DOCUMENT RESUME

ED 128 173 SE 020 917

AUTHOR Manteuffel, Mary S.
TITLE Implementing PLATO in Biology Education at Three Community Colleges. CERL Report X-47.
INSTITUTION Illinois Univ., Urbana. Computer-Based Education Lab.
SPONS AGENCY National Science Foundation, Washington, D.C.
REPORT NO CERL-R-X-47
PUB DATE Feb 76
NOTE 39p.; Marginal legibility in Figures
AVAILABLE FROM PLATO Publications, Computer-Based Education Research Lab, 252 Engineering Research Lab, University of Illinois, Urbana, Illinois 61801 ($1.25 prepaid)

EDRS PRICE MF-$0.83 HC-$2.06 Plus Postage.
DESCRIPTORS *Biology; *College Science; *Community Colleges; *Computer Assisted Instruction; *Educational Research; Higher Education; Instruction; Science Education; Teaching Methods
IDENTIFIERS *PLATO; Programmed Logic for Automatic Teaching Operations; Research Reports

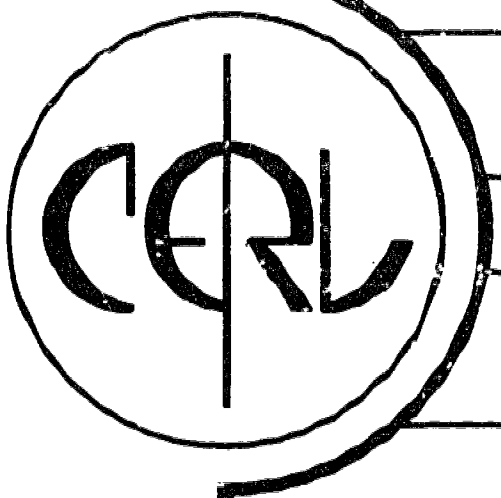
ABSTRACT

A field test of PLATO IV computer-assisted instructional lessons is discussed. Biology classes at three city colleges of Chicago used PLATO IV as part of the Community College Biology Project. During the 1974-75 academic year, usage involved 49 classes, 1506 students, and over 8700 hours on the system. Approximately 53 PLATO biology lessons were available for use. Practical knowledge obtained from the major areas of teacher-user orientation, lesson design strategies, documentation of the implementation process, and lesson validation are described. Sample lessons are included. (MH)

CERL Report X-47 February 1976

IMPLEMENTING PLATO IN BIOLOGY EDUCATION AT THREE COMMUNITY COLLEGES

MARY S. MANTEUFFEL



Computer-based Education Research Laboratory

University of Illinois Urbana Illinois

IMPLEMENTING PLATO

IN BIOLOGY EDUCATION

AT THREE COMMUNITY COLLEGES

Mary S. Manteuffel
Community College Biology Coordinator
Computer-based Education Research Laboratory

February 1976

The author is indebted to the following for their important assistance in this project: R. A. Avner, K. Herrick, P. Jordan, and S. Boggs (all of CERL, University of Illinois at Urbana-Champaign) and S. Knisley and S. Pellum for typing of this report.

The Community College PLATO Project receives financial support from the National Science Foundation (US NSF C-723) and the University of Illinois at Urbana-Champaign.

IMPLEMENTING PLATO IN BIOLOGY EDUCATION AT THREE COMMUNITY COLLEGES

by

Mary S. Manzeuffel

I. PROJECT DESCRIPTION

The Community College Project was established as part of the National Science Foundation contract with the University of Illinois Computer-based Education Research Laboratory (CERL) to field test PLATO IV in five subject areas at five different Illinois colleges from Fall 1974 to Spring 1976.* The project provided for the design and development of courseware, the establishment of administrative liaison, implementation of the resulting PLATO lessons in the colleges, data collection, lesson validation, and project evaluation. An independent evaluation of the entire PLATO project is being conducted by the Educational Testing Service.

Biology classes at three City Colleges of Chicago (Kennedy-King, Malcolm X, and Wilbur Wright) used PLATO IV as part of the Community College Biology Project. During the 1974-75 academic year, usage involved 49 classes, 1506 students, and over 8700 hours on the system. Approximately 53 PLATO biology lessons, written by authors from the University of Illinois and the City Colleges of Chicago, were available from which the instructors could choose. The CERL Community College biology group assisted the instructors in the implementation of PLATO but did not attempt to regulate their choice of lessons.

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* The community colleges are: Parkland College in Champaign, Illinois; Kennedy-King College, Malcolm X College, Wilbur Wright College, and the Chicago Urban Skills Center, all in Chicago, Illinois.

The large-scale project discussed here was conducted in a real-world situation for which no precedent existed. This report attempts to communicate some of the experience we gained during the 1974-75 phase of the field test. Practical knowledge obtained from the major areas of teacher-user orientation, lesson design strategies, documentation of the implementation process, and lesson validation will be described here. It is this record of the introduction of a new educational technology which the Community College Group feels can benefit others faced with large scale implementation of computer-assisted instruction.

II. TEACHER-USER ORIENTATION

Acceptance of the new technology by the faculty of the cooperating institutions is essential for the establishment of an effective field test. The technology cannot merely be introduced by an external source but must be imported. For this reason, the creation of a human network between CERL and the City Colleges of Chicago has been crucial to the implementation of PLATO. PLATO has been accepted in these community colleges as a result of liaison efforts by CERL personnel and site coordinators, released-time for teachers to work on PLATO, the offering of PLATO-user courses, and instructional sessions with the individual teacher-user at the terminal.

In the area of biology, PLATO usage increased significantly from Fall 1974 to Spring 1975. Reasons for this increase were frequent liaison efforts by the CERL biology coordinator and interaction between current teacher-users with other teachers. In order to facilitate the effective implementation of PLATO, the coordinator provided guidelines for the instructors which were based on past experience with PLATO classes. Shown below is a listing of the guidelines and some of the problems which have been observed when these guidelines are ignored.

Implementation Guidelines	Sample Implementation Problems
1. Instructor should learn how to use PLATO through introductory lesson ("introduceb" or "help").	-- Instructor got stuck in lesson due to lack of knowledge about keyboard use and could not handle student problems during PLATO sessions.
2. Instructor should choose which lessons to use in course on basis of subject matter, lesson design, and difficulty level using hard copy catalog. Considerations should be given to adjustment of syllabus to accommodate the lessons.	-- When lessons were chosen only by title, students were given lessons which were too difficult, too long, or needed handouts. If syllabus was not adapted for use of PLATO, unnecessary repetition and lack of time to complete syllabus resulted.
3. Instructor should review lessons as a student on PLATO.	-- When this step was omitted, instructor could not help students when content problems arose in lessons (e.g., at questions, setting up experiments).
4. Instructor should learn options available as an "instructor" on PLATO (e.g., controlling roster, leaving notes to students, designing a curriculum, looking at student records.	-- When unfamiliar with these options, instructor could not clear password when student forgot it, add new students, monitor amount of use of PLATO by each student.
5. Instructor should schedule a time to use PLATO during classtime (e.g., one hour per week).	-- When instructor neglected to indicate a desire to placed on the schedule, his/her class was often not able to use PLATO due to the high demand for the PLATO classroom. If a time was scheduled outside of classtime, often students did not use PLATO (most commuter-college students have jobs and families which limit their free time).
6. Instructors should accompany students to the PLATO center and circulate among them to answer questions during the sessions.	-- When instructors merely sent their students to the PLATO classroom, student frustration often occurred due to a lack of a subject-matter resource person. A PLATO site coordinator is present in the classroom to aid with terminal problems, but he is not qualified to answer questions about biology.

3. DOCUMENTATION OF THE IMPLEMENTATION PROCESS

3.1 The Documentation Process

A case study approach to documentation of PLATO usage in this project was adopted due to the variability between classes. Many teacher-users required students to use PLATO one hour of classtime per week all semester, while a few offered PLATO to their students as an optional supplement outside of class. Certain teacher-users faithfully reviewed lessons prior to student use. There is evidence that others relied only on the title of the lesson to decide which lessons to use. Many teacher-users circulated among the students, while others never observed students using the lessons.

Included here are three of the spring semester 1975 case studies chosen to illustrate some of the implementation methods, attitudes, variations in teacher and student PLATO experience, and problems involved in using PLATO in biology classes at the community college level (see Appendix A). Two of the classes chosen were taught by teachers who had prior PLATO experience, while one was taught by a first-time teacher-user.*

Data contained in these case studies were obtained from teacher interviews and questionnaires, student questionnaires and comments, hardware reports, and PLATO course records.

3.2 Summary of Spring 1975 Case Studies

Upon examination of all case studies from spring semester, it became apparent that no one facet of PLATO usage could explain the acceptance or non-acceptance of the system. PLATO experience and attitudes of teachers

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* A separate report, entitled "Community College Spring 1975 Usage Report," containing all the case studies and further documentation of usage was also compiled.

and students along with methods of implementation all influences reception of PLATO in the classroom. These interrelationships have been examined through teacher implementation since this factor directly affects the other variables.

Teacher Experience

The level of PLATO experience of the twenty-two teachers involved varied considerably. However, most can be classified into three major categories: (1) those first-time PLATO users whose training only consisted of a brief orientation by the CERL biology coordinator (e.g., Teacher-User 2), (2) those who participated in a one-semester users course for credit, which included teaching of the instructor mode and preparing lesson designs, and finally (3) those who have been or are currently involved in authoring courseware (e.g., Teachers 1 and 3). Fourteen of the twenty-two teachers were using PLATO in their classes for the first time. Of these, three had taken the PLATO users course. Only eight teachers had used PLATO in their classes prior to this semester (henceforth referred to as "experienced"). Two had taken the users course and five had authored.

If one isolates the student attitudinal responses of classes taught by experienced teachers from the combined responses of all classes, there is a significant difference in the number of positive responses on key attitudinal questions. The students of experienced teachers had a more positive attitude towards PLATO than those of less experienced teachers, as can be deduced from the statistics below:

Group I = Students of the teachers who had prior experience using PLATO

Group II = Students from all the PLATO sections (experienced and not experienced)

ITEM 1

I think PLATO is..."an effective approach to education."

	Total # Students	# Students Agreeing With the Above	% Agreeing With the Above	Probability of 163 or More (out of 264) Agreeing With the Above (by binomial test)
Group I	264	163	61.7%	0.0005167
Group II	629	324	51.5%	

Thus, there is evidence for a significant difference between responses in the two groups, with Group I being more positive towards PLATO.

ITEM 2

If I were to advise a friend who was going to take the same course, I would suggest he "take PLATO section if at all possible."

	Total # Students	# Students Agreeing With the Above	% Agreeing With the Above	Probability of 159 or More (out of 264) Agreeing With the Above (by binomial test)
Group I	264	159	60.2%	0.0019689
Group II	629	322	51.2%	

Thus, there is evidence for a significant difference between responses in the two groups, with Group I being more positive towards PLATO.

A dependence on the method of PLATO incorporation may account for the above association. Our teacher questionnaire did not adequately reflect this diversity (e.g., 90.5% of the twenty-one teachers responding said that lessons were generally used "as a scheduled review of material covered in class" and 90.5% responded that they circulate among students during PLATO sessions). In addition, 80.9% of the teachers responded that they "relied on their own review of the PLATO lesson prior to student usage." Student comments suggest that this was not the case in many instances (e.g., "Biology material on

PLATO did not coincide with class" and "I don't understand what I am supposed to do in this lesson").

The data also hint that teachers more experienced with PLATO are better able to estimate their students' capabilities and are more selective in designing a PLATO curriculum. Fewer lessons were required by experienced teachers (13.5) compared to non-experienced teachers (15.6); yet experienced teachers required students to use PLATO more frequently (59.5% used it four times per month) than the entire pool of teacher-users (55.8% used it four times per month). The case study of Teacher-User 2 (non-experienced) illustrates this observation.

General Problems

Apart from the effect of implementation on student attitude, there were occasional problems with the hardware and courseware. Hardware problems were beyond the teachers' control, but some of the courseware difficulties could have been anticipated by conscientious review prior to student use.

Internal problems with some biology lessons were discovered during the project (this was the first class use of some of the courseware). Lesson quality was identified by 38.1% of the teachers as the "major drawback to using PLATO currently" and 34.8% of the students said "PLATO does not accept my answers often enough," a problem of inflexible answer judging in most cases.

Undoubtedly, problems encountered in lessons contributed to student attitude toward the lessons themselves. Overall consensus among students revealed three lesson classifications: (1) lessons that were frequently indicated as most helpful (Cellular Structure and Function, Cellular Reproduction), (2) those most often mentioned as least helpful (Evolution and Ecology), and (3) those that divided student opinion (Nature of the Gene, Energy Trans-

formations, and Genetics). One should not assume that these lessons necessarily represent the best and the worst. Student opinion towards the lessons was very often highly dependent on the degree of success they encountered. This success can be influenced by everything from lesson design to subject difficulty to prior preparation for the PLATO session to the instructor's availability during the session.

The second major problem designated by teachers (33.3%) and students (31.5%) was the malfunctioning of terminals and system crashes. Only one class had a significant amount of hardware difficulty (25% of classes were interrupted by hardware problems), but these problems did not appear to have an adverse effect on student attitude.

The number of students in a class (20 - 40) often exceeded the number of functioning terminals (average was about 21 out of 24). This was identified as a problem by almost 50% of the teachers; but addition of terminals, reduction in class sizes, or alternative scheduling was not possible at the time.

Conclusion

Despite the isolated negative occurrences described above, PLATO has received an overwhelmingly positive response in community college biology. Of the teachers involved, 80% wish to continue using PLATO in their classes and an additional 15% are favorably disposed if their course assignment concurs. As for the students, over 50% responding would recommend "taking a PLATO section if at all possible."

LESSON DESIGN STRATEGIES

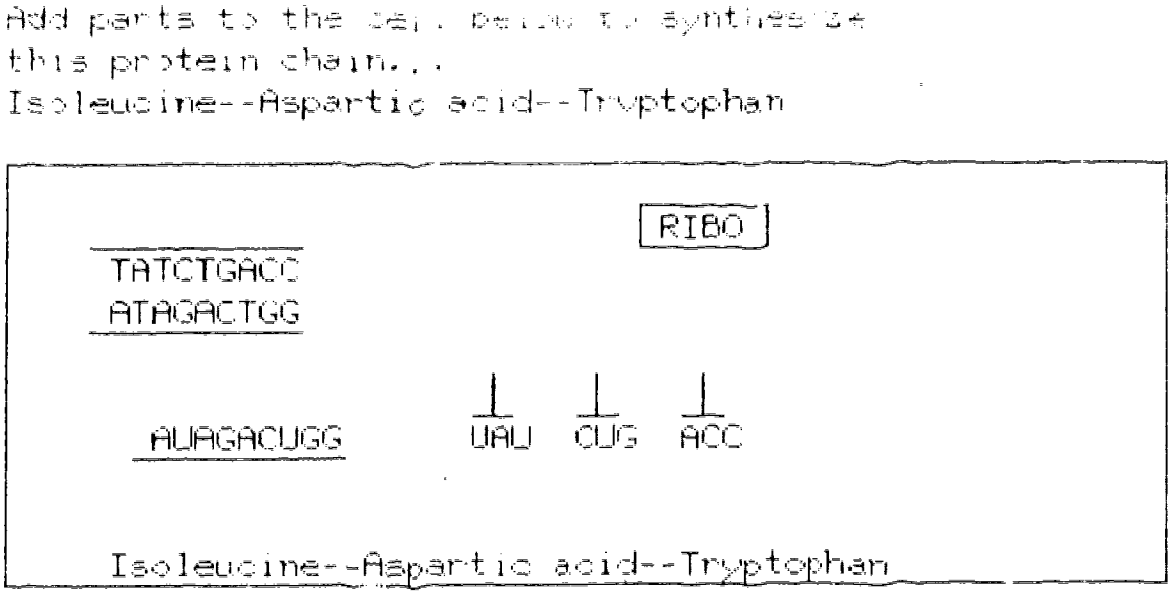
Due to variation of author background and experience and the evolutionary nature of the PLATO system, the existing biology lessons have a wide range of instructional design. Four categories of lesson design have been identified in the biology lessons: simulation or model, problem solving, tutorial, and inquiry, with the bulk of the lessons being tutorial. Samples from the 53 lessons have been chosen to illustrate each type.

Design	Sample Lesson
1. Simulation or Model	ADH and Water Balance in Humans (by R. Arsenty, University of Illinois): Student manipulates physiological conditions (e.g., alcohol ingestion, cancer, sweating) and observes changes in water balance via a stylized model of the human body. (See Figure 1.)

Figure 1.
Model of Human Body Used to Show Changes in Water Balance.

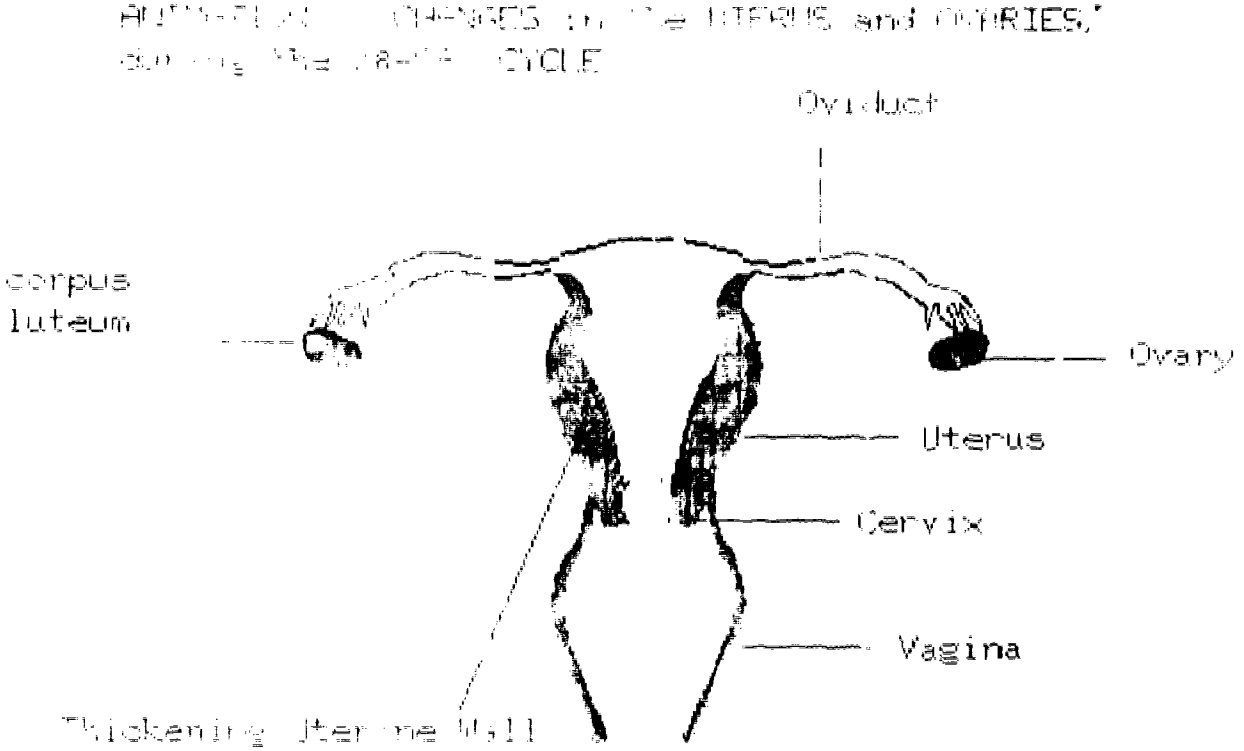
Design	Sample Lesson
2. Problem Solving	DNA and Protein Synthesis (by P. Tenczar and R. Baillie, University of Illinois): Student must assemble a protein given three amino acids and corresponding m-RNA codea; an understanding of nitrogeneous base pairing is required. (See Figure 2.)

Figure 2.
Student is asked to assemble a protein chain.



Design	Sample Lesson
3. Inquiry	Comparative Serology (by G. Hyatt, University of Illinois, Chicago Circle): This lesson presents comparative serology as an "evidence for evolution" through two inquiry experiments where student is required to deduce ancestry of animals by examining serological data.
4. Tutorial	Hormonal Control of the Menstrual Cycle (by L. Porch, City Colleges of Chicago; revised by M. Manteuffel and S. Boggs, University of Illinois): Student observes changes in ovaries, uterus, and hormone levels during the 28-day cycle via animations, discussions, and graphs and is questioned on concepts throughout. (See Figure 3.)

Figure 3.
Animation of Changes in the Uterus and Ovaries During the 28-Day Cycle.



Differences in student attitude towards the above lesson design types did not appear to be significant. Student comments indicated a favoritism towards lessons with numerous graphics and frequent interaction, but these characteristics can be present in any of the above types. The aspect of lesson design which did influence student attitude was the degree to which the lesson was flexible and responsive to student needs. Many of the lessons these community college biology students were using had not been reviewed by colleagues, tested with students, or validated to measure effectiveness in achieving their objectives. This process of "finishing" a lesson takes care of the inflexible answer-judging problems these students were experiencing.

In response to the need for more "finished" lessons, teacher-users and programmers involved in the project held biweekly meetings during Spring 1975 to discuss lesson development and revisions. The following is a list of what the group established as ideal steps in lesson development.

1. Group identifies gaps in the curriculum (first semester and second semester introductory courses) and agrees upon topics for new lessons.
2. Group defines desired lesson design.
3. Teacher designs and writes lesson for an agreed-upon topic.
4. Group discusses lesson design.
5. Teacher revises lesson design.
6. Programmer codes lesson.
7. Group members review lesson on PLATO.
8. Programmer and teacher revise lesson in response to the group's comments.
9. Teacher uses lesson in trial run with small group of students.
10. Programmer and teacher revise lesson in response to student data and comments.
11. Teacher completes documentation of lesson.

12. Classes use lesson and programmer revises it when necessary.

13. Teacher and programmer or project subject-matter coordinator attempt to evaluate lesson.

A number of the existing biology lessons were designed by individual instructors who had 25% released-time during one semester to work on a lesson. These lessons were coded and designed in 1973 but were not validated and tested (steps 7 - 13) until the 1974-75 field test. Many of the authors did not think about usage of their lessons outside their own classes since PLATO IV was still in an experimental stage. It became apparent in the field test, however, that these latter steps of "finishing" a lesson were essential for the lesson to be effective.

The group also established ground rules for the design and coding of new lessons:

1. Narrow topic enough so that lesson can be completed in 20 - 40 minutes.

2. Allow for frequent interaction with the student.

3. Use concise language and avoid sounding text-like.

4. Make answer judging flexible and provide HELP to ensure that student will be able to progress without undue frustration.

5. Use graphics to increase student interest and comprehension.

6. Utilize posttests or review quizzes to ensure student understanding of material prior to student completion of lesson.

7. Allow student flexibility to review within a lesson as much as possible (e.g., indexing, frequent use of access keys, etc.).

These guidelines were based on observations of students during the project by teacher-users, site coordinators, and CERL personnel. The students complained when a lesson contained many frames with all writing and little or no interaction or graphics. They became frustrated in lessons which did not accept answers they knew were right (a frequent problem in lessons which

have not been tested and validated). Feedback was very positive for lessons with frequent questioning, creative graphics, HELP available at every question, and which were short enough that they could easily be completed in one class period.

5. LESSON VALIDATION

Appraising the effectiveness of a PLATO lesson is an essential, although difficult, task. Variation in lesson design and the choice of which parameters to study from the large amount of available data are just two of the problems which existed here. Data collection was done using -area- commands, commands which are used to divide the lesson into logical subunits from which summary data is obtained. PLATO is capable of collecting data for each interaction of a student. However, due to the large-scale nature of this field test, data collection had to be limited to -area- summaries. Interpretation of this data was complex since detailed knowledge of the coding and design of each -area- in a lesson was essential.

Data available in -area- summaries were divided into four categories for interpretation: time, interaction, lesson difficulty, and anticipation of student need. These categories were chosen because the community college staff needed to know how long the students were taking to complete a lesson, how often the students were interacting with the terminal while using each lesson, whether the lesson matched the students' subject matter capabilities and needs, and whether the lesson was responsive to problems students had in grasping the material being presented. These student-performance data enabled us to determine whether the lesson was achieving its objectives and, if not, where revisions were needed.

The lesson on "The Hormonal Control of the Menstrual Cycle" was examined as a sample lesson to illustrate such a validation process (see Appendix B).

This lesson is particularly interesting because it meets the assumptions of the data collection procedures; the community college biology group was directly involved in revising it; and the data are more reliable. Data collected were used both in determining the effectiveness of the lesson and in making minor revisions where needed. Teacher and student feedback on the lesson has been positive (e.g., "The lesson was very good. It could be easily understood. The answers were able to be found in the context of the lesson, and help within the lesson was readily available. Also the diagrams were very well done.").

6. CONCLUSION

During the 1974-75 academic year, a field test of a new system for computer-assisted instruction was conducted in biology classes at three community colleges. The implementation of this new system, PLATO IV, involved a number of intricate processes since it was being used in established institutions. New courses were not created to accommodate PLATO, but rather teachers attempted to supplement their existing courses with PLATO. The PLATO sessions, manner of implementation, and student background could not be completely controlled in this real-world situation. As a result, documentation of the project was a challenge.

The processes and problems involved in the large scale implementation of PLATO in biology education at three community colleges have been described in this report. The range of lesson types used should, however, allow the results of this pilot project to be generalizable to other subject areas. It is hoped this record will benefit others from different fields who are using other educational technologies, as well as those involved with using PLATO in biology education.

APPENDIX A

SAMPLE CASE STUDIES

Teacher-User 1

PLATO Experience — This instructor began his PLATO experience in 1973 when he had 25% released-time during one semester to review biology lessons. He has used PLATO in his classes for two semesters and received 25% released-time to aid in lesson development in Spring 1975.

Attitude — This instructor decided to use PLATO because he was "interested in using a new type of resource that might possibly be helpful in aiding students to learn." He plans to continue using PLATO since he feels that PLATO increases some students' interest in biology and the brighter students get more out of PLATO.

Type of Use — Students from his classes were required to use PLATO one hour of classtime about two thirds of the semester. They used it as a scheduled review of material covered in class. He relied on his review of the lesson to match available lessons with his needs. During the PLATO sessions he circulated among the students to answer questions.

Problems

1. Problems with terminals (one of the PLATO sessions was cancelled due to telephone line problems)
2. System reliability (two of the PLATO sessions were cancelled due to crashes)

ETS — This instructor cooperated with ETS both fall and spring semesters by administering both the pre- and posttests and the student attitude questionnaires.

Student Data from Teacher-User 1

Spring Semester Class: Biology 102a (second semester introductory course without laboratory)

PLATO Experience — 86.4% of the students were first-time users

Student Attitude* — 68.2% said that the main advantage of PLATO is that you obtain a "better understanding of the material."

13.6% said that the most important advantage of PLATO is that you "learn more in the same amount of time."

9.1% said that "PLATO has no particular advantage in this course."

* Notes concerning percentages of student attitudes:
1. Students responded with more than one answer in certain questions.
2. Data are not included here for viewpoints selected by less than 9% of the students.
3. Percentages are based on the total number of respondents for the entire questionnaire.

Student Attitude (cont.)

77.3% felt that PLATO is "an effective approach to education."

50.0% felt that PLATO "gives more individual attention than the classroom situation."

31.8% felt that PLATO "teaches better than other audio-visual aids."

9.1% felt that PLATO "places the student in a dehumanizing situation."

72.7% said that they would advise a friend taking the same course to "take PLATO section if at all possible."

13.6% said that they would advise a friend taking the same course to "take PLATO section only if convenient."

18.2% said that they would advise a friend taking the same course to "fight tooth and nail to get into a PLATO section."

Student Problems

Concerning major drawbacks to using PLATO:

27.3% said "problems with the terminals" (crashes, red-lighting, etc.).

18.2% said "using the keyboard."

18.2% said "it takes too much time for what I get out of it."

27.3% said "PLATO does not accept my answers often enough."

13.6% said "the lessons are too long."

Lessons

These lessons were mentioned as the most helpful to students in this biology class this semester:

54.5% said "Meiosis."

50.0% said "Mitosis."

27.3% said "Genetics."

13.6% said "none."

13.6% said "all."

9.1% said "Menstrual Cycle."

These lessons were mentioned as the least helpful to students in this biology class this semester:

50.0% said "none."

9.1% said "Introduction to PLATO."

Student Comments

1. "I found this machine smarter than I thought."
2. "I feel PLATO has been helpful."
3. "PLATO takes class tension off student."
4. "Student can think over his answer--when answer is correct, it gives the student a feeling of confidence."
5. "Could have been more effective if I had dealt with it more."
6. "Overall answer system should be revised--PLATO accepts only one answer to a particular problem--it should accept variety."
7. "Would be very helpful if I could find more time to use the darn 'thing.' All in all A-OK."
8. "Helps a person understand a lesson more thoroughly and enables one to learn it faster."

Usage

Total # Student Users = 29 (22 responded to questionnaire)

Total # Hours Used = 150.89

Average # Hours Per Student During Semester = 5.13

S.D. = 4.56

Range (hours) = 0.61 - 22.11

% of time terminals were used by more than one student at the same time:

0% said "every time I use PLATO."

22.7% said "less than three times."

68.2% said "never."

Average # Days Used = 6.38

Average # Sessions Per student = 8.48

Average # Functioning Terminals Per Session = 21.4

Percentage of Hardware Problems = 12.5%

Total # Lessons Used by Class = 11

Teacher-User 2

PLATO Experience — This instructor used PLATO for the first time in class during spring semester.

Attitude — She decided to use PLATO in class because she "looked over the lesson descriptions and thought it was worth a try." She plans to use PLATO in class in the future. Concerning changes in student attitude or achievement, she states:

a. PLATO increases some students' interest in biology.
b. The brighter students get the most out of PLATO.
c. "Some students get so involved in the mechanics of choosing the right answer in order to continue, they lose the thought (only certain poor students and some lessons)."

Type of Use — Students from this instructor's classes used PLATO one hour of classtime almost every week. They used it as a major means of teaching material not covered in class or as a scheduled review of material covered in class. The instructor relied on her review of the lesson on PLATO to match available lesson to her needs. During the PLATO sessions, she circulated among the students and monitored the students when a terminal was available.

Problems

1. Problems with terminals (keyset, red-lighting, maintenance)
2. System reliability (crashes in the middle of class session)
3. Finding enough terminals for students ("students always have to double up which results in some 'weak' students seldom working independently")

ETS — This instructor had no contact with ETS personnel this semester.

Student Data from Teacher-User 2

Spring Semester Class: Biology 102a (second semester introductory course without laboratory)

PLATO Experience — 57.7% of the students were first-time users.

Student Attitude

61.5% said that the main advantage of PLATO is that you obtain "a better understanding of the material."

19.2% said that the most important advantage of PLATO is that you "learn more in the same amount of time."

19.2% said that "PLATO has no particular advantage in this course."

Student Attitude (cont.)

34.6% felt that PLATO is "an effective approach to education."

34.6% felt that PLATO "gives more individual attention than the classroom situation."

34.6% felt that PLATO "teaches better than other audio-visual aids."

15.4% felt that PLATO is "nothing but an expensive gimmick."

34.5% said that they would advise a friend taking the same course to "take PLATO section if at all possible."

50.0% said that they would advise a friend taking the same course to "take PLATO section only if convenient."

Student Problems

Concerning major drawbacks to using PLATO:

11.5% said "problems with the terminals."

15.4% said "using the keyboard."

26.9% said "finding a terminal for myself."

15.4% said "it takes too much time for what I get out of it."

46.2% said "PLATO does not accept my answers often enough."

23.1% said "the lessons are too hard."

15.4% said "the lessons are too long."

Lessons

These lessons were mentioned as the most helpful to students in this biology class this semester:

30.8% said "Hormonal Control of the Menstrual Cycle."

26.9% said "Mitosis."

19.2% said "Meiosis."

11.5% said "all."

11.5% said "Genetics."

7.7% said "Gene Mapping."

7.7% said "Ecology."

These lessons were mentioned as the least helpful to students in this biology class this semester:

23.1% said "none."

11.5% said "Population Dynamics."

7.7% said "Mitosis."

7.7% said "Meiosis."

7.7% said "most."

Student Comments

1. "Would be fine for biology but I feel it was used too extensively in this course. Once a month would be enough instead of once a week."
2. "I enjoyed PLATO. It is a wonderful teaching device."
3. "Some (lessons) too dragged out."
4. "PLATO is a good machine but pressing the button when a mistake occurs gets to be time consuming."
5. "Fun and educational."
6. "I learned a great deal from PLATO and I hope it will be used more often in other classes."
7. "Not enough terminals for the work assigned--too hard to catch up; lesson too wordy, not enough descriptive pictures and examples."
8. "I enjoyed working on PLATO. I looked forward to using it. At times it was difficult, but after I found my mistakes, I enjoyed it. It helped me very much better (sic) than class."
9. "PLATO is too particular for answers given. It can lead to much confusion."
10. "If the answer isn't known, you can't skip over to continue the lesson."
11. "Too many students and not enough time to finish the work."

Usage

Total # Student Users = 30 (26 responded to questionnaire)

Total # Hours Used = 239.21

Average # Hours Per Student During Semester = 7.91

S.D. = 6.01

Range (hours) = 1.05 - 26.68

% of time terminals were used by more than one student at the same time:

7.7% said "every time I use PLATO."

73.1% said "less than three times."

0.0% said "never"

Average # Days Used = 8.83

Average # Sessions Per Student = 11.74

(Data on systems problems were not available for this class.)

Total # of Lessons Used by Class = 21

Teacher-User 3

PLATO Experience — This instructor has used PLATO in his classes during Fall 1974 and Spring 1975 semesters. He took a "PLATO Users Course" during 1973 and designed a lesson which is currently being used by students. During spring semester, he had 25% released-time to aid in lesson development.

Attitude — He stated that he decided to use PLATO in his class "for student help and review of material, to replace laboratory work, and as an A or B objective in mastery learning." He does plan to continue using PLATO in subsequent semesters and feels that PLATO increases some students' interest in biology and the brighter students get the most out of PLATO.

Type of Use — Students from this class were required to use PLATO during about one third of the semester and could also use it optionally for an A or B grade on certain mastery learning modules. They used it as a scheduled review of material covered in class or in certain instances as a major means of teaching material not covered in class. He circulated among the students during the required PLATO sessions. To match available lessons with his needs, he relied on his review of the PLATO lesson prior to student use.

Problems
1. Not enough terminals for each student to work alone
2. Scheduling ("very little time for independent study")

ETS — This instructor cooperated with ETS in the fall semester but had no contact with ETS personnel during the spring semester. He agreed to work with ETS in Fall 1975.

Student Data from Teacher-User 3

Spring Semester Class: Biology 112 (second semester of introductory course with laboratory)

PLATO Experience — 63.6% of students were first-time users.

Student Attitude
72.7% said that the main advantage of PLATO is that you obtain a "better understanding of the material."

77.3% felt that PLATO is "an effective approach to education."

36.4% felt that PLATO "gives more individual attention than the classroom situation."

40.9% felt that PLATO "teaches better than other audio-visual aids."

Student Attitude (cont.)

59.1% said that they would advise a friend taking the same course to "take the PLATO section if at all possible."

40.9% said that they would advise a friend taking the same course to "take PLATO section only if convenient."

Student Problems

Concerning major drawbacks to using PLATO:

40.9% said "problems with the terminals" (crashes, red-lighting, etc.).

13.6% said "using the keyboard."

18.2% said "finding a terminal for myself."

13.6% said "it takes too much time for what I get out of it."

45.4% said "PLATO does not accept my answers often enough."

Lessons

These lessons were mentioned as the most helpful to students in this biology class this semester:

50.0% said "Mitosis."

45.4% said "Protein Synthesis."

27.3% said "Meiosis."

22.7% said "Genetics."

22.7% said "Hormonal Control of the Menstrual Cycle."

These lessons were mentioned as the least helpful to students in this biology class this semester:

18.2% said "Fruit Fly Experiments."

13.6% said "Ecology."

13.6% said "Protein Synthesis."

13.6% said "none."

Student Comments

1. "Some authors could program the lesson more clearly--more varieties of answers should be acceptable--generally I like it."
2. "PLATO does not accept correct answer."
3. "Great system, should be developed to include more classes."
4. "PLATO should accept more than one answer."
5. "Need more terminal time (ECS) so more than two or three different lessons could be used simultaneously."

Student Comments (cont.)

6. "Some of the lessons are hard to understand--I did not feel HELP or LABORATORY keys helped--in most cases, student had to have knowledge of the material that was not always possible."
7. "Extremely helpful...but variety of answers not programmed into lesson."
8. "PLATO is still in its infancy with maturing should become a useful AID! I experienced the feeling that I was disagreeing with Colossus."
9. "Lessons with diagrams were really helpful."
10. "I hope PLATO is continually revamped so more people can use it--this is of great value."
11. "Help and assistance to my classwork--gives me more confidence."
12. "Helpful, clearcut direct method of learning for people new to terminal, minor discrepancies in programs and coding errors can be confusing and turn them off--could be resolved by more thorough program testing."

Usage

Total # Student Users = 36 (22 responded to questionnaire)

Total # Hours Used = 248.38

Average # Hours Per Student During Semester = 6.84

S.D. = 4.45

Range (hours) = 1.27 - 24.95

% of time terminals were used by more than one student at the same time:

0.0% said "every time I use PLATO."

59.1% said "less than three times.

22.7% said "never."

Average # Days Used = 7.56

Average # Sessions Per Student = 11.47

(Data on systems problems were not available for this class.)

Total # Lessons Used by Class = 19

APPENDIX B

Sample Lesson Validation

1. Lesson: "Hormonal Control of the Menstrual Cycle"

2. Author: L. Porch
Department of Biology
Kennedy-King College
Chicago, Illinois

Revised by M. Manteuffel and S. Boggs
CERL -- Community College Biology

3. Objective: To study the human female reproductive system and hormonal changes during the twenty-eight day cycle.

4. Description:

Area		Design
1	A.	Anatomical Features: eight arrows, OK first try applies, HELP sometimes available, narrative style with questions interspersed, animation.
2	B.	Changes in the Ovaries and Uterus: eight arrows, OK first try applies, DATA to see animation again, animation with follow-up questions.
3	C.	Hormonal Changes: twelve arrows, OK first try applies, LAB to see chart again, contains chart and questions with narrative responses to student.
4	D.	Fertilization and Implantation: four arrows, OK first try applies, contains animation of fertilization with questions following.
5	E.	Review Questions: ten questions, minimum HELP available, student presses LAB to obtain instructions.

5. Average student time required for completion: 60 minutes

6. Grade level and subject area: Community College Introductory Biology

Data for "Hormonal Control of the Menstrual Cycle"

Time

Question: How long did the students need to complete the lesson?
Measure: Record the time for first completion of an area.

area = 1 (instructional)

Measure / *Course	Number of Students	Mean Time per Use (minutes)	S.D.	Completion Time Range (minutes)
K-112-1	10	21.73	13.54	7.7 - 49.4
K-112-6	16	15.89	9.49	5.0 - 35.3
W-102-16	24	17.49	9.08	4.5 - 42.2
W-112-18	7	7.30	2.54	4.3 - 11.5
W-112-19	17	8.36	3.50	4.9 - 18.7
W-102-20	18	10.68	3.51	4.2 - 18.0
W-112-20	18	5.92	1.27	4.2 - 8.9
Grand Values	110	12.58	8.74	

area = 2 (instructional)

K-112-1	6	31.60	18.96	15.1 - 58.2
K-112-6	18	24.09	16.33	5.6 - 61.7
W-102-16	18	19.69	9.75	10.0 - 38.3
W-112-18	15	10.42	6.20	4.5 - 23.5
W-112-19	16	10.59	4.17	4.3 - 19.6
W-102-20	17	12.32	3.72	6.3 - 20.3
W-112-20	17	10.64	2.82	6.0 - 15.4
Grand Values	107	15.83	11.34	

area = 3 (instructional)

K-112-6	19	27.24	17.71	9.6 - 73.1
W-102-16	7	30.29	19.92	13.4 - 65.6
W-112-18	14	20.43	18.44	8.0 - 72.5
W-112-19	16	10.25	3.78	1.3 - 15.7
W-102-20	15	15.97	5.87	5.0 - 29.1
W-112-20	18	12.08	5.45	4.4 - 25.4
Grand Values	89	18.39	14.32	

*course code = first letter ↓ indicates college - three numbers ↓ indicates course - one number ↓ indicates teacher user

area = 4 (instructional)

Measure / Course	Number of Students	Mean Time per Use (minutes)	S.D.	Completion Time Range (minutes)
K-112-1	4	21.93	11.86	12.0 - 39.0
K-112-6	18	8.48	3.54	4.3 - 19.1
W-102-16	8	12.63	6.51	4.7 - 23.9
W-112-18	12	6.44	3.87	4.0 - 18.3
W-112-19	14	5.71	3.28	1.7 - 16.3
W-102-20	16	8.57	5.68	4.5 - 27.9
W-112-20	18	4.66	0.99	3.1 - 6.8
Grand Values	90	8.00	5.80	

area = 5 (quiz)

K-112-1	3	8.13	2.48	5.3 - 9.9
K-112-6	15	7.42	3.03	2.5 - 13.9
W-102-16	6	5.15	3.33	1.7 - 9.4
W-112-18	12	3.68	1.59	1.4 - 5.8
W-112-19	16	3.93	2.38	1.7 - 10.3
W-102-20	20	6.48	3.56	2.0 - 15.5
W-112-20	20	3.79	1.48	2.0 - 7.1
Grand Values	92	5.21	3.00	

Interpretation: Students completed this lesson in about 60 minutes (the sum of average completion time for each area: 12.58 + 15.83 + 18.39 + 8.00 + 5.21 = 59.91 minutes). The range for completion time was high but is acceptable in light of the flexibility allowed for the student within each area and the variable emphasis teachers placed on the different sections.

Interaction

Question: What is the degree of student interaction in the lesson?

Measure: Record the mean number of interactions per minute. The number of interactions equals the sum of the number of answers plus the number of satisfied and unsatisfied branch-key requests.

area = 1 (instructional)

Course \ Measure	Mean # Interactions per Minute	S.D.
K-112-1	0.77	0.39
K-112-6	1.20	0.55
W-102-16	1.23	0.76
W-112-18	2.03	0.72
W-112-19	1.76	0.63
W-102-20	1.38	0.57
W-112-20	1.86	0.32
Grand Values	1.44	0.68

area = 2 (instructional)

K-112-6	1.24	0.39
W-102-16	1.16	0.47
W-112-18	1.62	0.63
W-112-19	1.74	0.61
W-102-20	1.55	0.72
W-112-20	2.12	0.70
Grand Values	1.55	0.70

area = 3 (instructional)

K-112-1	2.37	2.45
K-112-6	1.41	0.61
W-102-16	1.31	0.72
W-112-18	1.38	0.56
W-112-19	1.56	0.57
W-102-20	1.52	0.63
W-112-20	2.49	1.53
Grand Values	1.66	0.95

area = 4 (instructional)

Measure / Course	Mean # Interactions per Minute	S.D.
K-112-1	0.43	0.19
K-112-6	0.99	0.31
W-102-16	0.85	0.31
W-112-18	0.90	0.20
W-112-19	1.27	1.27
W-102-20	0.98	0.46
W-112-20	1.34	0.37
Grand Values	1.05	0.62

area = 5 (quiz)

K-112-1	1.20	0.44
K-112-6	1.88	0.64
W-102-16	2.73	1.30
W-112-18	3.03	0.90
W-112-19	2.77	0.94
W-102-20	2.15	0.86
W-112-20	2.74	0.65
Grand Values	2.46	0.92

Interpretation: From the above data it can be inferred that the lesson is consistently interactive. In each area students averaged over one interaction per minute. This lesson conforms with the hypothesis that quiz-type areas demand interaction (in this case 2.46 per minute) more frequently than instructional areas (here, 1.05 - 1.66 per minute). The standard deviations imply that these averages are relatively reliable.

Lesson Difficulty

Question: How difficult is this lesson for the student?

Measures: Lesson difficulty has been measured by the number of correct judgments received by the student on the first try at a question compared to the total number of responses.

area = 1 (instructional)

Measure / Course	Mean # Correct on 1st Try per Item	S.D.	Mean # Responses per Item	S.D.
K-112-1	0.81	0.16	1.25	0.15
K-112-6	0.71	0.19	1.40	0.41
W-102-16	0.72	0.19	1.35	0.28
W-112-18	0.70	0.17	1.23	0.31
W-112-19	0.77	0.12	1.25	0.23
W-102-20	0.77	0.16	1.25	0.27
W-112-20	0.89	0.11	1.15	0.17
Grand Values	0.77	0.17	1.28	0.28

area = 2 (instructional)

K-112-6	0.58	0.19	1.44	0.29
W-102-16	0.57	0.26	1.24	0.28
W-112-18	0.75	0.18	1.18	0.42
W-112-19	0.64	0.13	1.17	0.33
W-102-20	0.61	0.18	1.51	0.55
W-112-20	0.68	0.16	1.25	0.24
Grand Values	0.63	0.19	1.30	0.37

area = 3 (instructional)

K-112-1	0.66	0.01	1.52	0.21
K-112-6	0.47	0.16	1.53	0.33
W-102-16	0.45	0.12	1.40	0.28
W-112-18	0.70	0.12	1.20	0.11
W-112-19	0.62	0.23	1.19	0.38
W-102-20	0.61	0.20	1.61	0.41
W-112-20	0.61	0.15	1.37	0.30
Grand Values	0.58	0.19	1.39	0.35

area = 4 (instructional)

Measure / Course	Mean # Correct on 1st Try per Item	S.D.	Mean # Responses per Item	S.D.
K-112-1	0.54	0.22	1.69	0.38
K-112-6	0.51	0.23	1.87	0.51
W-102-16	0.58	0.18	1.57	0.31
W-112-18	0.75	0.18	1.33	0.46
W-112-19	0.61	0.29	1.24	0.46
W-102-20	0.63	0.33	1.81	1.21
W-112-20	0.68	0.22	1.53	0.50
Grand Values	0.62	0.25	1.59	0.68

area = 5 (quiz)

K-112-1	0.78	0.00	0.89	0.11
K-112-6	0.65	0.17	0.92	0.08
W-102-16	0.84	0.17	0.97	0.08
W-112-18	0.76	0.20	0.95	0.07
W-112-19	0.78	0.27	0.92	0.13
W-102-20	0.74	0.23	0.92	0.10
W-112-20	0.78	0.13	0.95	0.07
Grand Values	0.75	0.21	0.93	0.09

Interpretation: These measures indicate that a wide range of difficulties exist among the areas in the lesson. Throughout this lesson, 25 - 42% of the students received a wrong answer on the first try; yet, they averaged only 1.59 (see area 4) responses before they proceeded in the lesson. This result implies that the lesson was challenging, in that many students did not get the answer immediately; however, frustration was avoided because usually a single additional response allowed them to continue. Area 3 appeared to elicit an initial response from the most students (only 58% were correct on the first try). However, fewer subsequent attempts (average of 1.39 responses per item) were required before the answer was judged correct. Contrast this result to area 4 where 1.59 responses per item were required.

It might be deduced from the quiz area data that the instructional program successfully accomplished the objectives since 75% of the students completing this area answered the quiz questions correctly on the first try. This number of first-try successes was second only to area 1 where 77% of the students were correct on the first try.

Anticipation of Student Needs

Question: How satisfied are the students when they use this lesson? When they have a problem, is the lesson responsive to their needs?

Measures: The number of unanticipated responses the average student makes and the number of requests for branching that go unsatisfied give an indication of compatibility of the lesson with the student's needs.

area = 1 (instructional)

Measure / Course	Mean # Unanticipated Responses	S.D.	Mean # Unsatisfied Branches	S.D.
K-112-1	3.00	2.71	0.90	2.02
K-112-6	4.44	4.08	1.00	2.10
W-102-16	4.79	4.15	3.88	8.65
W-112-18	3.43	3.21	0.14	0.38
W-112-19	2.94	1.92	0.53	1.18
W-102-20	3.17	2.66	0.61	2.12
W-112-20	1.44	1.54	0.17	0.38
Grand Values	3.39	3.22	1.29	4.43

area = 2 (instructional)

K-112-6	8.61	7.59	3.39	8.28
W-102-16	6.06	6.19	1.28	3.10
W-112-18	3.07	4.17	1.20	4.13
W-112-19	4.56	4.44	1.88	2.58
W-102-20	6.24	5.65	0.94	2.16
W-112-20	5.29	3.42	3.06	4.49
Grand Values	5.77	5.56	2.71	5.07

area = 3 (instructional)

K-112-1	10.50	6.36	2.00	1.41
K-112-6	8.16	5.34	1.32	2.65
W-102-16	6.57	3.95	0.43	1.13
W-112-18	2.64	1.60	0.71	1.90
W-112-19	3.13	2.47	0.06	0.25
W-102-20	6.13	3.78	0.13	0.35
W-112-20	5.00	4.31	1.67	3.77
Grand Values	5.28	4.26	0.80	2.29

area = 4 (instructional)

Measure / Course	Mean # Unanticipated Responses	S.D.	Mean # Unsatisfied Branches	S.D.
K-112-1	2.25	1.26	0.25	0.50
K-112-6	2.44	2.01	0.22	0.73
W-102-16	2.13	1.25	0.13	0.35
W-112-18	0.83	1.70	0.00	0.00
W-112-19	0.86	1.83	2.00	6.42
W-102-20	2.94	4.48	0.19	0.54
W-112-20	1.50	1.79	0.06	0.24
Grand Values	1.84	2.53	0.42	2.58

area = 5 (quiz)

K-112-1	1.00	1.00	0.00	0.00
K-112-6	3.60	2.47	0.20	0.77
W-102-16	1.83	2.32	0.50	1.22
W-112-18	2.33	2.39	0.08	0.29
W-112-19	2.75	6.93	0.06	0.25
W-102-20	2.00	3.81	0.55	1.32
W-112-20	2.05	2.33	0.15	0.49
Grand Values	2.60	3.80	0.24	0.80

Interpretation: When "mean number of unanticipated responses" is divided by the total number of questions in the area, the following values are obtained:

area 1 $\frac{3.39}{8} = .42$

area 2 $\frac{5.77}{8} = .72$

area 3 $\frac{5.28}{12} = .44$

area 4 $\frac{1.84}{4} = .46$

area 5 $\frac{2.60}{10} = .26$

Interpretation:
(cont.)

This measure indicates that the quiz area (5) was the one in which students were the least frustrated (only one in four responses were unanticipated), while area 2 revealed that almost three out of every four responses a student received in this area were judged "no", indicating relative frustration. Area 2 had the highest (2.71) average number of unsatisfied branch requests. Even though this was higher than desired, the overall average for the entire lesson was less than one.