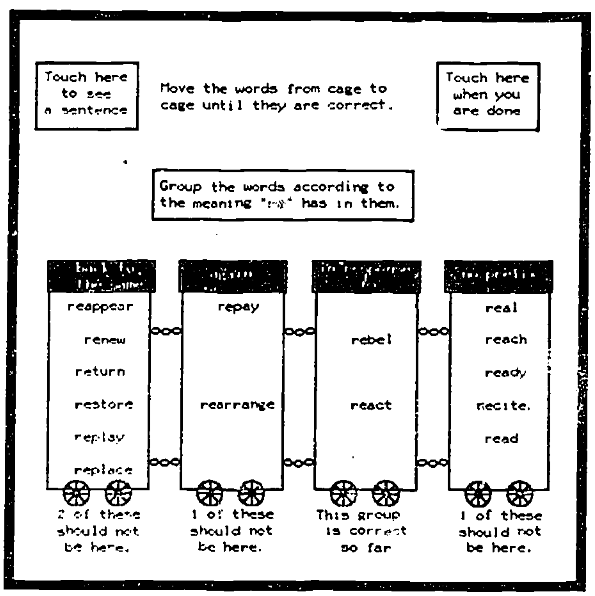


Figure 83. Word Zoo by Steve Hansell and Jessica Weissman. Copyright © 1978 by the University of Delaware PLATO Project.

Howard Careers Center

During the month of July, 1978, a terminal was installed at the Howard Careers Center's Title I Academic Skills Center to evaluate the benefits of PLATO's pre-college curriculum for use by vocational students. PLATO was mainly used for basic skills English and math instruction.

Both students and teachers were excited about having PLATO and were sad to see it leave at the end of the month. Ms. Vicki Gerht, the coordinator of the Title I Academic Skills Center, said, "The only problem we had with PLATO was that the month ended too soon!" Howard Careers Center hopes to have PLATO full time starting in September of 1979. Two teachers from the center have enrolled in the 1979 NSF Summer Institute in Computer-Based Education so they can become more knowledgeable about PLATO in preparation for September.

Silver Lake Elementary School

During Delaware's Winter Session, a terminal was placed in Silver Lake Elementary School to expose PLATO to as many district community members, groups, and students as possible. Mr. Joseph DiSalvo, Effective Education Specialist, headed this project. Each day demonstrations and hands-on sessions were given to students. The objectives of the demonstrations were:

1. to show students how computers work and to aid them in gaining computer literacy
2. to show students how computers can teach
3. to show students examples of PLATO lessons

One lesson used in the demonstrations was "The PLATO Story," Figure 84 , which explains how PLATO communicates with the student.

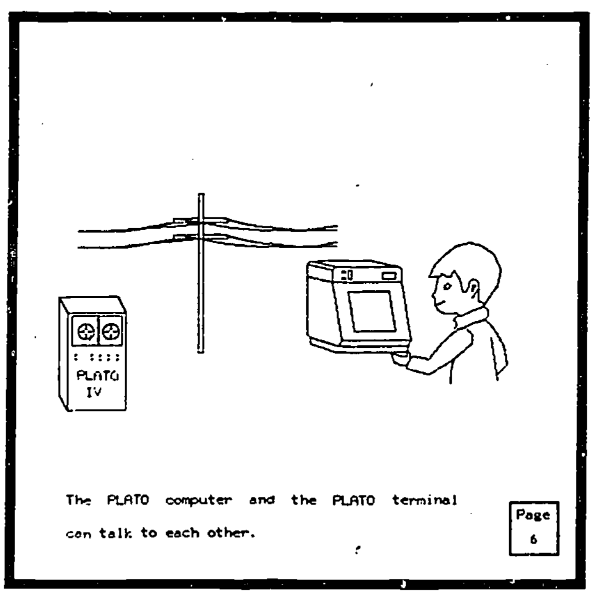


Figure 84. The PLATO Story, by Bob Yeager. Copyright © 1977 by the Board of Trustees of the University of Illinois.

During the evenings, demonstrations were scheduled for community members and decision-making committees in the Appoquinimink School District. The purposes of these demonstrations were to show how computers are used for instruction, to show the capabilities of the PLATO system, and to make the community and other groups aware of educational programs offered to the students in the district. Due to the positive student and teacher reactions, plans are being developed to have PLATO in the district if funds permit.

Townsend Elementary School

The Townsend Elementary School project is a cooperative effort among the Appoquinimink School District, the College of Education, and the Delaware PLATO Project. The PLATO classroom in Willard Hall Education Building was made available to 36 fourth graders and their teacher for an hour every Wednesday and Friday afternoon. While the students were learning from PLATO lessons selected by their teacher, undergraduate students from the University's mathematics methods courses observed the students, helped them, and often joined in and played math games with them. In this way, the prospective teachers were able to observe how children learn mathematics, and they could begin to consider the ever-increasing role that computers are playing in education.

One of the favorite lessons that the students used was "Make a Bundle," displayed in Figure 85. This is a game-like lesson that helps the students improve their speed and accuracy in working addition, subtraction, multiplication and division problems. The students make money by betting some of their bundles that they will answer the next problem correctly. The Hall of Fame displays a list of the twenty biggest bundle winners. This is motivational in that the students see their names appear on the list and watch them move up the list as their scores improve.

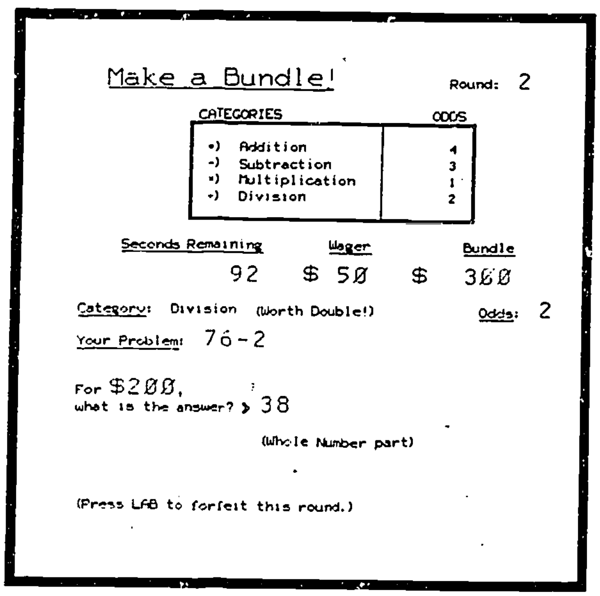


Figure 85. Make a Bundle, by Keith Slaughter. Copyright ⓒ1976 by the Board of Trustees of the University of Illinois.

Harlan Elementary School

The Title I Math Center at Harlan Elementary School, under the direction of Mrs. Sandra Simkins, purchased PLATO services through the University with Title I monies during the Spring of 1979. PLATO offered remedial mathematics instruction to students in grades four through six. Mrs. Simkins had other CAI terminals, including three Project DIRECT terminals. In her project report Mrs. Simkins wrote: "The arrival of the PLATO terminal is by far the best thing to happen here at Harlan. Although PLATO has been here only four months, I don't know how the Center survived before without it."

Sixty students were scheduled to attend the math center every day. Mrs. Simkins reported, "You can rest assured that the students will not be absent on the day of their turn, and if so, they are at your door the first thing in the morning to schedule a make-up time!"

Mrs. Simkins chose PLATO lessons that concentrated on basic facts review, subtraction with borrowing, long division, story problems, and fractions. One very popular game-like lesson, "Speedway," displayed in Figure 86, provided students with drill and practice in number facts. The students first establish their skill-levels in a practice race (10 problems) in which a car moves along a race track to illustrate the amount of time they take to answer each problem correctly. PLATO points out all errors made on the first try. In the next race, the students are given positive reinforcement when they correctly answer a previously missed problem. If they are having difficulties, PLATO illustrates the problem with a picture. The students win the race if they have beaten their previous speeds, thus winning is based on self-improvement. Missed problems are presented again; when the students have mastered the problems at one difficulty level they advance to more difficult problems. Graphs and charts showing student performance are presented before and after each game.

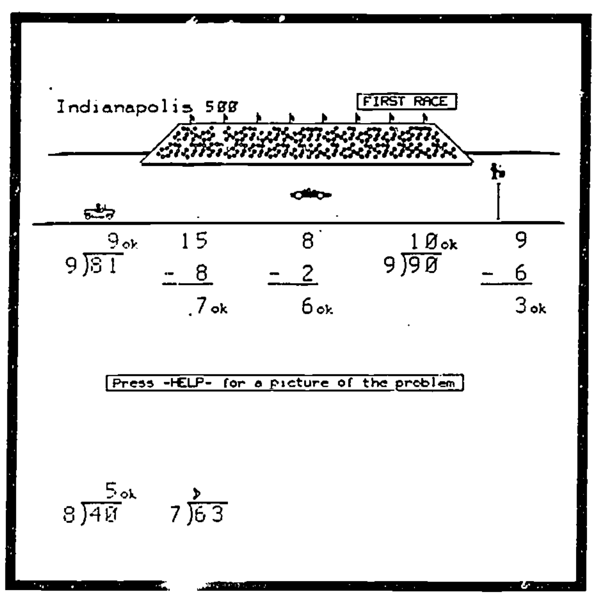


Figure 86. Speedway, by Bonnie A. Seiler. Copyright © 1974 by the Board of Trustees of the University of Illinois.

One fourth grade student from Harlan asked if she could learn how to program PLATO. Within four weeks she programmed a simple lesson on basic facts which was used by the students in the center. She won the first place Blue Ribbon in the Harlan Science Fair for her efforts.

The parents of these students were very impressed with computerized learning and especially with PLATO. They reported that it really increased their children's interest in and enthusiasm for mathematics. In a letter written to the Director of Federal Programs for the New Castle County School District they wrote:

> The PLATO computer that the University of Delaware has loaned Ms. Simkins is an important part of this program, since it creates an interest not only in learning to do mathematical calculations correctly, but also in increasing one's speed of computation. It also aids the teacher in diagnosing a student's weakness. The parents whose children have been stimulated by this program would hate to see the school lose this computer.

High School Programming Project

For the past three summers the Delaware PLATO Project has sponsored a five-week TUTOR programming course for high school students. Participants were chosen from Delaware high schools to come to the University twice a week for instruction and supervised programming practice. Many of these students had no prior computing experience or had experience only in BASIC.

During the five-week course each high school student planned and programmed a lesson in an area of personal interest. Lessons programmed by high school students have covered such topics as algebraic equations, units of measurement, and music. Several games have been written, as well as a test grade averager. One high school programmer is working with the mathematics project in developing remedial math programs to be used by freshman university students.

In addition to offering the summer programming courses, the PLATO Project participates in the R.E.A.L. (Relevant Experience for Alternative Learning) Project, a project which gives area high school students the opportunity to learn about career opportunities in various fields. To date, seven students have come from Project R.E.A.L. to learn about PLATO and the work of a PLATO specialist.

Class Demonstrations and Public Use

During the 1978-79 academic year, teachers of more than 300 pre-college students arranged to have their groups visit the University campus in order to use PLATO. In addition to regular elementary and high school classes, there were groups of students from science clubs, special education groups, gifted student programs, and nursery schools. One teacher offered the prize of visiting PLATO to the class that turned in the most homework assignments.

Many more students used PLATO on Friday evenings and on Saturdays, when the Willard Hall PLATO classroom is open to the general public (pre-college students must be accompanied by a parent). It was a common sight to see a parent and child sitting together in front of a terminal playing a math game. A teacher from lower Delaware arranged a 200 mile round trip to bring his gifted and talented students up to the University to use PLATO on Saturday.

Table 6 shows a summary of PLATO use of pre-college students during 1978-79. 319 students used PLATO for a total of 2,694 instructional hours.

Table 6

PLATO Use by Pre-College Students During 1978-79

Descriptive Title	Number of Students	Average Terminal Hours per Student	Time of Utilization			
			Summer	Fall	Winter	Spring
King Elementary-Project CHALLENGE	107	3.0			X	X
Upward Bound	43	3.0	X			
Howard Careers Center - Title I Academic Skills Center	50	1.6				X one month
Townsend Elementary	36	16.6		X	X	X
Harlan Elementary - Title I	68	4.0			X	X
High School Programmers	15	86.3	X	X	X	X

The Psychology Department is using the PLATO system both as an instructional delivery system and as a sophisticated research tool. Students in the Introduction to Psychology course and a course on Learning and Motivation have been using PLATO programs to study verbal and non-verbal memory, neuron structure and function, counseling, and complex statistical routines. For example, Figure 87, a sample display from a lesson on the physiological basis of learning, shows a simulation of a human cerebral cortex. Using the "Cortex-O-Matic" illustrated below, the student can create neuron pathways and discover that frequently used pathways are etched into the cortex surface.

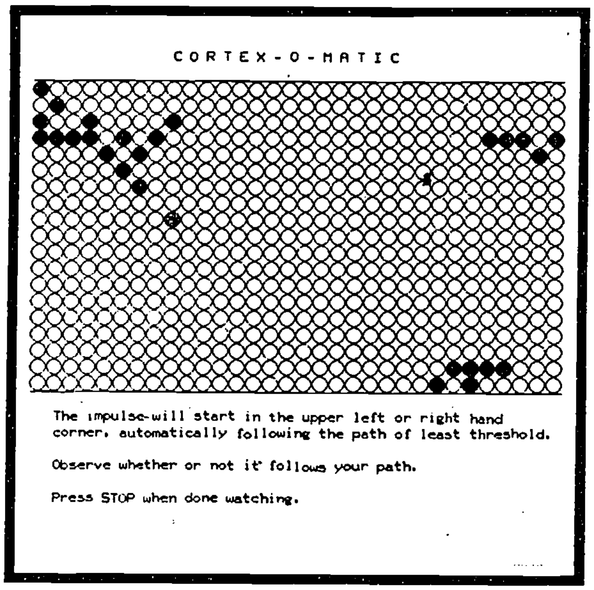


Figure 87. The Physiological Basis of Learning, by Stephen H. Boggs. Copyright © 1976 by the Board of Trustees of the University of Illinois.

The department is also developing research programs using PLATO as an interactive stimulus-giving, response-storing device. The purpose of the research is to collect information on the strategies used by students in memorizing a large list of words. Students are able to arrange the words at will on the display screen by simply touching a word to "pick it up" and touching a location on the screen to "put it down." The computer records data regarding the way in which the student arranges the words on the screen, the words that are remembered by the student after a ten minute study period, and the position on the screen of the words recalled by the student.

Drs. Gary Berg-Cross and John McLaughlin have written a lesson which illustrates how simple factors can affect the ease of solving problems. Called "Anagrams," it is being used both as an instructional lesson and for research. PLATO gives the students a direct experience of frequency effects by asking them to solve anagrams in a timed test. The results of this test are used to discuss the conditions which affect the time it takes to reassemble an anagram into a word. In addition, information from this anagrams task is being correlated with data from the memory experiment. Subjects who use different strategies to memorize are identified and compared for their ability to solve different types of anagrams. The supposition here is that there may be different cognitive "styles" which will characterize individuals in many situations.

Figure 88 shows the results of a student being asked to solve the anagram "GANRE." The student answered with "RANGE" in 20.11 seconds. PLATO displays all of the correct answers to the anagram plus the average time other college students took to come up with those answers.

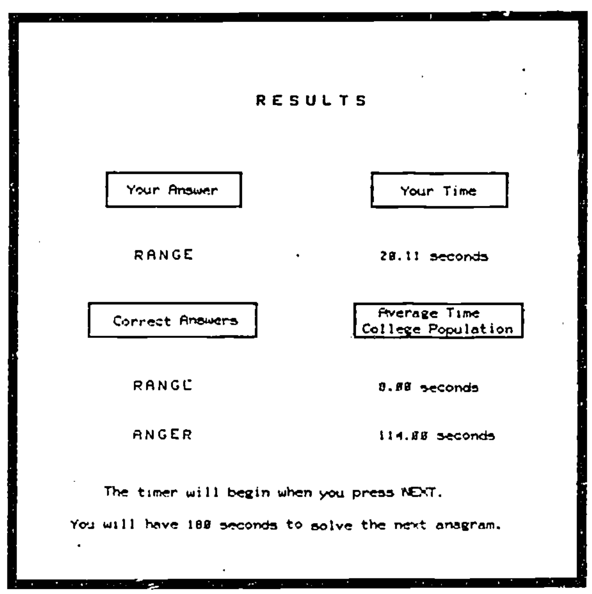


Figure 88. Anagrams, by Gary Berg-Cross. Copyright (c) 1979 by the University of Delaware PLATO Project.

The Security Department is currently using PLATO to supplement its training program for new employees. It is now used exclusively by the Student Service Officers, but future plans include the use of PLATO in all aspects of training in the department. All materials are developed by Security personnel. Through the use of PLATO's computer-managed instruction (CMI) package, PLATO determines the officers' problem areas and directs them to the appropriate sources for obtaining additional information on those subjects. In many cases the students are sent directly to an instructional lesson on PLATO for remediation; for other deficiencies they are told to study a particular code book or officer manual.

Figure 89 shows part of the lesson on proper completion of a notice of violation (ticket). The lesson presents the ticket block by block, showing the officers how to fill in the information required for each block. Upon completing the instructional portion of the lesson, the officers are evaluated on their abilities to complete an entire notice of violation for each of several simulated traffic violations.

Figure 90 illustrates part of a lesson intended to familiarize new officers with the Public Safety Code. The lesson introduces five safety codes at a time, and it immediately quizzes the officers following the display. Upon completion of the instructional portion of this lesson, the officers may opt for a final testing of all the safety-codes, randomly chosen and timed by PLATO.

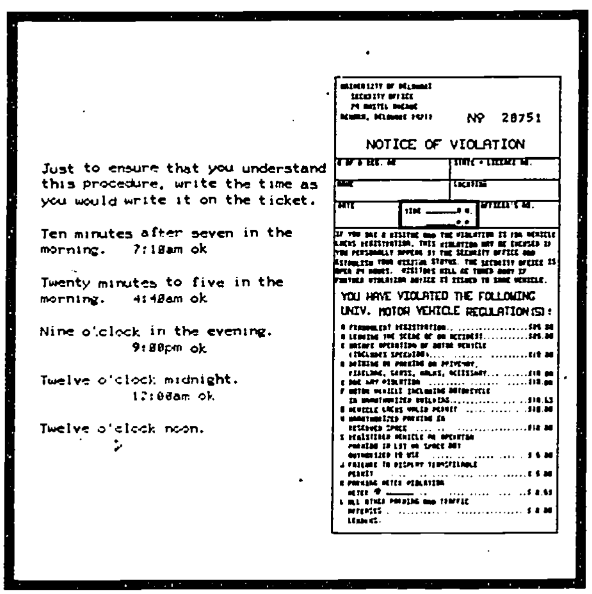


Figure 89. Ticketing, by Steven Swain and Raymond J. Schwartz. Copyright © 1978 by the University of Delaware PLATO Project.

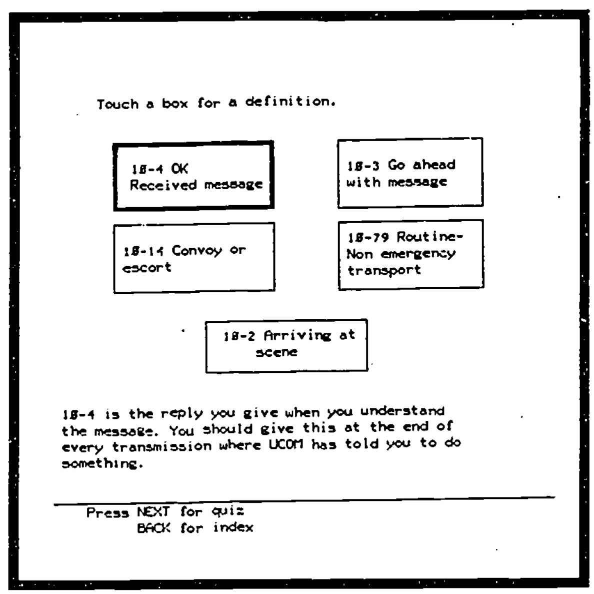


Figure 90. Tencode, by Steven Swain and Robert Krejci. Copyright © 1979 by the University of Delaware PLATO Project.

During the spring semester of 1979 the Sociology Department began using PLATO as an educational aid in a course on population dynamics. This course used a group of lessons developed by the Population Dynamics Group at the University of Illinois. These lessons interact with a large data base of information on population growth, energy consumption, food supply, and many other sociological variables related to population dynamics, for different time periods and countries. In many of these lessons the student can change certain parameters and observe how these changes effect the population over time.

The two displays shown below are from a lesson on population projection. Figure 91 shows how a student can change a population variable and observe the results in bar graphs. Following the student's instructions, PLATO has shown on the left side of the display what the population of Belgium would be in 1990 if a dramatic increase in the fertility rate were to occur, whereas the projection of the population of Belgium given the present value of that parameter is shown on the right side of the display.

Figure 92 shows how the student can compare the projections for two different countries. In this case the student has asked to see the projections for the populations of Belgium and Afghanistan using current demographic parameters. As with the previous example, the student can change the demographic parameters and observe how these changes effect the populations.

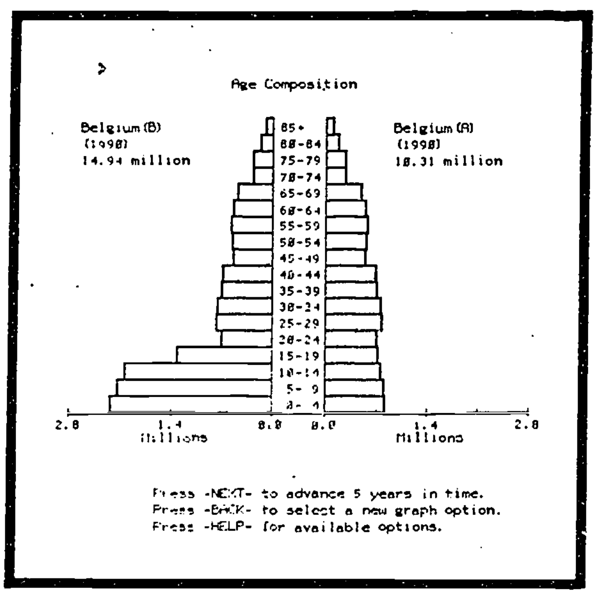


Figure 91 . Population Projections, by the Populations Dynamics Group. Copyright © 1975 by the Board of Trustees of the University of Illinois.

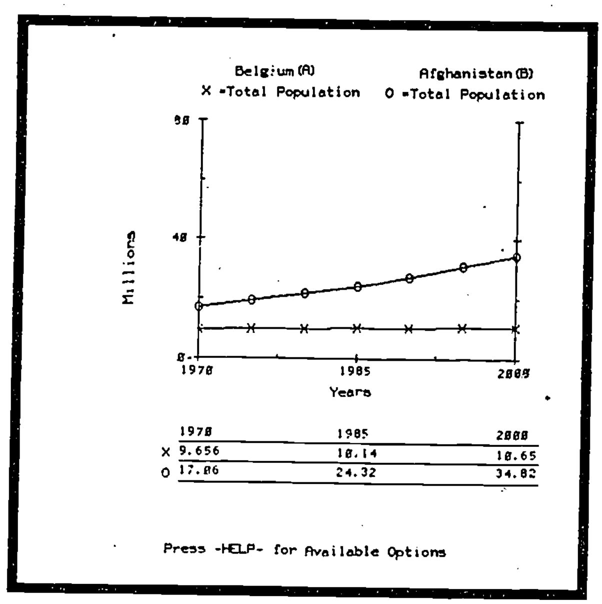


Figure 92. Population Projections, by the Populations Dynamics Group. Copyright © 1975 by the Board of Trustees of the University of Illinois.

The Theatre Department is continuing to develop its interactive timeline. The purpose of the lesson is to help students gain a better understanding of the history of theatre and of the historical relationship of theatre to other arts and the sciences. Figure 93 shows a sample display from the timeline lesson. Students touch appropriate places on the display in order to move forward and backward in time, to see events from a particular nation or from a particular discipline, and to specify the level of detail they want. For example, the student can ask what happened in Germany during the Baroque in order to learn the most important events of that period, or they can ask what happened in Germany in 1750 to learn events in a particular year. Students will be able to select a period and then compare what happened during that period among various countries and disciplines. Quizzes will be included in the lesson to measure the students' mastery of the historical periods which they explore.

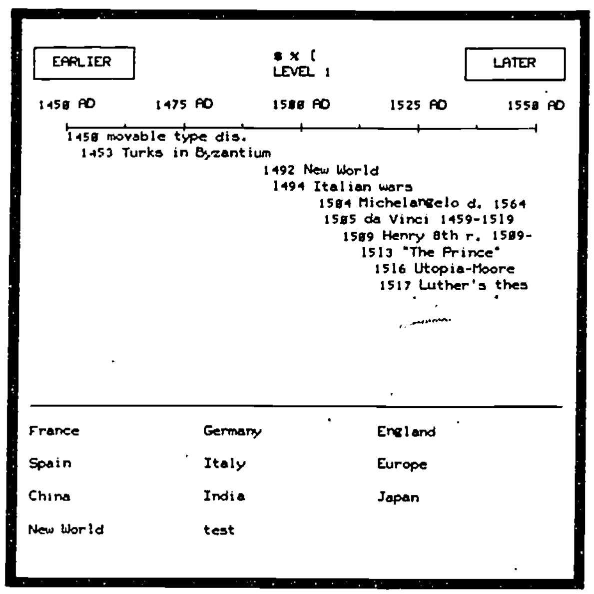


Figure 93. Interactive Timeline, by Brian Hansen. Copyright © 1977 by the University of Delaware PLATO Project.

CHAPTER III. RESEARCH & EVALUATION

Because of its developmental nature, the Delaware PLATO Project regularly conducts a rigorous internal evaluation. Student opinions are highly valued and are collected in a systematic manner. Controlled experiments are conducted to test the effectiveness of new lesson materials. Project leaders prepare bi-monthly project reports which are used in monitoring program development throughout the year. And a list of the principal values that PLATO has for the University is maintained. The manner in which these components interact is explained in the model for project evaluation.

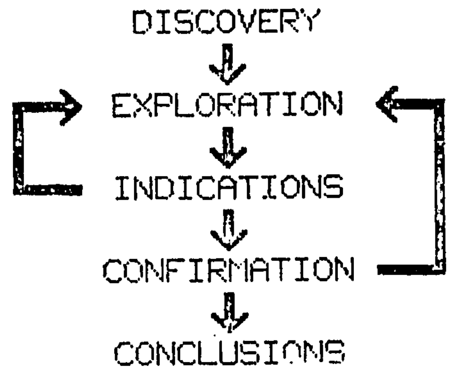
-Model for Project Evaluation-

At our College of Education's recent learning symposium on evaluation, Herbert J. Walberg maintained that the process of inquiry contains five main stages, namely, discovery, exploration, indications, confirmation, and conclusions. Every event in the history of PLATO at our university fits into one of these categories, both at the overall project level and within each individual department. At the project level, PLATO was discovered by our computer assisted instruction committee during the Fall of 1974. The University explored the potential of PLATO during the trial period in the Spring of 1975. Indications were summarized in the report of the Summer of 1975. Confirmation that PLATO has potential for the University was obtained during the 1975-76 and 1976-77 academic years, based on the successful implementation of PLATO in so many departments. The conclusion that PLATO is a worthwhile long-term activity led to the installation of Delaware's own PLATO system during the 1977-78 academic year.

Each department goes through these stages individually when it begins a PLATO project. Discovery usually takes place at one of the periodic PLATO demonstrations, or through a colleague who personally shows his work to a new person. Exploration consists of reviewing existing PLATO lessons, learning about the capabilities of the PLATO system, and reading literature about uses of PLATO. This phase is facilitated by the orientation seminar (above, p. 21), the lesson review process, (above, p. 24), and materials in the PLATO library (above, p.17). Indications are discussed and codified in meetings with peers, PLATO staff members and departmental chairpersons. Confirmation is attained through repeated success of the program in its academic environment. Success is measured through administration of student questionnaires, and through controlled studies of educational effectiveness. A continuous cycle of exploration, indications, and confirmation occurs in most departments, as shown in Figure 94.

Figure 94

Process of Inquiry in Departments Using PLATO



-Student Questionnaires-

A very important component in the evaluation of the Delaware PLATO Project is the opinion of the students. The instructor of every PLATO course is required to have the students complete a questionnaire. Figure 95 shows a standard questionnaire which is given to each instructor as a model for evaluation of PLATO. The instructor can administer the questionnaire as it stands, or they can change, delete, and add items peculiar to their specific courses.

During the 1976-77 academic year the student response to PLATO was very positive. Perhaps the two most representative items concerned whether students felt PLATO was an enjoyable learning experience, and whether they felt PLATO was worth the effort. Overall, eighty-nine percent of the students felt PLATO was enjoyable, and eighty-six percent of the students felt it was worth the effort.

Student comments dealt with a variety of topics. They requested more versatility in signing up for time on PLATO, more terminals, and more programs. They asked that lessons developed at other universities be modified to use Delaware terminologies when different terms are used. They want more exercises to practice in preparation for regular hourly exams. They asked that PLATO be used for a greater percentage of their courses. Students commented about PLATO's patience, stating that they were glad that the computer never gets tired of helping them. The most frequent comment concerned the self-paced, individualized learning format. Students feel that PLATO helps them most by providing individualized, immediate feedback to their answers.

Figure 95

STUDENT EVALUATION OF PLATO

Course ______________ **Instructor** ____________________ **Date** ____________

Please answer the following questions about your experiences with the PLATO system and the lessons which you have seen. Your responses will provide valuable information for evaluating and improving PLATO. Thank you for your cooperation.

Indicate your degree of agreement with each of the following statements by marking:

A = Strongly Agree
B = Agree
C = Neutral
D = Disagree
E = Strongly Disagree

1. Using PLATO was an enjoyable learning experience.
2. The mechanics of using the PLATO terminal distracted me from learning.
3. The major points of the lesson were made clear.
4. The lessons on PLATO were too advanced for our level.
5. I learned what the lessons tried to teach.
6. I already knew the material covered in the lessons.
7. Most of the time the work on PLATO was too easy for me.
8. I was frequently frustrated while working on PLATO.
9. The lessons progressed too slowly.
10. The PLATO lessons were unnecessarily picky about the form of the correct answer.
11. The pace of the lessons was too fast.
12. PLATO is an efficient use of the student's time.
13. PLATO is well suited to presenting instructional material in this subject.
14. PLATO gives the student more feedback than other forms of instruction do.
15. The PLATO lessons helped me learn the material more thoroughly than with other forms of instruction.
16. The lessons made allowances for students with different levels of understanding.
17. A lesson on PLATO is more interesting than traditional instruction.
18. I found myself just trying to get through the material rather than trying to learn.
19. In view of the effort I put into it, I was satisfied with what I learned while using PLATO.
20. Too much class time was spent using PLATO.
21. I would like to spend more class time using PLATO.
22. I would like to take another course which uses PLATO.
23. I was able to schedule enough time each week in which to work.

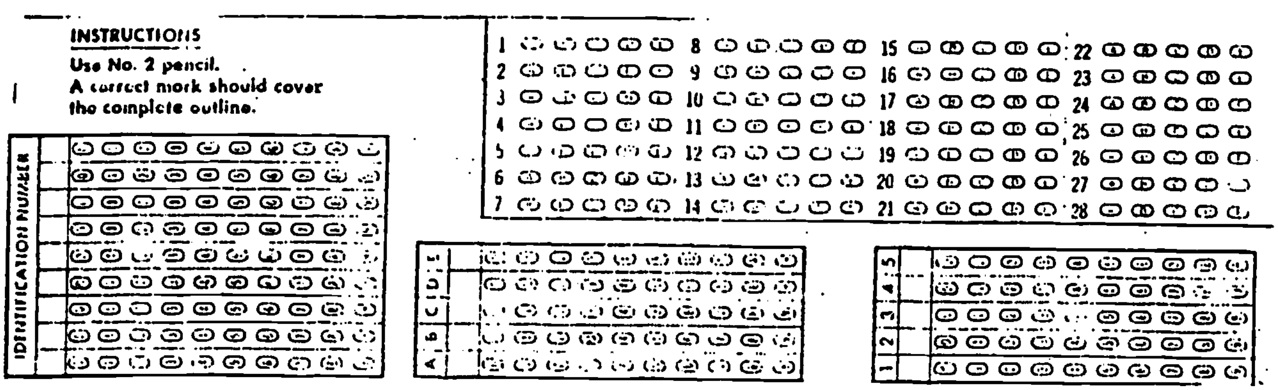


Figure 95 (continued)

24. How many hours have you spent on PLATO in this course? (Circle one)

2 or less	3-5	6-10	11-15	16 or more

25. Have you used PLATO in any other courses? (Circle one) Yes No

26. Have you ever used a computer (other than PLATO) before? (Circle one) Yes No

If so, in what ways is PLATO different from other computers?

27. What have you liked most about PLATO?

28. What have you liked least about PLATO?

29. What aspects of the PLATO classroom (acoustics, lighting, noise level, policies, staff, etc.) were distracting to learning?

30. What aspects of the PLATO classroom were helpful or conducive to learning?

31. What comments, criticism or suggestions do you have for making more effective use of PLATO in this course.

During the 1977-78 academic year, questionnaire results confirmed the original student opinions expressed in 1976-77. Having determined the overall general student enthusiasm for PLATO, the Delaware PLATO Project began to shift its emphasis from student evaluations of courses as a whole to evaluations of selected lessons in order to learn more about how to design lessons in the most effective manner. For example, it was noted that in one-third of the course evaluations more than fifty percent of the students agreed that the PLATO lessons were unnecessarily picky about the form of the correct answer. An investigation into the nature of the lessons which were causing difficulty for the students revealed that unfavorable ratings were being given most often to lessons that require short answer responses rather than for lessons that require touch or numeric responses. This indicates that designers of lessons which use short answers should carefully consider whether their materials might not be more effectively taught using touch responses or numerical answers, and that if the students are going to be required to type in short answers, the key words used in judging the answers should be as flexible as possible The experience gained from this lesson-by-lesson evaluation will provide more sharply focussed information on the reasons why some lessons work better than others.

-Experimentation-

Experimentation in the Delaware PLATO Project has taken three main forms. First, faculty members have used PLATO to do perceptual research, where PLATO serves as a multi-faceted stimulus presentation and response recording device. Second, there are controlled experiments on the effect of PLATO on student achievement. Third, experiments have been conducted into the effects of alternative programming strategies upon student achievement and student attitudes. Whereas the three previous Summative Reports of the Delaware PLATO Project have included descriptions and screen displays from research projects, space no longer permits their inclusion, and with this Fourth Summative Report the convention of printing abstracts from published studies is being established. The remainder of this section gives abstracts from articles dealing with perceptual research, student achievement, and programming strategies, respectively.

Perceptual Research

Hofstetter, Fred T. 1978. Computer-Based Recognition of Perceptual Patterns in Harmonic Dictation Exercises. Journal of Research in Music Education, Vol. 26, pp. 111-119.

During the 1975-76 academic year, student response data was saved for a group of 17 freshman music majors as they worked through 15 units of harmonic dictation exercises delivered on the University of Delaware's GUIDO system. Analysis of the student data base led to the identification of seven confusion tendencies that affect the perception of harmonies: bass line confusions, confusions of inversion, confusions of chord function, confusions of chord quality, unperceived sevenths, unperceived roots, and favorite response confusions. The level of student achivement on individual harmonies was found to be highly correlated with the percentage of times these harmonies were asked in the curriculum.

Mahler, William A., and Richard S. Sharf. 1977. CAREERS: A Computer-Based Career Guidance System. Presented at the ADCIS Winter Conference, Wilmington, Delaware, February 21-24.

This paper reports on a new system, which has two major parts. The first part is a computerized version of John Holland's inventory of interests and self-determined competencies, which is called The Self-Directed Search (1974). The individual's responses to the 228 items of this inventory determine the sequence in which various occupations are presented in the second part of the system. The person is able to request and receive various kinds of information about each occupation as it is presented.

This project differs from other computerized guidance projects in several ways: First of all, it was developed at relatively little expense, aided by a small internal grant from the Division of Continuing Education at the University of Delaware. Secondly, it begins with an assessment of the individual's interests and abilities using a well validated inventory, rather than simply having the person explore a large data base of job information without any direction. Another difference is that the data base is designed to include occupations of interest to college students and adults who might be returning for further education. Access to and use of the system is simple so that people who have never used a computer terminal can use the system. Finally, in addition to providing career guidance services, the system is used to develop a data base of information on how people make career choices.

Tobin, Aileen W., and Venezky, Richard L. 1979. The Effect of Orthographic Structure on Letter Search: An Attempt to Replicate and Extend Previous Findings. Presented at the Annual Meeting of the American Educational Research Association, April 8, 1979, San Francisco, California.

This study attempted (a) to compare the relative effects of experimental design and orthographic structure on the speed of letter search and (b) to determine the psychological reality of the differences in the structure of the four types of letter strings presented in the search displays, based on a rating procedure similar to that described by Underwood and Schulz. Replicating the results of previous research, differences in orthographic structure had no effect ($p > .05$) on the mean rate of search when a between-subjects design was adopted, but a significant effect ($p < .01$) when the paradigm was expanded to permit a within-subjects analysis of the data. However, all post hoc comparisons of the mean subjective ratings were highly significant ($p < .01$), suggesting that subjects can clearly distinguish between strings of letters have different amounts of local orthographic structure.

Hoffman, James E., Billie Nelson, and M. Laubach. 1979. A dual task analysis of controlled and automatic detection. Presented at the 20th annual meeting of the Psychonomic Society, Phoenix, Arizona.

Extensive practice in looking for the same set of targets in a visual search task eventually results in the task becoming "automatic", i.e., search time is independent of the number of characters in both the target set and visual display. In contrast, when the target and distractor characters periodically change roles, subjects use a "controlled" search in which each element of the visual display is compared to the target set in a serial fashion.

The goal of the present research was to measure the attention demands of controlled and automatic search by pairing a primary search task with a secondary task of detecting which of several points of light located next to each display letter was briefly extinguished (flicker task). Results indicated that neither of the two tasks were performed together as well as they could be performed separately. There were two components to the loss in flicker location accuracy that occurred when it was paired with visual search. The largest component was independent of the processing load of the search task and whether search was in controlled or automatic mode. The second, smaller component did reflect processing load, even in the case of automatic detection. Continued training in the automatic detection task eventually eliminated the dependence of secondary task accuracy on search load.

These two components are presumed to reflect two different sources of interference in the dual task situation. The first component reflects competition between tasks in encoding information into short-term memory. Evidently, even highly practiced and presumably automatic tasks require this processing resource. The second component reflects preparation and rehearsal carried out prior to onsent of the visual display. Extensive training can eliminate the need for active rehearsal of the target set.

Student Achievement

Barlow, David A., A. Stuart Markham, Jr., and James G. Richards. 1979. Plato Facilitation of Precision Motor Analysis in Biomechanics. Proceedings, ADCIS Conference, San Diego, California, February 27 - March 1, pp. 1005-1012.

Programmed Logic for Automatic Teaching Operations (PLATO) was developed at the University of Illinois in the 1960's. PLATO was designed to provide computer-assisted instruction (CAI) in teaching a variety of subject matters on many campuses. Recognized as one of the leading systems of teaching by computer, PLATO has the capability of individually instructing several hundred students at one time while carrying on two-way communications. This system enables the student to receive visual information in words, figures, graphs, pictures, and sounds. PLATO is therefore concerned with on-line use of computers by students to further individual learning, by teachers to supervise instruction, by programmers to prepare instructional material, and by researchers to study the optimization of learning.

The purpose of this investigation was to explore a single additional application for PLATO in the realm of undergraduate research projects conducted in the sport science of biomechanics. More specifically, an effort was made to determine the feasibility and value of utilizing PLATO in the precision motion analysis (quantification) of high speed cinematographical data. Parameters measured included: 1) Time required to conduct a complete analysis; 2) Accuracy/quality of film data reduction; and 3) Knowledge or understanding of biomechanical principles affecting human movement.

All undergraduate students (N=92) in Biomechanics at the University of Delaware during 1977 and 1978 were randomly assigned to two research project groups. A Control group performed all mechanical calculations without the aid of an on-line computer system. An Experimental group was assigned to the PLATO System in order to use appropriate software developed by the investigators for motion analysis of film data. Both groups were required to complete the exact same specific objectives for this research project.

A 16 mm Locam Camera, operating at 100 frames/second was used to photograph all students in the performance of a selected sport skill technique. Appropriate cinematographical techniques and procedures were followed to enable the quantified assessment of selected kinematic factors of human performance. Initial film measurements, including coordinates of 19 segmental end points of the human body, were acquired with the utilization of various manual and automatic digitizers. The PLATO terminals were then used to determine the specific measurement of centers of gravity, joint angles, velocities and accelerations.

In order to compare selected variables measured for the Control and Experimental groups, a multivariate analysis of variance (MANOVA) was conducted at the conclusion of all projects. Significant F-ratios were obtained for all comparisons.

Within the limitations of this investigation, the simplistic application of PLATO using CAI techniques (as compared to long-hand manual procedures) resulted in the following measurable benefits: 1) Considerable decrease in overall data reduction time; 2) Increased accuracy of data reduction; 3) Tremendous increase in quantity of quantified film data; and 4) Increased excitement in the conduct and understanding of biomechanical research. PLATO facilitation techniques obviously enhanced the quality of all research projects involving film analysis of human movement in biomechanics.

Hofstetter, Fred T. 1975. GUIDO: An Interactive Computer-Based System for Improvement of Instruction and Research in Ear-Training. Journal of Computer-Based Instruction, Vol. 1, No. 4, pp. 100-106.

The University of Delaware has established a center for computational musicology for improvement of instruction in music courses and investigation of the nature of musical skills. During its first year the center has developed an interactive computing system (named GUIDO for Graded Units for Interactive Dictation Operations) for recording student learning patterns in ear-training courses. Learning stations consist of a graphics terminal with keyboard, which is used for displaying musical notation and recording student responses, and a synthesizer through which the computer generates aural stimuli. Interactive learning programs have been written in two modes: (1) drill-and-practice mode, in which students hear dictation exercises and are asked questions about what they hear; and (2) touch-sensitive playing mode, in which students can make up their own ear-training examples, examples which they would otherwise not be able to play. By means of these programs each student receives individualized practice in ear-training, and each student's learning patterns are recorded for further study.

The experiment reported was conducted with a freshman ear-training class to determine GUIDO's impact on student achievement in harmonic dictation. During the first semester, all 33 students received the same course of instruction in ear-training, with all drill-and-practice done in the tape laboratory. At the beginning of the second semester, the class was randomly split into two groups; 17 students were assigned to an experimental GUIDO group which practiced ear-training at the computer terminals, and 16 students were assigned to a control TAPE group which practiced in the tape laboratory. At the end of the first semester (before the implementation of GUIDO), the mean harmonic dictation scores of the GUIDO and TAPE groups were 77 percent and 76 percent, respectively. At the end of the experiment the mean scores were 86 percent for the GUIDO group and 75 percent for the TAPE group. The results of a t-test applied to the GUIDO and TAPE scores at the end of the experiment indicate that the difference between the two groups is significant at the .05 level.

Culley, Gerald R. 1979. Computer-Assisted Instruction and Latin: Beyond Flashcards. Classical World, Vol. 72, No. 7, pp. 393-401.

CAI in languages has usually been limited to rigid drills in vocabulary or forms. This article uses two Latin verb lessons developed by the author to show how computer instruction can be made much more versatile and powerful. Routines which conjugate the verb permit a diagnostic lesson to analyze student-typed Latin verbs and localize errors to stem, tense/mood sign or personal ending, providing corrective comments as appropriate; to determine when a student has typed some genuine -- but incorrect -- verb form, and to parse that form; and to lead a confused student through a series of grammatical questions about a given item to the correct answer. A companion lesson which gives practice in generating or recognizing verb forms in a gaming format can be tailored in content and difficulty by the student. Thus students may use the same lesson throughout the school year, increasing the number of conjugations, tenses, etc. in use so as to maintain interest and challenge. Finally, the lessons are capable of collecting data on student error patterns which can provide the basis for improved classroom instruction.

Programming Strategies

Arenson, Michael. 1979. Computer-Based Ear-Training Instruction for Non-Music Majors. Journal of Computer-Based Instruction, Vol. 6, No. 1, p. 39.

During the spring semester of 1978, student performance data were kept for music majors enrolled in a first-year ear-training course and non-music majors enrolled in a non-majors fundamentals course as both groups went through the GUIDO computer-based ear-training lessons on the University of Delaware PLATO system. One group each of majors and non-majors went through the interval drills in a traditional non-competency-based format, while one group each of majors and non-majors were routed through a competency-based format. Each group was given the same off-line pre- and post-test.

The music majors in the competency-based group performed better than the music students in the non-competency-based group. However, the non-majors did not show this difference.

In the competency-based format, students were required to respond to each interval presented in four seconds. Otherwise they would be counted wrong. It seems evident now that the non-majors were too inexperienced in responding quickly to musical stimuli. Only one of the 30 non-majors in the competency group completed all units. Since the non-competency-based students were allowed to guess at the names of the intervals presented to them, they always eventually answered correctly. Thus it is doubtful that they developed any greater skill at interval perception than did students in the competency-based group.

Hofstetter, Fred T. 1979. Evaluation of a Competency-Based Approach to Teaching Aural Interval Identification. Journal of Research in Music Education, Vol. 27, No. 4, pp. 201-213.

During the 1977-78 academic year, two groups of 12 freshman ear-training students were given the exact same course of instruction in ear-training, with all drill-and-practice given by the computer. The only difference was that, for group A, a set of competencies was defined and entered into the computer and the students were not allowed to progress from one unit to another until they had obtained the level of competency required for a given unit. The average pre-test score for group A was 77 percent, and the average pre-test score for group B was 75 percent. Application of t-test showed that there were no significant differences among the two groups.

At the end of the course, a post-test was administered to both groups. Group A, which was the competency-based group, had achieved an average score of 93 percent, whereas Group B, which was the non-competency group, had a significantly lower average score of 83 percent. There was no significant difference in the amount of time spent practicing intervals. However, the advancement criteria caused the competency-based group to spend less time on the easier units and more time on the more difficult units. Moreover, students participating in the competency-based format felt that the computer was helping them to learn more than the students who were in the non-competency-based group.

Nichols, Raymond D., and James H. Wilson. 1977. The Computer Display As A Medium In The Teaching Of Aesthetics In Visual Design. Proceedings, ADCIS Winter Conference, Wilmington, Delaware, February 21-24, p. 248.

Computer graphics have been investigated and improved markedly in recent years, but their application to art education has been largely neglected. In order to facilitate instruction in an introductory course in basic design, programs were developed on the PLATO system to allow computer graphics to serve as a medium for a student activity that had previously been done using traditional media.

This use of the computer for the execution of technical procedures was aimed at three educational goals: 1) Students, able to revise previous work with minimal effort, are less likely to alter their aesthetic judgment as a result of effort expended than has been the case using traditional media. 2) Students and faculty, no longer influenced by variations in the students' technical abilities, are forced to concentrate on aspects of visual design. 3) Students using the program should be encouraged by it to involve thought processes throughout the experience, rather than to divorce creative thought, execution, and evaluation.

The courseware has been used by 60 University of Delaware freshmen, and preliminary results show that initial goals were achieved. Further, students were able to execute more intricate designs in a shorter time. Finally, students profited from a greater opportunity for ongoing feedback, both through interaction with their instructor and through viewing of classmates' designs. These factors have combined to emphasize perception of the experience as education rather than simply production.

Nichols, Raymond D. 1979. The PLATO Display In The Teaching Of Optical Letterspacing. Proceedings, ADCIS Conference, San Diego, California, February 27 - March 1, pp. 1022-1026.

Education in the visual arts possesses one very great problem in the student's normal course of study: the ratio of the effort required to 'get an idea' or 'make a judgement' and the amount of effort required to put that idea/judgement into practice. It is here that contemporary technology, namely computers and more specifically PLATO, can serve as an educational tool which may potentially become one of the most important changes to visual arts education.

In the graphic and advertising design area of the Department of Art, University of Delaware, we are heavily involved in the teaching of advertising design as visual communication, a subject very dependent on the visual appearance of the printed word. When one designs an advertisement there are two main goals relating to its effectiveness:

1. the recognition by the viewer of the desired objectives of the advertisement, and
2. the actual reading by the viewer of a major portion of the advertisement.

As advertisements are viewed as 'out of context' material in magazines and newspapers (given the reason these publications are normally purchased) it is important that the reading matter be designed as easily readable and aesthetically pleasing as possible.

It is with this readability in mind that correct 'optical letterspacing' becomes a major concern for the designer. Words in headings, subheadings, etc. must be spaced so as to be read easily, trying to avoid the visual division of the individual word into groups of letters smaller than the word itself. Words which break down into small words can create confusion for the viewer, hindering a positive response.

An example: **LARGE**

Due to the physical form of the letters and the fact that each letter is placed the same distance from each other in this example we, as viewers, begin to perceive the word 'LARGE' as two words, 'L', and 'ARGE', creating confusion in the mind of the reader.

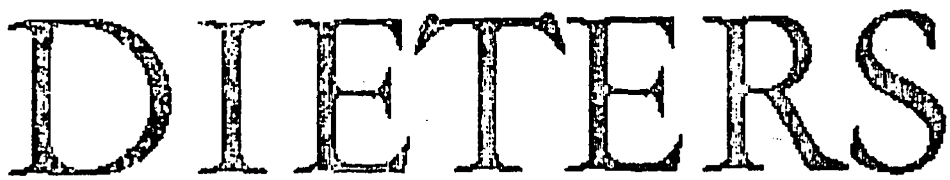
The problem that occurs in the classroom, where the instruction is aimed at heightening the students' awareness of the spacing and teaching them to make the correct judgements, is the amount of time which is necessary to physically execute the word with enough accuracy and weight that a judgement, resulting in a positive educational experience, can be made as to the correctness of the spacing. Simply outlining (which is the quickest method of executing the letters) does not illustrate the weight of the various letters against one another, and the outlining and filling in of the letters can take from 30 to 90 minutes, even in a fairly rough stage. The more accurate the designer wants the spacing, the more exact the execution must be in the preliminary stages.

PLATO, though, provides a format where specific typefaces can be displayed allowing the student to easily execute words of their own or of the instructor's choosing.

An example:

DIETERS

This is the form in which PLATO displays the desired word, in this case DIETERS in the typeface Garamond.



This is the finished form of the word after the correct spacing has been completed by the student. The actual execution of the spacing of this particular word by the author required 2 minutes, 35 seconds and a minimal amount of physical effort.

The format of the lesson provides five alphabets for practice (each representing one of the five major families of typefaces). The spacing of the individual letters can be controlled to 1/60th of an inch by moving them either singly or in groups. The instructor can input up to five required words per typeface (these would provide a form for testing and data keeping) and five comparison words. Both the required and comparison words can be spaced by the instructor and stored, with the student able to visually compare his result with that of the instructor's.

Through PLATO the student involved in 'optical letterspacing' can, in one hour's time, space 10 to 20 words, giving him considerable practice and also providing a quick comparison or evaluation of his spacing solution to that of the instructor's.

Weaver, Charles A., and Seiler, Bonnie Anderson. 1977. Computer Assistance In The Social Processes Of Learning. Proceedings, ADCIS Winter Conference, Wilmington, Delaware, February 21-24, pp. 26-38.

Computer assisted instruction has traditionally been associated with individualized instruction. While there is a great need for such instruction there are also dangers associated with it.

Many observers have noted that it is important for students to verbalize what they have learned and to interact directly with teachers and fellow students about materials being studied. Great damage can result when individualized instruction is carried out in a situation in which social interaction is lacking.

Computers can be used effectively to aid the student communication process as well as to individualize instruction. In this paper we discuss various ways in which computers can facilitate student-student interaction and also can direct students to deal with one another's written ideas.

Examples include lessons in which students learn from each other's strategies and moves, work cooperatively to solve a common problem, pose problems for other students to solve, display their work for others to use, and exchange questions and comments about subject matter with teachers. Specific examples are taken from materials developed by the authors as part of the PLATO Elementary Mathematics Project.

Wilson, James H., and Elaine P. Paden. 1978. The Effects of Drill Structure on Learning in Phonetics Lessons. Proceedings, ADCIS Conference, Dallas, Texas, March 1-4, pp. 448-456.

This study is undertaken to investigate the advantages and disadvantages of different forms of drills as used in CAI lessons in phonetic transcription. Measurements of student learning, student attitude and time required for completion are considered for drills constructed 1) with and 2) without specific rehearsal of items initially missed. Time spent by students in exploratory and quiz sections of the lessons is also recorded. Recommendations are made for other similar applications.

Nichols, Raymond D. 1979. Plato In The Teaching Of Foundation Visual Design. Proceedings, ADCIS Conference, San Diego, California, February 27 - March 1, pp. 986-990.

Foundation courses in visual design rely on two basic skills on the part of the student in order for the course to provide a positive educational value. These skills are:

1 technical or hand skills necessary to implement and present an idea to some viewer, and

2 conceptual skills necessary to the actual mental task of solving a specific problem.

To provide this educational experience to our students, it becomes necessary to separate these two skills in order to demonstrate the strengths and weaknesses of each and to show the relation of both to the process of design.

Unit design was developed to provide a solution to four distinct problems that occur with beginning students in the foundation courses in visual design:

1 the restriction which is placed on the visual presentation of the student's ideas resulting from the level of the student's basic technical (hand) skills;

2 the final solution having been dictated not by the student's aesthetic tastes but by the fact that it is easier to change one's tastes than it is to change the actual design;

3 the difficulty involved in the instructor's evaluation which is due to the different mixtures of technical and conceptual skills of the students,

making it hard to separate the two areas for discussion or criticism; and

4 the difficulty for the instructor in presenting an effective criticism to the student (given that the experiences and tastes which the instructor uses for his evaluation are not the same experiences and tastes that the student uses in receiving and evaluating the criticism) makes a clear understanding between the instructor and the student quite difficult.

The 'Unit Design' program provides for the designing of a two-dimensional image (called a 'unit') which can be placed into a 4 by 4 array by rotating, mirroring and/or reversing the positive/negative relationships of each section.

The 'unit' consists of the dot-like elements of the plasma panel, each of which can be on or off, combining to create the desired image. As these dots are in a fixed position, the method for inputing a given image is the same for all students. Having completed the input of the 'unit', the student then progresses into design mode where this 'unit' is used to create a modular design comprised of a 4 by 4 array of 'units.' In this mode the student can alter the 'unit' by rotating 0 , 90 , 180 , or 270 , mirroring from any of those positions, and/or reversing the positive/negative relationship. The modular design is manipulated until the student arrives at what is felt to be the best, or a series of the best, of the available solutions with regard to the student's aesthetic tastes. These designs can then be judged for aesthetic value in relation to other available designs.

Lesson 'Unit Design' utilizes a dithering process for the input of the 'unit'. Dithering is a process which takes a video image and analyzes the tonal density of small areas. These densities can then be duplicated on the PLATO screen by turning on various combinations of plasma panel dots.

The lesson provides the following solutions to the previously stated problems:

1 the lesson reduces the technical skill, necessary for the execution of the design, to a simple matter of using the dithering process to input the image into the computer, and the editing of this image has been reduced to the adding or subtracting of fixed dots from which the image is made;

2 the actual execution of the final design is handled through a series of judgements on the part of the student and can be carried out by simply touching the computer screen, making any changes necessary to the final form of the design very simple to implement; and

3 students who create images using the 'Unit Design' lesson have utilized the same technical skills so that any evaluation on the part of the instructor will not have to take into consideration the manner (or at least it will be the same for all students) in which the final design was done and can concentrate on the actual aesthetics and design of the piece.

Culley, Gerald R. 1978. Beyond Flashcards: Using the Computer's Power. American Philological Association, Vancouver, B.C.

This is an account of one means of bringing the computer's computational power and branching capability to bear on language teaching, thus escaping the wasteful, rigid "flashcard" approach. It is a program duplicating the logic of the regular Latin verb and so capable of locating the error in a student's response as within the stem, tense/mood sign, or personal ending. Judging by segments also permits several special checks for common errors, such as inappropriate tense signs. This approach also makes it possible to establish whether the student's incorrect verb belongs anywhere at all in the tense system of the verb demanded of him. A confused student is led through ten to twelve grammatical questions to isolate the source of his error and correct it, with animation effects revealing the correct form segment by segment as he proceeds with its grammatical identification. Completion of an exercise yields a diagnostic readout, e.g., "trouble in the 3rd plural imperfect passive, both moods." The student may then use a companion lesson to practice these areas, specifying the exact grammatical parameters from which the computer may present challenges in a gaming format.

The code is written so as to permit students to work on any part of the year's curriculum with very little more demand upon computer memory than is made by one student in a single exercise, and versions of the lessons tailored (i.e., in vocabulary and order of introduction of the forms) for any textbook can be quickly and easily produced. The computer saves error patterns on which changes in classroom work or in the computer lessons may be based.

Culley, Gerald R. 1979. Two-Pronged Error Analysis from Computer-Based Instruction in Latin. University of Delaware Symposium on Language and Linguistics.

This paper describes first-stage results from a package of computer lessons on Latin morphology. It deals with two kinds of error analysis: an immediate response to partially correct verb, noun and adjective forms which will guide the student toward the correct answer, and the collection of precise data on errors by type which will lead to improved teaching by both traditional and electronic means.

These features were made possible by the development of logical models of the Latin verb, noun and adjective in computer code, making it possible for the computer to inflect these parts of speech. Since the machine has this capability for synthesis, it of course has the corresponding analytical capability; it can break down a student's typed response into its structural components of stem, tense/mood sign and personal ending for verbs or base and case ending for nouns and adjectives. Thus the machine can localize errors and offer appropriate comments to the student based on which component is faulty. Further checks within that faulty element can be made for specific errors; e.g., substitution of one tense sign for another.

The same feature permits information on student errors to be saved according to its nature: errors in the stem, errors in personal ending, etc. The first year of use with students has begun to reveal points of difficulty in learning these inflected forms. The relative percentages of errors indicate, for example, that the tense/mood sign of the future gives much more trouble in 3rd and 4th conjugative verbs than in others; and that passive personal endings must be introduced with very careful exposition. A second stage of data collection based on these data will permit still more precise conclusions to be reached.

-Overall Educational Value of PLATO for the University of Delaware-

As the Delaware PLATO Project has grown from the installation of its first terminal on March 14, 1975 to the purchase of its own PLATO system, and as the number of departments using PLATO has increased from the original three to the present thirty, the faculty and students have identified many benefits of PLATO to the University of Delaware. It is through the realization of these benefits that PLATO has received a widespread support and acceptance at the university. This report concludes with the classification of these benefits according to eleven main purposes which are enumerated and explained as follows:

1. To individualize instruction. Faculty members and students often complain that the level of instruction is never right for all members in a class. Some are fast learners; others are slow learners. Some drop out because a course is too boring; others drop out because they can't keep up. The individualized, self-paced approach of PLATO has proven to be a remedy for this problem of individual differences.

2. To expand the university's educational market. The market needs a delivery system which can economically deliver instruction over a wide geographical area. Through computer-based techniques, the university can reach more students. For example, if three people in Georgetown wanted to learn Persian, PLATO could teach them whereas a regular course would be cancelled due to small enrollment. This aspect becomes even more important as the learner population is becoming more adult in its make-up.

3. To reduce the time needed for instruction. Computer-based self-paced techniques make it possible for students to finish courses in less than the normal fourteen-week semester. PLATO could allow students to complete their degree ahead of schedule, thereby reducing the cost of instruction to the parent and to the taxpayer.

4. To emphasize the intrinsic joy of learning and deemphasize competition with peers as a motivating force. In the computer-based environment the anxieties associated with the traditional classroom are minimized. The student is free to respond as he wishes without the fear of ridicule from either his peers or his teacher. In such an environment learning is a lot of fun, and motivation is high.

5. To enable students to develop a richer intuitive grasp of complex phenomena through graphic visual representation. Especially applicable to PLATO is the saying that "A picture is worth a thousand words." The ability of PLATO to create interactively a display suited to the student's specific learning needs cannot be overestimated.

6. To provide students with access to a wide range of data for checking out hypotheses. A good example of this benefit is the population dynamics PLATO program. Stored in the computer are up-to-date data on the populations of countries throughout the world. The student is able to set variables which affect the futures of those populations, such as time and extent of famines, and can then see the effects of those variables upon future generations of the populations.

7. To enable the students to learn more of the complexities of phenomena through modeling and simulation. In addition to giving students drill-and-practice and tutorials on various subjects, PLATO can also allow the student to create models and simulate complex phenomena. For example, the student can make electronic circuits, design clothes, compose music, draw pictures, mix chemicals, breed fruit flies, and then study the results of the models and simulations. Such flexibility is not a regular part of education in university courses; it should be.

8. To encourage students to tailor their learning experiences to meet their own objectives. How often do students complain that they did not get what they wanted out of a course? They may have met the instructor's objectives, but they did not meet their own objectives. PLATO can help them do both. For example, in the university's advanced music theory courses, very little time is spent on set theory. However, some students want to explore it in depth. It is a complex analytical system which cannot be learned by the average student by reading a book. Interactive instruction in this area is made available to the students who want it by means of PLATO's set theory program. There are ten hours of instruction available for students who want to learn set theory, including periodic tests which assure the student that he is mastering the material. In this way, students are encouraged to extend their learning beyond the requirements of the course.

9. To give immediate feedback. One of the greatest advantages of computer-based techniques is immediate feedback. Through individual interaction with the computer, each student partakes in a dialogue in which he receives instantaneous responses to his input. There is no other medium which provides this interaction, a benefit which has led to the documentation of significant improvement of instruction in such diverse areas as anesthesiology, French, music, mechanics, dentistry, sociology, calculus, geography, ecology, health, physics, and accounting.

10. To provide students an anonymous way of asking questions about sensitive matters. Recent research has shown that the use of anonymous sign-ons whereby students can use PLATO without revealing their identities has encouraged students to ask questions and get responses on sensitive issues which they would normally be afraid to discuss. PLATO's groupnotes notefile capabilities enable students not only to ask questions and to get responses on their own personal questions, but also to see the questions and responses anonymously written by other students. Especially in the area of sex education this has proven to be an excellent means of allowing students to anonymously explore sensitive personal issues.

11. To provide maximum flexibility. Micro-electronic technology has progressed to the point at which practically any electronic device can be connected to a PLATO terminal. The terminal already has a slide projector, a touch-sensitive screen, a random-access audio device, a speech synthesizer, and a music generator. The terminal also contains a micro-processor, the latest development in computer hardware, which secures product flexibility for the foreseeable future.

APPENDIX

Catalog of Programs Under Development in the Delaware PLATO Project

CATALOG OF PROGRAMS UNDER DEVELOPMENT IN THE DELAWARE PLATO PROJECT

-Instructional Lessons-

Department	Title	File Name	Developer	Programmer(s)
Agriculture	APS101 Sample Test Questions	apsintro	Paul Sammelwitz	Paul Sammelwitz
	The Endocrine System	endocrine	Paul Sammelwitz	Paul Sammelwitz
	Relations	relations	George Haenlein	Craig Lewis Daniel Tripp
Anthropology	Cellular Structure	physanthro	Margaret Hamilton	Monica Fortner
	Anthropological Descent Theory	ndescent	Norman Schwartz Monica Fortner	Charles Collings
	Anthropological Residence Theory	nresidence	Norman Schwartz Monica Fortner	Charles Collings
	An Introduction to DNA for Anthropologists	antdna	Jean Rounds Margaret Hamilton	Monica Fortner Jean Rounds
rt	Aesthetic Value	value	Raymond Nichols	Joseph Maia
	Composition Using Grey Scale Tones	greyscale	Raymond Nichols	Joseph Maia
	Design Aesthetics and Creation	unitdesign	Raymond Nichols	Charles Wickham Jim Trueblood
	Letter Spacing	spacing	Raymond Nichols	Charles Wickham
	Newspaper Copy Fitting	copyfit	Raymond Nichols	Joseph Maia
	Painting on a Computer		Raymond Nichols Ben Williams	Ben Williams
	Rotating Squares Generator	squares	Raymond Nichols James Wilson	James Wilson
	Random Dot Pattern Generator	random	Raymond Nichols	Klaus Abele
	Slide-Tape Presentation Editor	artslide	Raymond Nichols	James Trueblood

Department	Title	File Name	Developer	Programmer(s)
Biology	A Temperature Sensitive Morphological Mutant of Drosophila Melanogaster	tsfly	David Sheppard	Kathleen Bergey
	Gene Mapping in E. coli by Conjugation Analysis	conjug	Aart Olsen	Aart Olsen
	Human Karyotype Analysis	karyo	Aart Olsen	Aart Olsen
Chemical Engineering	Expansion of an Ideal Gas	thermol	Stanley Sandler	Douglas Harrell
	Modeling of Binary Mixtures	thermo2	Stanley Sandler	Douglas Harrell
	Desuperheater	thermo3	Stanley Sandler	Douglas Harrell
	Repressurizer	thermo4	Stanley Sandler	Douglas Harrell
	Steam Turbine	thermo5	Stanley Sandler	Douglas Harrell
	Introduction to Mass Balance	massball	Robert Pigford	Brian Russell
	Dryer-Recycle Mass Balance	massbal2	Robert Pigford	Brian Russell
Civil Engineering	Shear and Moment	civengl	Eugene Chesson	Jeffrey Snyder
Computer Science	Turing Machine Simulator	tmsim	Ralph Weischedel	Joseph P. Maia
	Push-Down Automata Simulator	pdsim	Ralph Weischedel	Joseph P. Maia
Counseling	Holland's Self-Directed Search and Career Inventory	searchl	Richard Sharf William Mahler	William Mahler Mark Laubach
	Job Aids	jobroute	Richard Sharf Mark Laubach	Mark Laubach
	Occupation by Career Code	search7	Richard Sharf Mark Laubach	Mark Laubach
Economics	Review of Graphing	econgraph	Karna Mathre James O'Neill	Karna Mathre
Education	Big Story (imitative reading)	readalong	Peter Pelosi	Jessica Weissman

Department	Title	File Name	Developer	Programmer(s)
Education (continued)	Factors in Reading Comprehension	factors	Frank Murray	Judith Sandler
	Fast Accurate Symbol Transcription for Evaluation of Elementary Reading	swiggles	John Pikulski	Deborah Braendle
	Make a Spy (Sight word game)	makespy	Jessica Weissman Bonnie Seiler	Jessica Weissman
	Metric Estimation Game	skunkwar	Bonnie Seiler James Wilson	James Wilson Bonnie Seiler
	Sight Word Attack Team (SWAT)	swat	Rosalie Bianco Peter Pelosi Jessica Weissman Bonnie Seiler	Jessica Weissman
	Sight Word Teaching Method Simulations	sightword	Peter Pelosi	Jessica Weissman
	Spot the Spy (Sight word game)	spotspy	Jessica Weissman Bonnie Seiler	Jessica Weissman
	SWAT Missons (Sight word game)	mentalspy	Jessica Weissman Bonnie Seiler	Deborah Braendle
	SWAT Promotion Test	swattest	Rosalie Bianco Peter Pelosi	Jessica Weissman
	Word Zoo (Classifying prefixes by meaning)	wordzoo	Steven Hansell	Jessica Weissman
	Hang-a-Spy (Hangman with spies)	hangspy	Jessica Weissman Bonnie Seiler	Jessica Weissman
	Spy Concentration (Concentration with spies)	newtwo	Jessica Weissman Bonnie Seiler	Jessica Weissman
	Spy Meeting (Sight word game)	spymeet	Jessica Weissman	Jessica Weissman
	Diagnostic Test of Classroom English	dtest	Louis Arena Marcia Peoples	Everett Langhans
	IS and ARE, the Missing Links	cdelete	Louis Arena Marcia Peoples	Jessica Weissman
	The Power of Negative Thinking	negativl	Louis Arena Sophie Homsey	Jessica Weissman
	An S at the End	threepv	Louise Arena Phyllis Townsend	Jessica Weissman

Department	Title	File Name	Developer	Programmer(s)
Education (continued)	The Animal Game	animal	Louis Arena Sophie Homsey	Jessica Weissman
Home Economics (Human Resources)	Metric Practice	seemet	Dorothy Elias Frances Mayhew Frances Smith	David Anderer Dorothy Elias
	Alteration Laboratory	ald	Dorothy Elias Frances Mayhew Frances Smith	Davis Anderer Dorothy Elias James Wilson
	Pattern Measurement	patterns	Dorothy Elias Frances Mayhew Bonnie Seiler Frances Smith	David Anderer Dorothy Elias
	Ease Requirements	ease	Dorothy Elias Frances Mayhew Frances Smith	Davis Anderer Dorothy Elias
	Body Measurement	bigbody	Dorothy Elias Frances Mayhew Bonnie Seiler Frances Smith	David Anderer Dorothy Elias
	Home Economics Usage Data Display	hroutput	David Anderer	David Anderer
Languages	The Verb Factory	factory1, 2	Gerald Culley	Gerald Culley
	Cursus Honorum: A Latin Verb Game	cursus	Gerald Culley	Gerald Culley
	Review of English Grammar	udgrammar	Gerald Culley	Gerald Culley
	Substitution Drill and Editor	subdrill submaker	Dan Williams	Dan Williams
	Touché: A Word Order Touch Lesson	touche	George Mulford	Dan Williams
	Hidden Word Game and Generator	subpuz	Christine Brooks	Christine Brooks
	Language Lab Tape Preparer	tapemaker	George Mulford	James Wilson
	Mare Nostrum: A Game with Latin Nouns and Adjectives	mare	Gerald Culley	Gerald Culley
	Translat: Exercises in Translating Latin Sentences	translat	Gerald Culley	Gerald Culley

Department	Title	File Name	Developer	Programmer(s)
Languages (continued)	German Adjective Endings	pgerm	Anne Howard	Anne Howard
	Ringers: A Grammar Recognition Lesson	ringers	George Mulford	George Mulford
Mathematics	Vector Field Plotter	vplotter	Morris Brooks	Morris Brooks
	Calculus Basic Skills	calcprac	Morris Brooks	Morris Brooks
	Power Series Plotter	psplotter	Morris Brooks	Morris Brooks
	Parametric Curve Plotter	pplotter	Morris Brooks	Morris Brooks
	Sigma Notation Quiz	sigma	Morris Brooks	Morris Brooks
	Sequence Plotter	sequence	Morris Brooks	Morris Brooks
	Interval Notation Quiz	interval	Morris Brooks	Morris Brooks
	Polar Coordinate Game	polarco	Alan Stickney	Alan Stickney
	Rectangular Coordinates	carteco	Alan Stickney	Alan Stickney
	Derivative, Difference Quotients, and Increments	deriv4	Alan Stickney	Alan Stickney
	Differentiation Formulas	deriv5	Alan Stickney	Alan Stickney
	Integration Using Areas	integ1	Alan Stickney	Alan Stickney
	Properties of Integrals	integ2	Alan Stickney	Alan Stickney
	Two Variable Function Plotter	plot2	Alan Stickney	Alan Stickney
	Surface Plotter	plot2b	Alan Stickney	Alan Stickney
	Rootfinder and Function Plotter	rootfind	Alan Stickney	Alan Stickney
	Simulation of TI58 Calculator	ticalc	Alan Stickney	Alan Stickney Joseph Maia
Military Science	Solving Problems Statistically	yellow	Thomas Reinhardt	Michael Houghton Thomas Noyes

Department	Title	File Name	Developer	Programmer(s)
Music	GUIDO Ear-Training System:			
	Intervals	dictation	Fred Hofstetter	William Lynch
	Melodies	dictation	Fred Hofstetter	William Lynch
	Harmonies	dictation	Fred Hofstetter	William Lynch
	Rhythms	dictation	Fred Hofstetter	William Lynch
	Competency-Based Chord Quality Drill	chords	Fred Hofstetter	William Lynch
	Competency-Based Harmonic Dictation Drill	harmony	Fred Hofstetter	William Lynch
	Interval Hall of Fame	intervals	Fred Hofstetter	William Lynch
	Competency-Based Melodic Dictation Drill	melody	Fred Hofstetter	William Lynch
	Competency-Based Rhythmic Dictation Drill	rhythm	Fred Hofstetter	William Lynch
	Fundamentals of Ear-Training	udthomas	Robert Hogenson	Richard Thomas
	Note Reading Hall of Fame	notegame	Peter McCarthy	Deborah Braendle
	Set Names (after Forte)	setnames	Fred Hofstetter	James Trueblood
	Intervals	bintrain	Michael Arenson	Richard Thomas
	Pitch Identification Test	cmimus	Michael Arenson	William Lynch
	Musical Terms Glossary	cmimusterm	Michael Arenson	William Lynch
	Aural Recognition of of Scales and Modes	modes	Michael Arenson	Russell Kozerski William Lynch
	Clef Transposition Test	cmimus2	Michael Arenson	Russell Kozerski
	Grand Staff Test	cmimus3	Michael Arenson	Russell Kozerski
	Scale and Mode Test	cmimus4	Michael Arenson	Patricia Bayalis
	Key Signature Test	cmimus5	Michael Arenson	Patricia Bayalis

Department	Title	File Name	Developer	Programmer(s)
Music (continued)	Four Voice Triad Test	cmimus6	Michael Arenson	Patricia Bayalis
	Beat Unit and Division Test	cmimus7	Michael Arenson	Patricia Bayalis William Lynch
	Meter and Time Signature Test	cmimus8	Michael Arenson	Patricia Bayalis William Lynch
	Rhythm Notation Test	cmimus9	Michael Arenson	Patricia Bayalis William Lynch
Nursing	Human Heart Valves (adapted from Illinois vet med lesson)	heartv2	Mary Anne Early	Charlotte Criste David Graper
	The Nursing Process (adapted from Settlemeyer, University of Pittsburgh)	soapie	Shirley Cudney	Charles Wickham James Trueblood
	Simulated Treatment of Diseases	simexec	Mary Ann Early	Monica Fortner James Trueblood
	Nursing Sample Challenge Test Driver	nursesampl	Mary Carroll Mary Ann Early Monica Fortner Caroline Freid Keith Slaughter	Monica Fortner Keith Slaughter
	Nursing Inventory Operations	nopts	Mark Laubach Donald MacKay Al Start	Mark Laubach
Physical Education	Film Motion Analysis	analysis	David Barlow	Stuart Markham
	Volleyball Strategies	vball	Barbara Viera	Stuart Markham
	Gait Analysis	gait	David Barlow	Stuart Markham
Physics	A Problem In Angular Velocity	udfou	Cheng-Ming Fou	Charles Wickham
Psychology	Anagrams	anagrams	Gary Berg-Cross John McLaughlin	Judith Sandler
Security	Ticketing	secure	Steven Swain	Raymond Schwartz
	Professionalism	secprof	John Schimmel	Raymond Schwartz

Department	Title	File Name	Developer	Programmer(s)
Security (continued)	Motor Vehicle and Bicycle Regulations (PCMI module)	sectrain	Steven Swain	Raymond Schwartz
	Criminal Code (PCMI module)	crimcode	Steven Swain	Raymond Schwartz
	Phonetic Alphabet Code for Law Enforcement	alphdrill	Raymond Schwartz	Raymond Schwartz
	Public Safety 10 Code (PCMI module)	tencode	Steven Swain	Robert Krejci
Theatre	Interactive Timeline	timeline	Brian Hansen	Michael Larkin James Wilson

-Research Programs-

Department	Title	File Name	Developer	Programmer(s)
Art	Statistical Package for Letter Spacing	artstats	Raymond Nichols	Charles Wickham
Educational Foundations	Effect of Orthographic Structure on Letter Search	scan	Aileen Tobin Richard Venezky	David Anderer
	Graph Reading	graphs	Victor Martuza	James Trueblood
	Reading Studies	readlab	Frank Murray	Judith Sandler
Psychology	Memory Experiment	remember	John McLaughlin	Judith Sandler

-Utilities-

Department	Title	File Name	Developer	Programmer(s)
UDPLATO	Comprehensive Accounting Analysis Package	arequest	Charles Wickham James Wilson	Charles Wickham
	Classroom Scheduler Package	scheduse	Bonnie Seiler Joseph P. Maia	Joseph P. Maia
	Equipment Inventory Programs	mopts	Mark Laubach	Mark Laubach
	Group Statistics	printer	Charles Wickham	Charles Wickham
	PLATO Users Survey Package	udopinion		Daniel Tripp

Department	Title	File Name	Developer	Programmer(s)
UDPLATO (continued)	UD Lesson Catalog Package	lcat	David Anderer Bonnie Seiler	David Anderer
	User Directory	udpeople	Mark Laubach Bonnie Seiler James Wilson	Mark Laubach
	Time Management Utility	tmux	Mark Laubach	Mark Laubach
	UD PLATO Events Bulletin Board	udminder	Mark Laubach	Mark Laubach
	Information System for Small Documents	infosts	Mark Laubach Daniel Tripp	Mark Laubach
	Equipment Usage Statistics Package	mstats	Mark Laubach James Wilson	Mark Laubach
	Balance Sheet Equation	bsheet	Angelo DiAntonio	George Betz
	Math Practice Problem Driver	mprac	Ronald Wenger Keith Slaugher	Jay Green Carol Leefeldt Keith Slaughter
	Math Diagnostic Test	matest	Ronald Wenger Keith Slaughter	Keith Slaughter
	Accounting Sample Test Driver	actgtest	Monica Fortner Keith Slaughter	Louisa Bizoe William Childs Monica Fortner Carol Leefeldt Keith Slaughter
	Determining Pattern Alterations	mcd	Dorothy Elias Frances Mayhew Frances Smith	David Anderer Dorothy Elias James Wilson
	String Rating	ratedriver	Jane Hart Richard Venezky	David Anderer