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AUTHOR Pheall, Michael; And Others
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ABSTRACT

This paper reports on two related instructional intervention projects: one completed and the other ongoing. The first involved a "Tutored-Videotaped-Instruction" (TVI) strategy in a three-course calculus sequence; the second, an NSF-funded project using microcomputers, television, tutoring, testing, and related technologies and methods in a "Center for Assessment, Tutoring and Enrichment Resources" (CATER). Evaluation results from the TVI courses are presented as instrumental and consequential evidence of the impact of the project. Procedures in both papers are outlined. A report of progress in the NSF project concludes the paper. (Author/MK)

# MULTIPLE TECHNOLOGIES IN AN INSTRUCTIONAL INTERVENTION PROGRAM TO ASSIST IN TEACHING PRE-CALCULUS AND CALCULUS COURSES

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BY

MICHAEL THEALL
MINA B. GHATTAS
MAURICE E. GILMORE
MICHAEL KOFFMAN

NORTHEASTERN UNIVERSITY, BOSTON, MASSACHUSETTS

## INTRODUCTION

This paper is presented as a report of two related instructional intervention projects: one completed and the other, ongoing. The first involved a "Tutored-Videotaped-Instruction" (TVI) strategy in a three course calculus sequence; the second, an NSF-funded project using microcomputers, television, tutoring, testing, and related technologies and methods in a "Center for Assessment Tutoring and Enrichment Resources" (CATER).

Evaluation results from the TVI courses are presented as instrumental and consequential evidence of the impact of project. Procedures in both projects are outlined. A report of progress in the NSF project concludes the paper.

It should be clearly stated at the outset, that there was never any attempt to conduct rigorous, experimental research. The participants in the projects were (are) well aware of the myriad other factors which influenced (or will influence) the students involved. Of primary importance is the fact that, in no case, did the intervention attempt to replace one kind of instruction with another. The object was to provide students with additional services and learning opportunities. In its simplest form, the TVI project did nothing more than motivate students to spend more "time-on-task" and this, in itself, was beneficial. It is hoped that in the NSF project, more influence can be exerted and more change attributed directly to the instructional strategies and materials. Data from this project will not be available for some time, however.

The report is presented in generally informal style. Specifics and technical details are available on request. Further NSF reports are, of course, forthcoming.

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## A Pilot Project in Calculus 10:150

The Tutored-Videotaped-Instruction (TVI) project was a joint effort of the Department of Mathematics and the Office of Learning Resources at Northeastern University. The project adopted procedures used at Stanford University and Massachusetts Institute of Technology in the instruction of engineering students. (Gibbons, Kincheloe & Down, 1977; Lynch, 1977) At these schools, regularly scheduled classes were video-taped and the tapes were played back later by a tutor who started and stopped tapes on request, answered student questions, and dealt with student problems. At Stanford and M.I.T., courses were for in-service professionals away from campus. At M.I.T., tapes were used to resolve problems arising in large-enrollment (300 student) lectures.

A primary reason for the use of TVI at Northeastern was that it provided otherwise unavailable assistance to first-year students beginning their studies in June. The engineering calculus sequence 10:150 - 10:152 covers a full academic year and students who begin in the summer quarter do not have access to a departmentally sponsored "Math Workshop" which is available in the Fall, Winter, and Spring quarters.

A second reason for undertaking the project was that, in taping the calculus classes, a bank of materials would be created which could supplement instruction in other situations: 1) TA and tutor trainees could view tapes of a senior instructor and extract content and instructional approaches; 2) calculus students could access the tapes out of class to review specific concepts [each tape was accompanied by a time/topic log]; and 3) a set of tapes covering basic concepts and principles could be edited for classroom use.

It was decided that a senior instructor of outstanding reputation should teach the calculus sequence. Prof. Holland Filgo, whose experience included televised instruction, was invited to be the instructor. An experienced tutor was also necessary. Mr. Ahmad Khashan, a graduate student in mathematics was assigned the tutor's position.

Project procedures were straightforward. Each class was videotaped in the classroom, the tutor attending and making notes of the topics discussed and the times of the discussion. Videotapes and topic logs were immediately available for the tutor's use in nearby rooms. After this initial post-class session, videotapes and logs were copied and put on file within 24 hours. One set of tapes and logs was kept in the tutoring room, the second in a Learning Resources Center for access by individual students.

During the summer term and at its conclusion, various data collection methods and instruments were used Included in the evaluation were interviews, a locally developed survey, the Adjective Rating Scale (Kelly et.al. 1976), and narrative reports. The appendices here, hold some results from the 10:150 evaluation. The local survey results indicate satisfaction with the quality of the course and the TVI assistance. Regular, informal interviews with students provided similar results. Question asking habits changed slightly, the extra assistance causing students to question less in class. Student reports here coincide with the instructor's narrative report of fewer questions in class. The Adjective Rating Scale followed patterns seen in previous administrations at Northeastern University (Theall, 1978) with an even heavier than usual orientation toward the perceived practicality of the course: scale mean was 1.93 on a 4-point scale with alpha reliability of .944 while the usual mean for this scale has been above 2.0. The instructor and tutor were satisfied with the results of the pilot project and wanted to continue with the next course in the sequence. Grades of students in the course were favorably distributed with respect to previous courses and a test-retest option seemed (in conjunction with Math Lab activities) to have helped students. Of particular interest in the appendix which holds test-retest information is the "performance of selected individuals" sheet. As shown, in only two cases were retest performances worse than the original <u>but</u> these were the only cases where the Math Lab <u>was not used</u> in preparation for the retest. The tutor's narrative notes

the regular correlation of Math Lab attendance with enhanced performance. Even if learning was a function of more, guided "time-on-task", the procedures involved seem to have had a positive effect. A report of evaluation data was presented in September 1978 and the decision was made to continue the TVI project in the Fall semester.

Calculus 10:151

In the Fall '78 term, TVI activities were expanded. The second course in the engineering calculus sequence (10:151) was video-taped and the summer videotapes were used with two new sections of 10:150. Professor Filgo taught one section each of 10:150 and 10:151, Mr. Khashan provided tutoring for 10:150 at Boston and Burlington campuses, and another tutor assisted in Prof. Filgo's 10:151 section. Procedures were generally similar to those used in the summer session.

A unique feature of Prof. Filgo's classes was the continuation of the test-retest option used in conjunction with tutoring. The object of the option was early diagnosis and correction of difficulties. Each test had two equivalent forms. The instructor carefully corrected test 1 and noted weak areas. Any student could retest but attendance at the "Math Lab" was strongly recommended. Students who failed the first test could not retest unless they had attended the "Math Lab". The retest option was quite successful. Of the 177 retests in 10:150 — 10:152, 84% resulted in higher grades. Of the remaining retests, 7% showed equivalent performance and 9% resulted in lower grades. Through the series of tests; retest performance was best for those students who regularly used the "Math Lab".

In the Fall 1978 term, evaluation activities were also broadened. In addition to student attitude, opinion, and performance data for participating classes, an attempt was made to determine factors important to student performance, and all data was also collected from three NON-TVI math classes. The purpose of the NON-TVI data collection was more informational than comparative. No hypotheses

were generated about the effects of TVI or its relationships to student attitude or performance. Neither were assumptions made about the superiority of one format over the other. As a result of the initial evaluation, the following questions were considered:

1. Are student attitudes similar in concept and strength to those found in the initial evaluation?
2. Do students in TVI courses attribute their performance to the same factors as do students in NON-TVI courses?
3. Are there differences in student opinions about instruction in TVI and NON-TVI courses?
4. What are student attitudes about TVI and their tutors?
5. What is the student estimate of the value of the TVI format?
6. Are there any relationships between TVI and overall student performance (as shown by course grades)?

From the initial evaluation and a review of evaluative literature, the following patterns were anticipated:

1. Senior instructors would receive the most favorable student ratings.
2. Students would consider their own effort and ability as the most important factors in their performance.
3. Many students in TVI courses would credit tutoring with having raised their grade.
4. Tutors would receive good student ratings and videotape alone would be considered only marginally helpful.
5. The distribution of grades in TVI courses, would be skewed toward the 'A' end in comparison with past NON-TVI courses.
6. Students would be oriented toward the practical aspects of their experience and consider it to be very worthwhile but would not rate its intellectual appeal as highly.
7. A high percentage of retest scores would show improvement.

The anticipated patterns were confirmed. Senior instructors were more highly rated than TAs or junior instructors (tutors are not included in this statement). The "combined" data presented later in this report thus give an overall picture, and comparisons of TVI and NON-TVI should not be made using this data. Individual instructor's ratings varied considerably and this variance clouds such comparisons. On the whole, ratings of instruction indicate a high degree of student satisfaction in the engineering calculus 10:150 and 10:151 courses. In fact, it is suspected that some of the effect of the TVI format was lost due to the generally high quality of instruction. In other words, the better the instruction, the less the need for assistance and the closer the ratings of students in TVI and NON-TVI groups.

Both tutors were highly rated in their tutoring roles. Though individual data are not presented, it should be noted that the Burlington students gave Mr. Khashan exceptionally high ratings and it was through their efforts and insistence that Mr. Khashan continued in the tutoring role during the subsequent quarter. In all tutored classes, students who used the services credited tutoring with having positively affected their grades (see Item # 39 in the "combined data of TVI classes" appendix). Videotapes alone were not considered very useful.

The attitudes of students and their attributions followed the expected pattern. Students placed a high value on, and were well satisfied with the practical aspects (the "worth") of their courses. They did not rate the intellectual appeal (the "interest") of the courses as highly, but there was no reason to expect such a rating. The courses were considered to be of average difficulty. Both TVI and NON-TVI students considered their effort and ability to be the most important factors influencing their performance and both groups were in general agreement about the relative importance of the other, related factors.

The grade distributions in Prof. Filgo's classes were skewed toward the 'A' end of the grading scale. Average student performance (as judged by course grade comparisons) was higher in these classes than in all but one other 10:150 - 10:151 class since the Winter 1976 quarter. Common final exams are used in the 10:150-51-52 sequence, thus some control can be said to exist over the possibility of classes being graded on different criteria. The retest option allowed many students the opportunity for improving grades. Of the 177 retests taken, 149 resulted in higher grades, 12 in similar grades, 16 in lower grades. Attendance at "Math Labs" was again related to improved scores.

A final note should be inserted about Math Lab attendance. Although the instructor and development personnel were somewhat disappointed by the frequency of students' use of the service, an interesting comparison can be made. During the 10 week 10:150 sequence, some 120 contact hours of tutoring were recorded: this service was provided only for the 24 students in the 10:150 group. During a previous quarter, when a departmentally offered, drop-in-type, "math workshop" service was available to all students taking math, the number of contact hours was only 90. The retest option and the relevance to 10:150 performance are considered to be the major reasons for greater attendance in the Math Lab.

Conclusions about 10:151

There seems enough information available to answer the questions posed earlier. Student attitudes toward instruction appear to be consistent and positive in both TVI and NON-TVI courses. Likewise, attitudes about the tutors and tutoring are positive with the emphasis on the tutor rather than the technology. The overall effect of the TVI format on grades seems positive but that effect is seen as a function of diagnosis and correction through both tutoring and the retesting option. It is felt that neither tutoring nor retesting would, alone, account for such grade improvement.

Calculus 10:152

The third course in the calculus sequence, 10:152 was videotaped in the

same manner as its predecessors. Again, Professor Filgo was instructor and Mr. Khashan was tutor. Class procedures, retesting, and "Math Lab" activities were similar to those in previous courses. End-of-course evaluation was similar in that a survey, the Adjective Rating Scale, and attribution questions were used, but in this case no comparative groups were surveyed. This decision was made because the primary concern was with continued student satisfaction and progress rather than proving the superiority of one method over another. Evidence from the 10:151 evaluation had already suggested generally high quality of instruction by persons in the calculus sequence and the TVI project was only a part of the overall instructional treatment. It was expected, in 10:152, that patterns of responses would be similar to those from other evaluations. These expectations were borne out. Appendices to this report include the 10:152 survey, Adjective Rating Scale, and attribution items as well as grades for cross-course comparisons. As before, students reported satisfaction with the course and with TVI; were oriented to, and thought highly of the practical value of the course; and attributed their performance largely to their own effort and ability. The Adjective Rating Scale results show, for the first time, a distinction between the positive and negative aspects of "worth": a distinction found in the original factor structure of the instrument. Grades were distributed along expected lines, with a high percentage of 'B's (42%) and no 'D' or 'F' grades. An interesting change in attributions is seen with respect to the rankings of the instructor's personality and teaching ability. Perhaps as a function of increased self confidence or the fact that assistance was available, the TVI students ranked instructors contributions as less important than did NON-TVI students. Beyond this, the 10:152 students considered personal fluctuations of mood, condition, etc. and course design as more important than the instructor's teaching ability. Given the high ratings received by the instructor and thus the removal of the possibility that students had no choice but to be self reliant, an interesting possibility is that confidence in self may be enhanced by special assistance

programs which, through provision of successful experiences, allow earlier development/maturation.

Summary

In general, it is felt that the TVI program had a positive impact. The cost-effectiveness of the program was not addressed in the original evaluation because some proposed uses of the videotapes had not been implemented. Present data indicate that TVI may help in retaining students who would not otherwise be able to continue in their academic programs. The retention of only a few such students would return the costs of the service. With the acceptance of the NSF proposal which is discussed in the next section, the question of TVI cost-effectiveness became essentially unimportant. The experience gained in TVI and the existence of the three-course set of videotapes make TVI well worth the expense. In fact, the only direct costs for TVI included additional videotape purchase and partial release time for one instructor. Tutoring positions would have been assigned regardless, and Office of Learning Resources staff and services were essentially within existing budgets.

## EXPANDING THE TVI CONCEPT

Though TVI was effective, reports of success with more complex technologies (Bork, 1975; Bowles, 1977; Brandt, 1979; Daly, Dunn, & Hunter, 1977; Dowd, 1977) prompted the development of a proposal to the National Science Foundation for the creation of a program expanding the TVI experience into a multiple technology instructional system using tutoring, computers and televison as primary vehicles for special instruction in calculus and pre-calculus courses.

There were four problems of primary concern in these courses:

1. Faculty who teach in large-enrollment, service courses cannot provide individual attention to those students who need assistance. This includes students with minimal preparation as well as advanced students.
2. In sequences such as pre-calculus and calculus, no time exists to demonstrate the application of mathematics to the specialty areas of the

students or to provide exercise/practice in these areas. Opportunities for interdisciplinary exchange are thus reduced, and conceptual difficulties often arise when students attempt to make the transition from the abstract mathematical principle to the concrete engineering/science problem.

3. The problems of underpreparation and reduced available faculty time cause more and more instructional responsibility to fall on tutors and/or teaching assistants. These persons are chosen because of demonstrated ability in the subject area - a paramount consideration - but their content expertise does not guarantee their pedagogical efficacy. Their repertoire of instructional strategies is often limited and they do not have easy access to instructional aids and/or assistance. As such, they are most limited in the area where the greatest problems exist: the instruction of beginning students who are having difficulty in mathematics.

4. The needs of advanced students are often overlooked. These students must have access to faculty if they are to be provided with enrichment materials and/or challenging projects. In the situation where faculty time is at a premium it is often impossible to work with advanced undergraduate students.

In order to address these problems, a Center for Assessment, Tutoring, and Enrichment Resources (C.A.T.E.R.) was proposed and the following objectives were established:

1. To design or adapt 35 "drill-and-practice" units covering the major topics in each of the five courses, and to make these units available to students for individualized instruction by means of the computer.

2. To produce on videotape five (5) lectures by Engineering faculty concerning applications of calculus to their disciplines, and to interface these with special practice problems made available on the computer.
3. To integrate the existing videotapes of the entire freshman engineering calculus sequence into the proposed individualized instruction "drill-and-practice" exercises on the computer.
4. To use the computer for the diagnostic and placement tests administered to all freshmen in the summer and fall.
5. To use videotapes of classroom instruction by experienced faculty to improve the instructional skills of graduate teaching assistants and tutors.

The timetable for implementing the project is displayed on the following pages.

| TIME | EVENT |
|---|---|
| Summer 1979 | Purchase and Installation of Software<br>"Lessonwriter" computer package from Dr. John De Ford, University of Utah<br>"Course Management" computer package from Dr. Kenneth L. Bowles, University of California, San Diego<br>"Graphical Characteristics of Functions," "Application of Calculus to the Design of the Diesel Engine," videotapes from Dr. Anthony L. Peressini, University of Illinois<br>"Coursewriter" computer package from Dr. Alfred H. Bork, University of California, Irvine<br>"Engineering Calculus for Minority Students," computer testing package from Dr. Gregory Hamilton, Michigan State University |
| | Purchase of Equipment<br>Terak Corporation Model 8510A microcomputer (4)<br>Videocassette Player (2)<br>9" Television (2)<br>Videotape Controller (2)<br>Study Carrels |
| | Construction of Physical Facility (convert existing classroom) |
| | Employ Computer Programmer |
| Fall 1979 | Development of Drill-and-Practice Units:<br>Pre-Calculus Course 10.144, "Addition and Subtraction of Polynomials"<br>10.145, "Solution of Quadratic Equations"<br>Calculus Course 10.150, "Functions and Graphs"<br>10.151, "Area Under a Curve"<br>10.152, "Integration Techniques: Substitution" |
| | Videotape/Computer Application Units<br>"Applications of Problems Solved Using Max-Min Theory in the Calculus of One Variable" |

## TIMETABLE OF PROJECT ACTIVITIES

| TIME | EVENT |
|---|---|
| Fall 1979 (continued) | Classroom Videotapes: Review, Edit and Cross-Reference Existing Lectures |
| | Construction of Physical Facility (convert existing classroom space) |
| | Training of Professors Bridger and Claflin in Use of "Coursewriter" and "Lessonwriter" Software |
| Winter 1980 | Development of Drill-and-Practice Units: |
| | Pre-Calculus Course 10.144, "Multiplication and Division of Polynomials" |
| | 10.144, "Special Products and Factoring I" |
| | 10.145, "Graphs of Linear and Quadratic Equations |
| | Calculus Course 10.150, "Elementary Limits of Algebraic Functions" |
| | 10.150, "Slopes of Lines and Linear Equations" |
| | 10.151, "Volumes by Slicing" |
| | 10.152, "Integration Techniques: By Parts" |
| | Videotape/Computer Applications Units |
| | "Scientific Applications of Related Rates Problems" |
| | Classroom Videotapes: Review, Edit and Cross Reference Existing Lectures |
| | Construction of Physical Facility |
| | Supervision of Programming Activity |
| | Evaluation |
| Spring 1980 | Development of Drill-and-Practice Units: |
| | Pre-Calculus Course 10.144, "Special Products and Factoring II" |
| | 10.145, "Simple Word Problems" |
| | 10.145, "Linear Systems in Two and Three Unknowns" |
| | Calculus Course 10.150, "Derivatives of Polynomials" |
| | 10.151, "Word Problems" |
| | 10.151, "Volumes Using Cylindrical Shells" |
| | 10.152, "Integration Techniques: Trigonometric Substitutions |

TIMETABLE OF PROJECT ACTIVITIES

| TIME | EVENT |
|---|---|
| Spring 1980 (continued) | Videotape/Computer Application Units<br>"Application of Separable Differential Equations to Real World Problems" |
| | Design diagnostic testing program for all freshmen |
| | Classroom Videotapes: Review, Edit and Cross-Reference Existing Lectures |
| | Evaluation |
| Summer 1980 | Development of Drill-and-Practice Units:<br>Pre-Calculus Course 10.144, "Addition and Subtraction of Algebraic Fractions"<br>10.145, "Angles and Their Measurement"<br>Calculus Course 10.150, "Use of the Product and Quotient Rules"<br>10.151, "Logarithmic Functions"<br>10.152, "Integration Techniques: Partial Fractions"<br>10.152, "Integration Techniques: Powers and Products of Trigonometric Functions" |
| | Implement, Field-Test, Revise Mathematics Diagnostic Program for all Freshmen |
| | Establish management procedures for C.A.T.E.R. facility |
| | Mathematics faculty workshops on use of C.A.T.E.R. facility |
| | Train tutors and C.A.T.E.R. staff |
| | Purchase of Equipment<br>Terak Corporation Model 8510A microcomputer (4)<br>Videocassette Player (2)<br>9" Television (2)<br>Videotape Controller (2)<br>Terak Proctor Terminal |
| | Evaluation |

# TIMETABLE OF PROJECT ACTIVITIES

| TIME | EVENT |
|---|---|
| Fall 1980 (25% of all freshmen engineering students use C.A.T.E.R. facility, 225 students) | Development of Drill-and-Practice Units:<br>Pre-Calculus Course 10.144, "Multiplication and Division of Algebraic Fractions"<br>10.145, "Definition of Trigonometric Functions: Special Angle<br>Calculus Course 10.150, "Graphs of Trigonometric Functions"<br>10.151, "Exponential Functions"<br>10.152, "Polar Coordinates"<br><br>Videotape/Computer Applications Units<br>"Application of Integration to Problems Involving Work, Pressure and Center of Mass"<br><br>Implement, Field-test and Revise Programs<br><br>Management of C.A.T.E.R. Facility and Development of Instructional Materials<br><br>Evaluation |
| Winter 1981 (50% of all freshmen engineering students use C.A.T.E.R. facility, 450 students) | Development of Drill-and-Practice Units<br>Pre-Calculus Course 10.144, "Rules of Exponents"<br>10.145, "Inverse Functions"<br>Calculus Course 10.150, "The Chain Rule"<br>10.151, "Trigonometric Functions"<br>10.152, "Taylor Series"<br><br>Video/Computer Applicatios Units<br>"Planetary Motion"<br><br>Management of C.A.T.E.R. Facility and Development of Instructional Materials<br><br>Evaluation |

## TIMETABLE OF PROJECT ACTIVITIES

| TIME | EVENT |
|---|---|
| Spring 1981 (75% of all freshmen engineering mathematics students use C.A.T.E.R. facility, 675 students) | Development of Drill-and-Practice Units<br>Pre-Calculus Course 10.144, "Solution of Linear Equations"<br>10.145, "Inequalities and Absolute Values"<br>Calculus Course 10.150, "Curve Sketching Using Derivatives"<br>10.151, "Inverse Trigonometric Functions"<br>10.152, "Indeterminate Forms"<br>Video/Computer Applications Units:<br>"Editing and Revision"<br>Management of C.A.T.E.R. Facility and Development of Instructional Materials<br>Evaluation |
| Summer 1981 (100% of all freshman engineering mathematics students use C.A.T.E.R. facility, 900 students) | Revise Drill-and-Practice and Video/Computer Applications Units Based on Evaluation Data<br>Workshop for faculty from other departments and colleges on C.A.T.E.R. facility<br>Purchase of Equipment<br>Terak Corporation Model 8510A microcomputer (2)<br>Evaluation |
| Fall 1981 (100% of all freshman engineering mathematics students use C.A.T.E.R facility, 900 students) | Revise Drill-and-Practice and Video/Computer Applications Units Based on Evaluation Data<br>Workshop for faculty from other departments and colleges on C.A.T.E.R. facility<br>Evaluation |

## TIMETABLE OF PROJECT ACTIVITIES

| TIME | EVENT |
|---|---|
| Winter 1982 (100% of all freshman engineering mathematics students use C.A.T.E.R. facility, 900 students) | Revise Drill-and-Practice and Video/Computer Applications Units Based on Evaluation Data |
| | Workshops for faculty from other departments and colleges on C.A.T.E.R. facility |
| | Evaluation |
| Spring 1982 (100% of all freshman engineering mathematics students use C.A.T.E.R. facility, 900 students) | Revise Drill-and-Practice and Video/Computer Applications Units Based on Evaluation Data |
| | Workshops for faculty from other departments and colleges on C.A.T.E.R. facility |
| | Evaluation |
| | Summative evaluation report |
| | Plan for program continuation |

Organizationally, the project had three major components: 1) instructional development and evaluation along with facilities design and administration were under the Office of Learning Resources; 2) math curriculum content and programming were under mathematics department; and 3) engineering faculty were responsible for content in the "applications" units. The organization is outlined in Figure 1.

Staff time was distributed as follows:

TABLE 1. DISTRIBUTION OF STAFF TIME

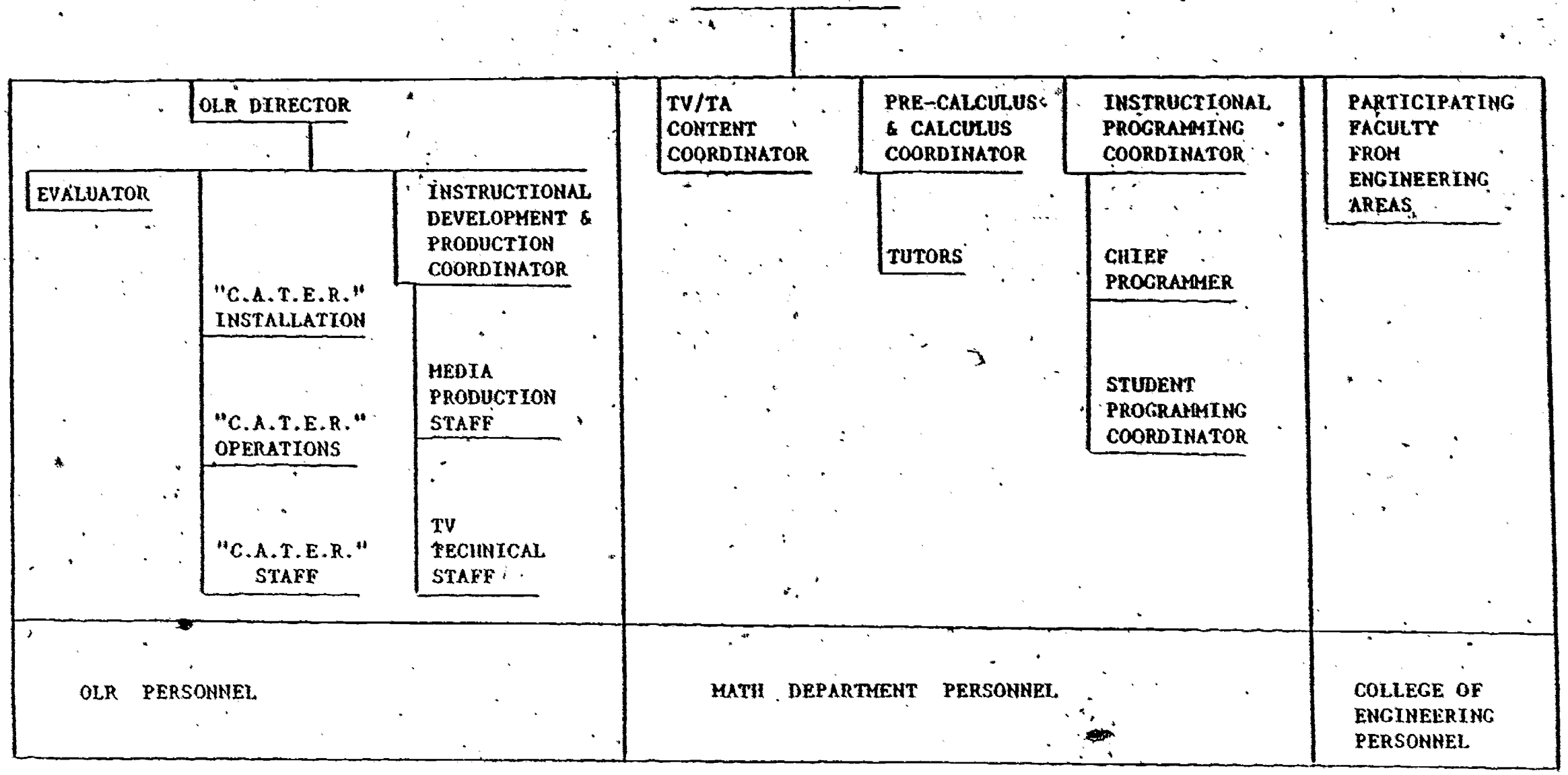
| | Summer 1979 | 9/79-6/80 | Summer 1980 | 9/80-6/81 | Summer 1981 | 1/81-6/82 |
|---|---|---|---|---|---|---|
| Project Director | 16% | 11% | 16% | 11% | 16% | 11% |
| | 16% | 33% | 0% | 33% | 0% | 33% |
| | 0% | 22% | 22% | 22% | 0% | 0% |
| Math Faculty | 0% | 33% | 0% | 33% | 0% | 0% |
| | 0% | 11% | 33% | 0% | 0% | 0% |
| Programmer | 100% | 100% | 100% | 100% | 0% | 0% |
| OLR Director | 10% | 10% | 10% | 10% | 5% | 5% |
| Evaluator | 0% | 11% | 22% | 22% | 33% | 33% |
| Instruct. Designer | 0% | 11% | 0% | 11% | 5% | 5% |
| Engineering Faculty | 0% | 11% | 0% | 11% | 0% | 0% |

## Expected Benefits

The five pre-calculus and calculus mathematics courses affected by this program are central to the development of over nine hundred (900) engineering students each year. At the present time a large number of these students are handicapped by poor mathematics preparation. Because of the number of students and other demands on their time, faculty cannot give these students sufficient individual attention. The majority of such students suffer not only in their mathematics classes, but in other related fields, particularly physics and chemistry, in which the application of calculus is expected. The software development and computer-assisted instruction facility would make it possible for individual students to test their understanding of subject matter, unit by unit, and to obtain supplemental instruction, either in the form of special videocassettes or tutors.

FIGURE 1

N.S.F. "CAUSE" - "C.A.T.E.R." ORGANIZATION



The existence of such computer assisted learning centers on campus is a predictable development in higher education. According to Bowles (1977) the cost to own and operate a microcomputer suitable for computer based instruction amounts to roughly $0.50 to $1.00 per hour of use (depending on volume). The falling equipment prices mean that the hourly cost will fall to roughly $0.10 per hour by the early 1980's. Bowles concludes that with such companies as Texas Instruments entering the microcomputer market, the cost of equipment in ten years will be so low that the essential issues regarding the use of computers for instruction will be purely organizational. Given the number of students in this project, the only cost-effective alternatives involve the use of technology. Furthermore, since a primary goal is to strengthen the students' grasp of important mathematical procedures, an interactive technology must be used. The computer ideally suits these requirements.

The NSF/CAUSE project will serve as a vanguard for the instructional use of the computer on the Northeastern University campus. If successful, the project's drill-and-practice, record-keeping, and videotape applications procedures would spread to other large service courses, particularly in the physical and biological sciences. While the proposed facility was designed primarily to service the nine hundred (900) students in five freshman engineering mathematics courses, it could eventually service other courses and departments, and could be expanded to include more terminals. Of particular interest in this project is the application of computers to assist not supplant, classroom instruction. No technologies in the past have proven themselves the equivalent of effective classroom instruction. The computer here is interfaced with another powerful technology, television. The combination of these two technologies overcomes deficits of each one individually. The computer lacks the visual and auditory stimuli of television, not to mention the advantages of motion. Television however, lacks the interactive branching and record-keeping capabilities of the computer. Eventually the videocassette will be replaced by the videodisc, which will greatly increase the power of this com-

puter/video interface. Also included in this project is the tutor, both in tne role of small-group instructor for tutored videotape instruction and in the conventional role of individualized tutoring. Determining the extent to which the tutors can manage and utilize the powerful technologies at their disposal may be one of the most practical outcomes of the project. Additionally, the potential exists to undertake research of a more rigorous nature. Questions related to "math anxiety", motivation, attribution theory, cognitive style, and other constructs can be addressed in the process of testing and implementing the program. The development of generalizable software (eg.: CAI units on problem solving, heuristics, exploratory rather than didactic lessons, etc.) is also a distinct possibility.

Progress to Date

This section briefly outlines events and accomplishments in the NSF - "C.A.T.E.R." project. Categories of activities are isolated for simplicity's sake.

1. Hardware/system software are presently operating on a limited basis. Four TERAK computers are in use and, after an initial period of technical problems, are operating reliably. Perhaps the major delay to date has been with system software. Originally, it was planned to use the "Lessonwriter" (Brandt, 1979) 1979) language from the University of Utah. The "Coursewriter" language (Bowles, 1977) from University of California at San Diego was considered as a supplement for special needs in (for example) course administration. Both languages are "PASCAL" derivatives. Because of the highly interactive nature of the lessons planned here, the usefulness of the two derivative languages was unexpectedly limited. At present, authors are generating lessons on paper and programmers are entering these lessons into the system in "PASCAL". Simultaneously, special software is being created to provide additional graphics support; extended options for evaluation of student responses; exploratory structures for lessons in the "discovery" mode; expanded character sets; extremely powerful text editing; and other similar

purposes. Much remains to be done in order to make the system software as powerful and flexible as possible. The reasons for creating such powerful software are found in the instructional design strategies outlined below.

2. Instructional design considerations in this project have put heavy demands on lesson writing software. A prototype lesson was created early in the project and it followed a generally traditional format. Explanatory material was presented first, followed by a problem. Based on the student's reply to a multiple choice question, right/wrong branches were executed. Distractor items in the question were chosen to represent the realm of results one might get having made one of the "typical mistakes students make in these problems". Incorrect choice branches were thus determined in a quasi-diagnostic manner. Given an error indicating a major problem, students would be channeled through a second explanation/problem sequence and eventually (given a second major error) would, through the computer/TV interface, see a brief videotape explanation of the topic taken from the set of TVI tapes.

As discussions on instructional strategy continued, and as problems with existing software arose, a new direction took shape. Assuming that all material would have been covered in class, more emphasis was placed on the notion of "drill and practice". Preliminary explanations were dropped in favor of immediate problem solving or more discovery-oriented strategies. Both strategies, however, placed heavy demands on software. Rather than providing multiple choice questions, for example, it became necessary to have the computer evaluate mathematical notations/equations entered by the student. Another possibility was for the system to allow the student to enter and manipulate parameters for, for example, curve sketching or adding functions. The complexity of such demands has initially slowed development of both software and course materials, but is expected in the long run, to allow much more sophisticated lessons to be created.

3. Curriculum content has also seen extensive discussion. The original 35 units may be reduced in number and an extensive context investigation is underway

in an effort to identify concepts and operations crucial to understanding the course material. This refinement of content may lead to clearer identification of key issues in many areas.

4. The C.A.T.E.R. facility has been designed and proposals for construction have been submitted. Construction should begin in May of 1980 to be ready for the freshman class entering in September 1980. Construction plans include carrel placement, design of study and tutoring areas, location of equipment, lighting and acoustic control, etc. to create an environment with maximum utility and minimum distraction.

Summary

The multiple technologies project is generally on schedule but expending much more effort than anticipated on system software and instructional strategy. To date instructional materials have only undergone content-face-validity review. Field tests with students will begin in March 1980. Despite the complexities of creating instructional materials and strategies which match the sophistication of the delivery systems, progress has been consistent and the benefits anticipated from the project remain achievable.

EXTRACTS FROM

THE INSTRUCTOR'S

NARRATIVE REPORT

10:150

Surely the most important questions we would like to have answered are:

1. How well are the students in this class doing?
2. How do they compare with classes in the past?
3. If there is a difference, what caused it?

First, I shall give my opinion on at least the first of these questions. Then I shall discuss how the experience of teaching this course has seemed different to me from the usual course.

## A. THE ACHIEVEMENT OF THE CLASS

My gut feeling is that this is a very good class. The students seem interested and attentive. They seem to have a good understanding of the basic concepts, and they have unusually good skills at the mechanics of this course, e.g. equation of lines, differentiation formulas, trigonometry formulas. I was surprised at how little trouble they had with something like the chain rule. Their grades at this point (just before the final exam) tend to bear out this impression.. The only things that detract from this picture are: (1) in trying to make tests which could be graded quickly, I probably tested more than usual their ability to do isolated tasks and less than usual their ability to analyze and solve a complicated problem, and (2) in trying to proceed very carefully, I paced the course a bit slower than usual. A possible third factor is that a good many of these students had a year of calculus in high school. I do not know if that is typical of a 10:150 class.

## B. THE EXPERIENCE OF TEACHING THIS CLASS

Here are some observations about how this class seemed different to me. In some cases, I shall speculate on possible reasons for the differences, in others not.

1. Most noticeable was that the students asked very few questions in class. White it is not my stule to get a lot of student discussion, I normally expect a lot of hands to go up when I ask if there are questions about homework. In this class, I practically had to beg them to get such questions.

2. Very few students came to my conference hours. This was quite noticeable, since freshmen tend to come for help much more often than advanced students.

3. I was somewhat less relaxed than usual in front of this class. Here are the reasons that occur to me:

   A. Everything I said has been recorded for "all the world" to hear.

   B. Having been designated as a "good teacher", I felt I had to live up to that.

   C. I was being observed by OLR people and by Mr. Khashan, who is an excellent, experienced teacher.

   D. At first I did not feel that it was my class. I was unsure whether a committee was in charge of the class, whether Khashan and I were in charge of the class, or whether I was in charge of the class. In other words, I felt like the spokesman for a gr[redacted] rather than the person in control. By the end of the term, however, I felt quite comfortable about all this.

One might speculate on a possible connection between my tenseness and the students' lack of response. Perhaps I conveyed to them the idea that the ~~class~~ was a performance by me, and therefore they should not interrupt.

4. On the other hand, I did feel more comfortable in this class about one thing. Because of the existence of the tutoring sessions, I didn't feel the need to make sure that everyone in the class understood a topic before moving on to the next one.

5. The course was a bit slower in pace than usual, for the following possible reasons:

   A. My beforementioned concern about proceeding very carefully.

   B. Lack of response from the students made me feel they weren't "getting it".

   C. Feeling I was under scrutiny, made me want to make sure the students made a good showing.

   D. The mechanics of the course: There were five tests, and there were also minor delays caused by losing the students the first day, combining the two sections, and one fire alarm.

6. I spent a lot more time than usual on test preparation, test correction (especially trying to analyze the students' deficiencies) and on meetings with OLR people.

7. In spite of the fact that few students came to see me, as a result of the class attention we paid to their performance, I am better acquainted with these students than I am with students in comparable classes.

C. MISCELLANEOUS OBSERVATIONS

1. I watched several of the tapes with Office of Learning Resources personnel. Their comments were extremely helpful in making me analyze my philosophy of teaching, and in increasing my awareness of what is actually going on in the classroom. I was too nervous to try to change my habits very much in this particular class, but I did tend to practice new approaches in my other class, which was much smaller and where my failures wouldn't be recorded, and the results were very gratifying to me.

2. I was very favorably impressed by the way Ahmad worked with students in the math lab.

3. I am mildly concerned that with all the attention we paid to the students who were not doing so well, we may have done less than we could for the really good ones.

## D. SUMMARY

On the positive side, I think we can say at the very least that we made it possible for a fair number of students to accumulate a better set of test scores than they normally would. I hope this means that they have a firmer knowledge of the material and are consequently better-prepared for subsequent courses, and I am cautiously optimistic that this is the case. On the negative side, a disappointingly large number of students simply dropped out of sight. In fact, I would say that there seems to be a clearer than usual separation between the group of students who are involved in the course and those who are not, and that this might be due mainly to the fact that we communicated to them that we cared whether they were involved or not.

# EXTRACTS FROM TUTORS' COMMENTS AND OBSERVATIONS

10:150

II. OBSERVATIONS:

1. It is very important to communicate with those students who fail the diagnostic test and to start immediately reviewing pre-calculus material with them.

2. The diagnostic test should be geared towards the material we assume they know; material they will need throughout the course.

3. The first two weeks are very important. Special effort should be made to make sure that "slow" students do not fall behind.

4. Some students especially those with language problems or a weak background in Math, should have special treatment. They need more time to catch up with the class.

5. Telephone numbers and addresses of each student might be helpful in the process of communication.

6. It is very important to face the students with their problems and the fact that they can get over their deficiencies.

7. It is very important to face the students with their mistakes and with the fact that they should stop making them.

8. It is very important to be friendly with the students and to show interest in their progress.

9. Students appreciate the extra help available. 122 students used the lab for periods of 1-3 hours.

10. The lab in its format provides the students with a pleasant atmosphere to study mathematics on their own or with others or with the help of the tutor.

11. It will be helpful to have the class away from Huntington Avenue which is extremely noisy.

12. After a problem is solved or a definition is written etc., it will be helpful if the camera person focuses on the blackboard so that slow students can catch up.

13. It will be extremely helpful to have a special videotape machine that enables the tutor to stop the tape with the picture showing.

14. It is important to analyze the students' mistakes after each test to be treated in the lab.

15. Some students don't have time for the lab (they work).

16. Some students have the attitude that they are going to try school for one semester. Others don't care about school to start with.

17. It will be extremely helpful to assign 2-3 hours for math lab. This way all the students will be available for help or any activities that happen in the lab.

## III. RESULTS:

Up to the date of this report, every student who is still coming to class and to the lab, is passing the course. Some of the students who showed up for the lab, consistently did extremely well, others did ok.

The results of the make-up tests correlated with the students' attendance in the lab. For the second and third make-up tests, students who attended a review session on a certain topic did much better than those who did not. The same students did poorly on the topics they did not attend review sessions for.

Some students dropped out of the course though they were doing well. Some did not have any hope of continuing (very weak math background - needed to study a lighter course).

In general, I think that the results were positive and a good number of students benefitted from the lab.

COURSE EVALUATION

CALCULUS 10:150

note: The following pages are extracted from an original, interim report generated for internal purposes. Only distributions of data are shown because, in the original report, ease of interpretation by other readers was important. Means and deviations were originally computed but were not readily available for this paper. Data cards , however, still exist.

CALCULUS 10:150 ..... COURSE EVALUATION

RESPONSES % PART I instruction

1. PACING (amount of material covered in relation to time available)
   - 0 a) too much material and not enough time
   - 81 b) adequate time devoted to each topic
   - 4 c) too much time devoted to each topic
   - 15 d) pacing OK because the math lab was available...otherwise, 'a)' above

2. CLARITY OF EXPLANATIONS (Prof. Filgo)
   - 62 a) instructor explained clearly and precisely
   - 38 b) explanations were generally clear
   - 0 c) explanations were sometimes confusing and difficult to follow
   - 0 d) explanations were often unclear and confusing

3. QUALITY OF PRESENTATION (Prof. Filgo as a speaker)
   - 54 a) extremely good
   - 42 b) very good
   - 4 c) acceptable
   - 0 d) poor

4. OUTLINING MATERIAL (providing organization and indicating directions & emphasis)
   - 65 a) topics were clearly outlined. I knew what to expect from each lecture.
   - 31 b) topics followed an outlined sequence but I was unsure of their relationships and emphasis until the lectures were finished
   - 0 c) outlines were rarely provided. I had no idea of where we were going or how things fit together.
   - OMIT = 4

5. OBJECTIVES (statements of what you would have to be able to know or do at the end of the class/course)
   - 54 a) objectives were usually stated
   - 38 b) objectives were occasionally stated
   - 8 c) objectives were rarely stated
   - 0 d) objectives were stated but were unclear or unexplained

6. NOTE TAKING
   - 73 a) I was able to take notes easily and attend to the lecture as well.
   - 0 b) I had to take notes so furiously that I missed parts of the lecture.
   - 0 c) I had a difficult time taking notes because I didn't know what to stress.
   - 23 d) I rarely take notes so the above don't apply.
   - 4 e) My note taking habits changed because I had additional resources (math lab; videotapes; tutor; etc.)

7. Were the relationships and applications of calculus to engineering made clear to you?
   - 31 a) regularly
   - 46 b) sometimes
   - 15 c) rarely
   - 8 d) this is not important to me

8. Choose the item below which is closest to your ranking of factors affecting your performance in this course.

RESPONSES

| % | | MOST IMPORTANT ..... | | LEAST IMPORTANT |
|---|---|---|---|---|
| 23 | a) | the instruction | my effort & ability | the subject |
| 12 | b) | the instruction | the subject | effort and ability |
| 35 | c) | effort & ability | instruction | subject |
| 12 | d) | effort & ability | subject | instruction |
| 12 | e) | subject | instruction | effort & ability |
| 8 | f) | subject | effort & ability | instruction |

PART II course design

1. CONTENT (The difficulty of the subject as taught...do not consider the additional assistance when answering)

0 a) much more difficult than most other courses I have taken
27 b) somewhat more difficult ...
42 c) about as difficult as most...
31 d) less difficult...

2. AMOUNT OF WORK (assignments...time spent studying...include math lab time)

8 a) much more work than most other courses I have taken
42 b) somewhat more ...
92 c) about as much work as most...
8 d) less work than most...

3. TESTS (the 4 tests taken so far)
Choose the item below which best matches your feelings about tests:

81 a) level of difficulty was OK and the tests covered what we were taught
19 b) tests covered what we were taught but were too long or too hard
0 c) tests did not cover what we were taught

4. RETESTING I
Choose one of the following:

69 a) I felt less anxious than usual about tests because I knew I would have a second chance.
27 b) The fact that retesting was possible did not lessen my anxiety about testing.

OMIT = 4

RETESTING II
Did you ever skip a test because you were not ready and you knew you could take a retest?

15 a) once.
0 b) more than once
85 c) never

5. SPECIAL ASSISTANCE I (whether you used it or not)
Choose the statement below which best matches your feelings about the special assistance available with this course.

46 a) Any effort to provide extra help is worthwhile.
50 b) The help available in this course reduces my anxiety about grades (even though I may not have used it).
4 c) More effort and resources should be devoted to programs aimed at students who do well.

SPECIAL ASSISTANCE II
My feelings about the extra help in this course compared to other courses offering

RESPONSES

%

extra help is that:

64 a) the program in this course is much more valuable
24 b) the program in this course is a bit more valuable
8 c) the program in this course is no better/worse than in other courses
4 d) the program in this course is less valuable

6. Choose the item below which is closest to your ranking of factors affecting your performance in this course

| | MOST IMPORTANT ..... | | .....LEAST IMPORTANT |
|---|---|---|---|
| 20 | a) course design (including extra help) | my effort & ability | the subject |
| 12 | b) course design (including extra help) | the subject | effort & ability |
| 32 | c) effort & ability | course design (including extra help) | the subject |
| 16 | d) effort & ability | the subject | course design (including extra help) |
| 12 | e) the subject | effort & ability | course design (including extra help) |
| 8 | f) the subject | course design (including extra help) | effort & ability |

PART III rapport (consider the class only)

1. Rate student-teacher rapport in this course

28 a) excellent
68 b) good
4 c) fair
0 d) poor

2. Rate student-student rapport in this course

20 a) excellent
56 b) good
24 c) fair
0 d) poor

3. Rate the availability of the instructor

56 a) easy to reach/meet with
8 b) sometimes unavailable
4 c) difficult to reach/meet with
28 d) because of the extra help, I didn't feel the need to contact the instructor often (or at all).

OMIT = 4

4. Did the instructor seem approachable, that is, did you feel comfortable talking with him, asking questions, etc?

60 a) extremely approachable
28 b) very approachable
12 c) some what approachable
0 d) not at all approachable

5. Did the instructor seem interested in his students, their progress, and their problems?

56 a) extremely interested
36 b) very interested
8 c) some what interested
0 d) not at all interested

RESPONSES % 6. Choose the item below which is closest to your ranking of factors affecting your performance in this course

| | MOST IMPORTANT..... | | .....LEAST IMPORTANT |
|---|---|---|---|
| 16 | a) rapport | my effort & ability | the subject |
| 0 | b) rapport | subject | my effort & ability |
| 28 | c) my effort & ability | rapport | subject |
| 32 | d) my effort & ability | subject | rapport |
| 12 | e) subject | effort & ability | rapport |
| 12 | f) subject | rapport | effort & ability |

PART IV general questions

1. Did the presence of the television equipment inconvenience you or cause any anxiety?

4 a) yes
96 b) no

2. Did you ask questions in class?

12 a) often
44 b) sometimes
44 c) rarely

3. Did the fact that extra help was available change your question asking habits?

36 a) yes
64 b) no

3a. If yes, how?

36 a) fewer questions
4 b) more questions

OMIT = 60

4. Choose the item below which is closest to your ranking of factors affecting your performance in this course

| | MOST IMPORTANT..... | | .....LEAST IMPORTANT |
|---|---|---|---|
| 48 | a) instruction | course design ( including extra help) | rapport |
| 12 | b) instruction | rapport | course design (including extra help) |
| 8 | c) course design (including extra help) | rapport | instruction |
| 20 | d) course design (including extra help) | instruction | rapport |
| 0 | e) rapport | course design (including extra help) | instruction |
| 8 | f) rapport | instruction | course design (including extra help) |

MIT = 4

MATH LAB EVALUATION (fill in if you ever used the math lab for any reason)

PART I general questions

1. About how many times did you use the math lab?

40 a) 1-3
20 b) 4-8
12 c) 9-13
12 d) 14+

41 6.

| % | |
|---|---|
| | 2. Why did you most often use the math lab? |
| 8 | a) to review classes |
| 23 | b) to study for tests |
| 50 | c) to study for retests |
| 19 | d) to seek additional information on any topic(s) |
| | 3. What methods/materials did you most often use? |
| 36 | a) instruction by tutor |
| 55 | b) tutor and videotape instruction |
| 0 | c) videotape alone |
| 5 | d) additional materials (including problems) |
| 5 | e) student study group |
| | 4. What is your general estimate of the value of the math lab? |
| 52 | a) extremely valuable |
| 38 | b) very valuable |
| 5 | c) somewhat valuable |
| 5 | d) not at all valuable |
| | 5. What is the value of the videotape/tutor method used in the math lab? |
| 38 | a) extremely valuable |
| 52 | b) very valuable |
| 5 | c) somewhat valuable |
| 5 | d) not at all valuable |
| | 6. What is the value of the videotape without the tutor? |
| 5 | a) extremely valuable |
| 38 | b) very valuable |
| 38 | c) some what valuable |
| 14 | d) not at all valuable |

OMIT = 5.

PART II the tutor

| | |
|---|---|
| | 1. Did the tutor establish a non-threatening (helping) relationship in the math lab? |
| 76 | a) very much so |
| 19 | b) to some degree |
| 5 | c) not very much |
| 0 | d) was very authoritative and threatening |
| | 2. Did the tutor seem to have a solid knowledge of the subject |
| 81 | a) very knowledgeable |
| 19 | b) somewhat knowledgeable |
| 0 | c) not very knowledgeable |
| | 3. Did the tutor explain clearly and precisely ? |
| 67 | a) almost always |
| 29 | b) often |
| 4 | c) sometimes |
| 0 | d) rarely |
| | 4. Did the tutor use the resources available (that is TV, materials, etc.) or did he simply lecture? |
| 81 | a) used resources often |
| 19 | b) used resources occasionally |
| 0 | c) used resources rarely |
| 0 | d) most often lectured |

RESPONSES

| % | |
|---|---|
| | 5. Was the tutor able to understand your question or problem? |
| 67 | a) almost always |
| 24 | b) often |
| 10 | c) occasionally |
| 0 | d) rarely |
| | 6. Was the tutor able to help you solve your problem or answer your questions? |
| 76 | a) almost always |
| 24 | b) often |
| 0 | c) occasionally |
| 0 | d) rarely |
| | 7. Did the tutor tie in math lab instruction and activities to class instruction and activities? |
| 67 | a) almost always |
| 33 | b) often |
| 0 | c) occasionally |
| 0 | d) rarely |
| | PART III administration |
| | 1. Did you resent efforts made to get you to use the math lab |
| 5 | a) very much |
| 24 | b) a bit |
| 71 | c) I had no such feelings |
| | 2. Would you specify your reasons for not using the math lab (if there were indications that you needed help). |
| 23 | a) I usually work out my own problems |
| 27 | b) I had no time |
| 0 | c) I didn't like the tutor |
| 5 | d) I didn't like being pressured |
| 0 | e) other (please list) (NONE LISTED) |
| OMIT = 45 | |
| | 3. Do you consider that the math lab: |
| 5 | a) kept you from failing |
| 76 | b) helped you raise your grade |
| 14 | c) made little difference to your performance |
| OMIT = 5 | |

COMBINED DATA OF TVI CLASSES

10:151

note: mean scores and distributions of scores are presented for all items..... on those items in which the mean score is underlined, the distribution of scores is the more accurate representation of the data

CALCULUS ..... COURSE EVALUATION

PART I instruction

| $\bar{X}$ | | |
|---|---|---|
| | | 1. PACING (amount of material covered in relation to time available) |
| 2.00 | 26 | a) too much material and not enough time |
| | 60 | b) adequate time devoted to each topic |
| | 1 | c) too much time devoted to each topic |
| | 13 | d) pacing OK because the math lab was available...otherwise, 'a)' above. |
| | | 2. CLARITY OF EXPLANATIONS (your instructor only ...not your tutor) |
| 2.347 | 28 | a) instructor explained clearly and precisely |
| | 26 | b) explanations were generally clear |
| | 29 | c) explanations were sometimes confusing and difficult to follow |
| | 17 | d) explanations were often unclear and confusing |
| | | 3. QUALITY OF PRESENTATION (your instructor's ability as a speaker) |
| 2.431 | 21 | a) extremely good |
| | 28 | b) very good |
| | 39 | c) acceptable |
| | 13 | d) poor |
| | | 4. OUTLINING MATERIAL (providing organization and indicating directions & emphasis) |
| 1.625 | 40 | a) topics were clearly outlined. I knew what to expect from each lecture. |
| | 57 | b) topics followed an outlined sequence but I was unsure of their relationshi and emphasis until the lectures were finished |
| | 3 | c) outlines were rarely provided. I had no idea of where we were going or how things fit together. |
| | | 5. OBJECTIVES (statements of what you would have to be able to know or do at the end of the class/course) |
| 1.625 | 56 | a) objectives were usually stated |
| | 31 | b) objectives were occasionally stated |
| | 10 | c) objectives were rarely stated |
| | 4 | d) objectives were stated but were unclear or unexplained |
| | | 6. NOTE TAKING |
| 1.833 | 51 | a) I was able to take notes easily and attend to the lecture as well. |
| | 28 | b) I had to take notes so furiously that I missed parts of the lecture. |
| | 10 | c) I had a difficult time taking notes because I didn't know what to stress. |
| | 8 | d) I rarely take notes so the above don't apply. |
| | 3 | e) My note taking habits changed because I had additional resources (math lab; videotapes; tutor; etc.) |
| | | 7. Were the relationships and applications of calculus to engineering made clear you? |
| 1.808 | 33 | a) regularly |
| | 56 | b) sometimes |
| | 8 | c) rarely |
| | 3 | d) this is not important to me |

PART II course design

$\bar{X}$

8. CONTENT (The difficulty of the subject as taught...do not consider the additional assistance when answering)

2.338 21 a) much more difficult than most other courses I have taken
37 b) somewhat more difficult ...
30 c) about as difficult as most...
13 d) less difficult...

9. AMOUNT OF WORK (assignments...time spent studying...include math lab time)

2.35 14 a) much more work than most other courses I have taken
44 b) somewhat more ...
35 c) about as much work as most...
7 d) less work than most...

10. TESTS tests taken so far)
Choose the item below which best matches your feelings about tests:

1.37 64 a) level of difficulty was OK and the tests covered what we were taught
34 b) tests covered what we were taught but were too long or too hard
1 c) tests did not cover what we were taught

11. RETESTING I
Choose one of the following:

1.34 71 a) I felt less anxious than usual about tests because I knew I would have a second chance.
28 b) The fact that retesting was possible did not lessen my anxiety about testing.

Filgo only

12. RETESTING II
Did you ever skip a test because you were not ready and you knew you could take a retest?

2.63 17 a) once
3 b) more than once
80 c) never

13. SPECIAL ASSISTANCE I (whether you used it or not)
Choose the statement below which best matches your feelings about the special assistance available with this course.

1.30 77 a) Any effort to provide extra help is worthwhile.
15 b) The help available in this course reduces my anxiety about grades (even though I may not have used it).
5 c) More effort and resources should be devoted to programs aimed at students who do well.

14. SPECIAL ASSISTANCE II
My feelings about the extra help in this course compared to other courses offering extra help is that:

1.42 70 a) the program in this course is much more valuable
20 b) the program in this course is a bit more valuable
9 c) the program in this course is no better/worse than in other courses
1 d) the program in this course is less valuable

PART III · rapport (consider the class only)

| $\bar{X}$ | % | |
|---|---|---|
| | | 15. Rate student-teacher rapport in this course |
| 2.32 | 24 | a) excellent |
| | 35 | b) good |
| | 31 | c) fair |
| | 10 | d) poor |
| | | 16. Rate student-student rapport in this course |
| 2.00 | 19 | a) excellent |
| | 60 | b) good |
| | 19 | c) fair |
| | 1 | d) poor |
| | | 17. Rate the availability of the instructor |
| 1.93 | 58 | a) easy to reach/meet with |
| | 17 | b) sometimes unavailable |
| | 3 | c) difficult to reach/meet with |
| | 21 | d) because of the extra help, I didn't feel the need to contact the instructor often (or at all). |
| | | 18. Did the instructor seem approachable, that is, did you feel comfortable talking with him, asking questions, etc? |
| 2.54 | 23 | a) extremely approachable |
| | 37 | b) very approachable |
| | 34 | c) some what approachable |
| | 7 | d) not at all approachable |
| | | 19. Did the instructor seem interested in his students, their progress, and their problems? |
| 2.44 | 22 | a) extremely interested |
| | 28 | b) very interested |
| | 39 | c) some what interested |
| | 10 | d) not at all interested |

PART IV general questions

| | | |
|---|---|---|
| | | 20. Did the presence of the television equipment inconvenience you or cause any anxiety? |
| Filgo only (10:151) | 100 | a) yes<br>b) no |
| | | 21. Did you ask questions in class? |
| 2.35 | 12 | a) often |
| | 42 | b) sometimes |
| | 46 | c) rarely |
| | | 22. Did the fact that extra help was available change your question asking habits? |
| 1.73 | 33 | a) yes |
| | 64 | b) no |
| | | 23. If yes, how? |
| 1.17 | 83 | a) fewer questions |
| | 17 | b) more questions |

MATH LAB EVALUATION (fill in if you ever used the math lab for any reason)

PART I general questions

| $\bar{X}$ | % | | |
|---|---|---|---|
| | | 24. | About how many times did you use the math lab? |
| 1.87 | 45 | a) | 1-3 |
| | 30 | b) | 4-8 |
| | 17 | c) | 9-13 |
| | 8 | d) | 14+ |
| | | 25. | Why did you most often use the math lab? |
| 2.42 | 21 | a) | to review classes |
| | 48 | b) | to study for tests |
| | 17 | c) | to study for retests |
| | 23 | d) | to seek additional information on any topic(s) |
| | | 26. | What methods/materials did you most often use? |
| 1.66 | 72 | a) | instruction by tutor |
| | 13 | b) | tutor and videotape instruction |
| | 0 | c) | videotape alone |
| | 8 | d) | additional materials (including problems) |
| | 8 | e) | student study group |
| | | 27. | What is your general estimate of the value of the math lab? |
| 1.32 | 75 | a) | extremely valuable |
| | 19 | b) | very valuable |
| | 4 | c) | somewhat valuable |
| | 2 | d) | not at all valuable |
| | | 28. | What is the value of the videotape/tutor method used in the math lab? |
| 2.28 | 28 | a) | extremely valuable |
| | 28 | b) | very valuable |
| | 34 | c) | somewhat valuable |
| | 11 | d) | not at all valuable |
| | | 29. | What is the value of the videotape without the tutor? |
| 3.18 | 2 | a) | extremely valuable |
| | 7 | b) | very valuable |
| | 61 | c) | some what valuable |
| | 30 | d) | not at all valuable |

PART II the tutor

| | | | |
|---|---|---|---|
| | | 30. | Did the tutor establish a non-threatening (helping) relationship in the math lab? |
| 1.17 | 85 | a) | very much so |
| | 13 | b) | to some degree |
| | 2 | c) | not very much |
| | | d) | was very authoritative and threatening |
| | | 31. | Did the tutor seem to have a solid knowledge of the subject |
| 1.10 | 90 | a) | very knowledgeable |
| | 10 | b) | somewhat knowledgeable |
| | 0 | c) | not very knowledgeable |

32. Did the tutor explain clearly and precisely ?

1.26
77 a) almost always
19 b) often
4 c) sometimes
0 d) rarely

33. Did the tutor use the resources available (that is TV, materials, etc.) or simply lecture?

2.42
32 a) used resources often
28 b) used resources occasionally
6 c) used resources rarely
34 d) most often lectured

34. Was the tutor able to understand your question or problem?

1.28
75 a) almost always
21 b) often
4 c) occasionally
0 d) rarely

35. Was the tutor able to help you solve your problem or answer your questions?

1.30
75 a) almost always
19 b) often
6 c) occasionally
0 d) rarely

36. Did the tutor tie in math lab instruction and activities to class instruction and activities?

1.44
64 a) almost always
30 b) often
4 c) occasionally
2 d) rarely

PART III administration

37. Did you resent efforts made to get you to use the math lab

2.83
0 a) very much
18 b) a bit
82 c) I had no such feelings

38. Would you specify your reasons for not using the math lab (if there were indication that you needed help).

1.90
32 a) I usually work out my own problems
55 b) I had no time
6 c) I didn't like the tutor
3 d) I didn't like being pressured
3 e) other (please list)

39. Do you consider that the math lab:

2.04
21 a) kept you from failing
55 b) helped you raise your grade
21 c) made little difference to your performance

COMBINED DATA OF NON-TVI CLASSES

10:151

note: mean scores and distributions of scores are presented for all items .... on those items in which the mean score is underlined, the distribution of scores is the more accurate representation of the data

CALCULUS ..... COURSE EVALUATION

PART I instruction

| $\bar{X}$ | % | |
|---|---|---|
| | | 1. PACING (amount of material covered in relation to time available) |
| 1.89 | 12 | a) too much material and not enough time |
| | 87 | b) adequate time devoted to each topic |
| | 1 | c) too much time devoted to each topic |
| | | 2. CLARITY OF EXPLANATIONS |
| 1.814 | 31 | a) instructor explained clearly and precisely |
| | 57 | b) explanations were generally clear |
| | 10 | c) explanations were sometimes confusing and difficult to follow |
| | 1 | d) explanations were often unclear and confusing |
| | | 3. QUALITY OF PRESENTATION (your instructor's ability as a speaker) |
| 2.081 | 19 | a) extremely good |
| | 56 | b) very good |
| | 24 | c) acceptable |
| | 1 | d) poor |
| | | 4. OUTLINING MATERIAL (providing organization and indicating directions & emphasis) |
| 1.524 | 52 | a) topics were clearly outlined. I knew what to expect from each lecture. |
| | 43 | b) topics followed an outlined sequence but I was unsure of their relationships and emphasis until the lectures were finished |
| | 5 | c) outlines were rarely provided. I had no idea of where we were going or how things fit together. |
| | | 5. OBJECTIVES (statements of what you would have to be able to know or do at the end of the class/course) |
| 1.637 | 52 | a) objectives were usually stated |
| | 31 | b) objectives were occasionally stated |
| | 16 | c) objectives were rarely stated |
| | 0 | d) objectives were stated but were unclear or unexplained |
| | | 6. NOTE TAKING |
| 1.774 | 68 | a) I was able to take notes easily and attend to the lecture as well. |
| | 6 | b) I had to take notes so furiously that I missed parts of the lecture. |
| | 7 | c) I had a difficult time taking notes because I didn't know what to stress. |
| | 18 | d) I rarely take notes so the above don't apply. |
| | | 7. Were the relationships and applications of calculus to engineering made clear to you? |
| 1.835 | 31 | a) regularly |
| | 58 | b) sometimes |
| | 9 | c) rarely |
| | 2 | d) this is not important to me |

PART II course design

8. CONTENT (The difficulty of the subject as taught.)

| $\bar{X}$ | % | |
|---|---|---|
| 3.012 | 3 | a) much more difficult than most other courses I have taken |
| | 20 | b) somewhat more difficult ... |
| | 49 | c) about as difficult as most... |
| | 28 | d) less difficult... |

9. AMOUNT OF WORK (assignments...time spent studying.)

| | | |
|---|---|---|
| 2.895 | 1 | a) much more work than most other courses I have taken |
| | 27 | b) somewhat more .... |
| | 53 | c) about as much work as most... |
| | 18 | d) less work than most... |

10. TESTS ( tests taken so far)
Choose the item below which best matcnes your feelings about tests:

| | | |
|---|---|---|
| 1.163 | 85 | a) level of difficulty was OK and the tests covered what we were taught |
| | 14 | b) tests covered what we were taught but were too long or too hard |
| | 1 | c) tests did not cover what we were taught |

PART III rapport (relationships with other people)

11. Rate student-teacher rapport in this course

| | | |
|---|---|---|
| 1.788 | 36 | a) excellent |
| | 53 | b) good |
| | 6 | c) fair |
| | 5 | d) poor |

12. Rate student-student rapport in this course

| | | |
|---|---|---|
| 2.185 | 15 | a) excellent |
| | 54 | b) good |
| | 28 | c) fair |
| | 2 | d) poor |

13. Rate the availability of the instructor

| | | |
|---|---|---|
| 2.512 | 39 | a) easy to reach/meet with |
| | 14 | b) sometimes unavailable |
| | 2 | c) difficult to reach/meet with |
| | 44 | d) I didn't feel the need to contact the instructor often. |

14. Did the instructor seem approachable, that is, did you feel comfortable talking with him, asking questions, etc?

| | | |
|---|---|---|
| 1.869 | 37 | a) extremely approachable |
| | 40 | b) very approachable |
| | 21 | c) somewhat approachable |
| | 1 | d) not at all approachable |

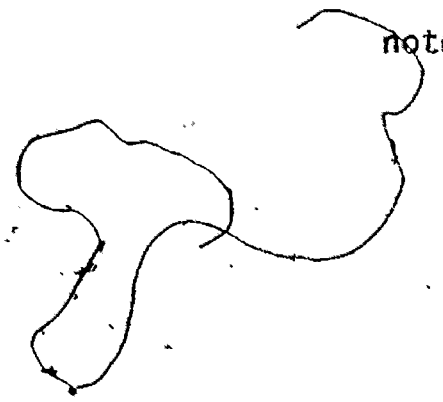
15. Did the instructor seem interested in his students, their progress, and their problems?

| | | |
|---|---|---|
| 1.821 | 32 | a) extremely interested |
| | 54 | b) very interested |
| | 14 | c) somewhat interested |
| | 0 | d) not at all interested |

COURSE

SURVEY

10:152



note: mean scores, deviations, and distributions of scores are presented for all items .... on those items in which the mean score is underlined, the distribution of scores is the more accurate representation of data

# COURSE EVALUATION ... CALCULUS 10:152

CALCULUS ..... COURSE EVALUATION

PART I instruction

| $\bar{x}$ | SD | % | |
|---|---|---|---|
| | | | 1. PACING (amount of material covered in relation to time available) |
| | | 12 | a) too much material and not enough time |
| 2.41 | 1.0 | 59 | b) adequate time devoted to each topic |
| | | 6 | c) too much time devoted to each topic |
| | | 24 | d) pacing OK because the math lab was available...otherwise, 'a)' above |
| | | | 2. CLARITY OF EXPLANATIONS (your instructor only ...not your tutor) |
| | | 65 | a) instructor explained clearly and precisely |
| 1.35 | .49 | 35 | b) explanations were generally clear |
| | | — | c) explanations were sometimes confusing and difficult to follow |
| | | -- | d) explanations were often unclear and confusing |
| | | | 3. QUALITY OF PRESENTATION (your instructor's ability as a speaker) |
| | | 71 | a) extremely good |
| | | 24 | b) very good |
| 1.35 | .60 | 6 | c) acceptable |
| | | — | d). poor |
| | | | 4. OUTLINING MATERIAL (providing organization and indicating directions & emphasis) . |
| | | 41 | a) topics were clearly outlined. I knew what to expect from each lecture. |
| 1.70 | .68 | 47 | b) topics followed an outlined sequence but I was unsure of their relationshi and emphasis until the lectures were finished |
| | | 12 | c) outlines were rarely provided. I had no idea of where we were going or how things fit together. |
| | | | 5. OBJECTIVES (statements of what you would have to be able to know or do at the end of the class/course) |
| | | 59 | a) objectives were usually stated |
| 1.47 | .62 | 35 | b) objectives were occasionally stated |
| | | 6 | c) objectives were rarely stated |
| | | — | d) objectives were stated but were unclear or unexplained |
| | | | 6. NOTE TAKING |
| | | 88 | a) I was able to take notes easily and attend to the lecture as well. |
| | | 6 | b) I had to take notes so furiously that I missed parts of the lecture. |
| 1.23 | .75 | -- | c) I had a difficult time taking notes because I didn't know what to stress. |
| | | 6 | d) I rarely take notes so the above don't apply. |
| | | -- | e) My note taking habits changed because I had additional resources (math lab; videotapes; tutor; etc.) |
| | | | 7. Were the relationships and applications of calculus to engineering made clear you? |
| | | 35 | a) regularly |
| | | 59 | b) sometimes |
| | | 6 | c) rarely |
| 1.78 | .58 | — | d) this is not important to me |

PART II course design

| $\bar{x}$ | SD | % | |
|---|---|---|---|
| | | | 8. CONTENT (The difficulty of the subject as taught...do not consider the additional assistance when answering) |
| | | — | a) much more difficult than most other courses I have taken |
| 3.0 | .61 | 18 | b) somewhat more difficult ... |
| | | 65 | c) about as difficult as most... |
| | | 18 | d) less difficult... |
| | | | 9. AMOUNT OF WORK (assignments...time spent studying...include math lab time) |
| | | 12 | a) much more work than most other courses I have taken |
| 2.76 | .97 | 24 | b) somewhat more ... |
| | | 41 | c) about as much work as most... |
| | | 24 | d) less work than most... |
| | | | 10. TESTS tests taken so far) |
| | | | Choose the item below which best matches your feelings about tests: |
| | | 82 | a) level of difficulty was OK and the tests covered what we were taught |
| 1.76 | .39 | 18 | b) tests covered what we were taught but were too long or too hard |
| | | — | c) tests did not cover what we were taught |
| | | | 11. RETESTING I |
| | | | Choose one of the following: |
| | | 65 | a) I felt less anxious than usual about tests because I knew I would have a second chance. |
| 1.35 | .493 | 35 | b) The fact that retesting was possible did not lessen my anxiety about testing. |
| | | | 12. RETESTING II |
| | | | Did you ever skip a test because you were not ready and you knew you could take a retest? |
| | | 29 | a) once |
| 2.53 | .93 | 6 | b) more than once |
| | | 65 | c) never |
| | | | 13. SPECIAL ASSISTANCE I (whether you used it or not) |
| | | | Choose the statement below which best matches your feelings about the special assistance available with this course. |
| | | 59 | a) Any effort to provide extra help is worthwhile. |
| .47 | .62 | 36 | b) The help available in this course reduces my anxiety about grades (even though I may not have used it). |
| | | 1 | c) More effort and resources should be devoted to programs aimed at students who do well. |
| | | | 14. SPECIAL ASSISTANCE II |
| | | | My feelings about the extra help in this course compared to other courses offering extra help is that: |
| | | 53 | a) the program in this course is much more valuable |
| .58 | .71 | 35 | b) the program in this course is a bit more valuable |
| | | 12 | c) the program in this course is no better/worse than in other courses |
| | | — | d) the program in this course is less valuable |

PART III rapport (consider the class only)

| $\bar{x}$ | SD | % | |
|---|---|---|---|
| | | | 15. Rate student-teacher rapport in this course |
| 1.70 | .68 | 41 | a) excellent |
| | | 47 | b) good |
| | | 12 | c) fair |
| | | — | d) poor |
| | | | 16. Rate student-student rapport in this course |
| 2.0 | .70 | 24 | a) excellent |
| | | 53 | b) good |
| | | 24 | c) fair |
| | | — | d) poor |
| | | | 17. Rate the availability of the instructor |
| 1.81 | 1.32 | 69 | a) easy to reach/meet with |
| | | 6 | b) sometimes unavailable |
| | | — | c) difficult to reach/meet with |
| | | 25 | d) because of the extra help, I didn't feel the need to contact the instructor often (or at all). |
| | | | 18. Did the instructor seem approachable, that is, did you feel comfortable talking with him, asking questions, etc? |
| 1.58 | .79 | 59 | a) extremely approachable |
| | | 24 | b) very approachable |
| | | 18 | c) some what approachable |
| | | — | d) not at all approachable |
| | | | 19. Did the instructor seem interested in his students, their progress, and their problems? |
| 1.64 | .49 | 35 | a) extremely interested |
| | | 65 | b) very interested |
| | | — | c) some what interested |
| | | — | d) not at all interested |

PART IV general questions

| | | | |
|---|---|---|---|
| | | | 20. Did the presence of the television equipment inconvenience you or cause any anxiety? |
| 2.0 | 0 | — | a) yes |
| | | 100 | b) no |
| | | | 21. Did you ask questions in class? |
| 2.41 | .61 | 6 | a) often |
| | | 47 | b) sometimes |
| | | 47 | c) rarely |
| | | | 22. Did the fact that extra help was available change your question asking habits? |
| 1.70 | .47 | 29 | a) yes |
| | | 71 | b) no |
| | | | 23. If yes, how? |
| 1.0 | 0 | 100 | a) fewer questions |
| | | — | b) more questions (n=5) |

MATH LAB EVALUATION (fill in if you ever used the math lab for any reason)

PART I general questions

| $\bar{x}$ | SD | |
|---|---|---|
| | | 24. About how many times did you use the math lab? |
| 1.57 | .57 | 57 a) 1-3 |
| | | 29 b) 4-8 |
| | | 14 c) 9-13 |
| | | — d) 14+ |
| | | 25. Why did you most often use the math lab? |
| 2.35 | .74 | 14a) to review classes |
| | | 36b) to study for tests |
| | | 50c) to study for retests |
| | | —d) to seek additional information on any topic(s) |
| | | 26. What methods/materials did you most often use? |
| .57 | .93 | 64a) instruction by tutor |
| | | 21b) tutor and videotape instruction |
| | | 7c) videotape alone |
| | | 7d) additional materials (including problems) |
| | | —e) student study group |
| | | 27. What is your general estimate of the value of the math lab? |
| .64 | .74 | 50a) extremely valuable |
| | | 36b) very valuable |
| | | 14c) somewhat valuable |
| | | —d) not at all valuable |
| | | 28. What is the value of the videotape/tutor method used in the math lab? |
| .64 | .74 | 50a) extremely valuable |
| | | 36b) very valuable |
| | | 14c) somewhat valuable |
| | | —d) not at all valuable |
| | | 29. What is the value of the videotape without the tutor? |
| 2.57 | .93 | 21a) extremely valuable |
| | | 7b) very valuable |
| | | 64c) some what valuable |
| | | 7d) not at all valuable |

PART II the tutor

| | | |
|---|---|---|
| | | 30. Did the tutor establish a non-threatening (helping) relationship in the math lab? |
| .14 | .36 | 86a) very much so |
| | | 14b) to some degree |
| | | —c) not very much |
| | | —d) was very authoritative and threatening |
| | | 31. Did the tutor seem to have a solid knowledge of the subject |
| .07 | .26 | 93a) very knowledgeable |
| | | 7b) somewhat knowledgeable |
| | | —c) not very knowledgeable |

| $\bar{x}$ | SD | % | |
|---|---|---|---|
| | | | 32. Did the tutor explain clearly and precisely ? |
| | | 64 | a) almost always |
| 1.35 | .49 | 36 | b) often |
| | | — | c) sometimes |
| | | — | d) rarely |
| | | | 33. Did the tutor use the resources available (that is TV, materials, etc.) or simply lecture? |
| | | 62 | a) used resources often |
| 1.84 | 1.21 | 8 | b) used resources occasionally |
| | | 15 | c) used resources rarely |
| | | 15 | d) most often lectured |
| | | | 34. Was the tutor able to understand your question or problem? |
| | | 85 | a) almost always |
| 1.15 | .37 | 15 | b) often |
| | | — | c) occasionally |
| | | — | d) rarely |
| | | | 35. Was the tutor able to help you solve your problem or answer your questions? |
| | | 92 | a) almost always |
| 1.07 | .277 | 8 | b) often |
| | | — | c) occasionally |
| | | — | d) rarely |
| | | | 36. Did the tutor tie in math lab instruction and activities to class instruction and activities? |
| | | 77 | a) almost always |
| 1.46 | .96 | 8 | b) often |
| | | 8 | c) occasionally |
| | | 8 | d) rarely |

PART III administration

| | | | |
|---|---|---|---|
| | | | 37. Did you resent efforts made to get you to use the math lab |
| | | 14 | a) very much |
| 2.57 | .75 | 14 | b) a bit |
| | | 71 | c) I had no such feelings |
| | | | 38. Would you specify your reasons for not using the math lab (if there were indication that you needed help). |
| | | 36 | a) I usually work out my own problems |
| | | 55 | b) I had no time |
| 1.90 | 1.13 | — | c) I didn't like the tutor |
| | | — | d) I didn't like being pressured |
| | | 9 | e) other (please list) |
| | | | 39. Do you consider that the math lab: |
| | | 14 | a) kept you from failing |
| 2.14 | .66 | 57 | b) helped you raise your grade |
| | | 29 | c) made little difference to your performance |

CALCULUS 10:150 – 10:152

TEST - RETEST - GRADE

RESULTS

## PERFORMANCE OF SELECTED STUDENTS IN CALCULUS 10:150

| DT | CT | 80 T1 | 80 R1 | 60 T2 | 60 R2 | 60 T3 | 60 R3 | 120 T4 | 120 R4 | FIN | GRADE |
|---|---|---|---|---|---|---|---|---|---|---|---|
| 53 | 13 | 63B- | | 55A | | 57A | | ● 93.5B- | 94B | 84.5C | B |
| 52 | 18 | 73A- | | 33.5D | 32D | ● 26.5F+ | 41.5C | ● 58D- | 56.5D | 58F | D |
| 33 | 12 ● | 59C+ | 67B | | 48B | 57A | | ● 53.5F+ | 74.5C- | 74D | C+ |
| 35 | 16 ● | 52C- | 62B- ● | 30D- | 45.5B- | ● 19G+ | 38C- | ▽ 60D- | 54.5F+ | 68D- | C- |
| 24 | 10 | 67B | ● | 35.5D | 45B- | ● 36.5C | 46B- | ▽ 76C- | 71D+ | 77.5D+ | C |
| 46 | 22 | 67B | | 47.5B | | 49.5B | | ● 73C- | 83.5C+ | 87.5C | B |

● = increase in grade

▽ = decrease in grade

DT = diagnostic test
CT = calculus pre-test
T1 = test 1; R1 = retest 1; etc.
FIN = final exam

| | 1 | 1R | 2 | 2R | 3 | 3R | 4 | 4R | FINAL | COURSE |
|---|---|---|---|---|---|---|---|---|---|---|
| 1. | 49D- | ▲88A+ | 30D+ | ▲43.5B+ | 39.5B | | 31.5C+ | ➚30.5C+ | 87B+ | B |
| 2. | 60C- | ▲81.5A- | 27D- | ▲40.5B | 33C | ▼37.5C- | | 24D | 67.5C | C |
| 3. | 62C- | | | 27.5D | 15G | 32C- | 26.5D+ | ▲31.5C+ | 69C | C |
| 4. | 75B | | | 40.5B | 30D+ | 42.5B+ | | 26.5C | 72C+ | B |
| 5. | 90A+ | | 39.5B- | ▲48A | 49.5Z+ | | 35.5B | ▲38B+ | 96A | A |
| 6. | 72.5B- | ▲75B | 18G+ | ▲34C | 31.5C- | | | 12G+ | 67C | C |
| 7. | 90A+ | | 37C+ | ▲50A+ | 42B+ | | 36.5B | ▼28.5C | 95A | A |
| 8. | 69.5C+ | ▲79B+ | 42.5A+ | | 43B+ | | 32C+ | | 79B- | B |
| 9. | 82A- | | 30D+ | ▲40.5B | | 42B+ | | 18.5F+ | 76B- | B |
| 10. | 66C+ | ▲85.5A | 44A- | 46A | 40.5B | 47A | 37B | ▼25D+ | 93A- | A |
| 11. | 72B- | ▲71.5B- | 32C- | 42.5B+ | 37C+ | 44A- | 19.5F+ | ➚18F+ | 86.5B+ | B |
| 12. | 74B | 76B | 76B | | 30.5D+ | ▼25.5D- | 29.5C | | 50.5D- | C |
| 13. | 70B- | | 38B- | | 37C+ | ▲47A | 38B+ | | 69.5C | B |
| 14. | 83A- | ▼77.5B+ | 37C+ | ▼33.5C | 46.5A | | 26.5D+ | ▲27.5C | 89B+ | B |
| 15. | 64C | ▲72.5B- | 30D+ | ▲43B+ | 34C | ▲41.5B | 36B | ▼26.5C- | 89B+ | B |
| 16. | 72.5B- | | 41 | | | 19F- | 16F | ▲22D | 56D | D |
| 17. | | 61C- | 17.5G+ | ▲26.5D- | | 31C- | 25D+ | 21.5D- | 51.5D- | D |
| 18. | 52D | ▲57D+ | 27F | ▲32C | 31.5C- | | | 17F | 44F+ | D |
| 19. | 66.5D+ | ▲69C+ | 30.5D+ | ▲34.5C | 20F | ▲30D+ | 15F- | ▲25D+ | 53.5D | C |
| 20. | | 67.5C+ | | 46A | 22F | ▲36C+ | | 22D | 70C | C |
| 21. | | 80A+ | | 45A- | 45.5A- | | | 33B- | 95.5A | A |
| 22. | 41.5F | ▲62.5C | 17G+ | ▲30.5D+ | 31C- | ▲35C | 28.5C- | ➚27C- | 64C- | C |
| 23. | 78B+ | | | 23.5F | | | | withdr. 12/4/78 | | |
| 24. | 41.5F | ▲70.5B- | 25.5D- | ▲44A- | 32C- | ▲40B | 26D+ | ▲27C- | 85.5B+ | B |
| 25. | 65.5C | ▼53D | 41B | | 39B- | | | 30.5C | 65.5C- | C |
| 26. | 36G+ | | | | | | | | | |
| 27. | | 77.5B+ | 37.5B- | ▲42B+ | 36C+ | | 31C | ➚30C | 84B | B |
| 28. | | 84A | 37.5C+ | ▲46.5A | 49.5A | | 41.5A- | | 100A+ | A |

CALCULUS 10:150 test / retest results

increase = 38 decrease = 8 no change = 3

1 = test 1; 1R = retest 1; etc.
arrows indicate direction of
retest results

| | 1 | 1R | 2 | 2R | 3 | 3R | 4 | 4R | 5 | 5R | Final | Course |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| 1. | 65.5B | ▲76 A | 31.5D | ▲44.5A- | 36.5C+ | - | 67B- | ▲76A | 39.5C+ | 38 ►C+ | 89A | A |
| 2. | 67 B+ | ▲80 A+ | 39.5B- | - | 37.5B- | ▼35.5C+ | 69B ►64B | | 8 H | ▲44 B | 65C- | B |
| 3. | 68.5B- | - | 46.5A | ▼22 F- | 41 B | ▲43 B+ | 74B+ | - | 50.5A | - | 89A- | A |
| 4. | 34 F | ▲57.5C+ | 15 G- | ►15 G- | 19.5F- | ▲30.5D+ | 59C | ▼45D | 12 H+ | ▲38.5C+ | 46F | D |
| 5. | 56 C | ▲73 A- | 47.5A | - | 20.5 F | ▲44 A- | - | 40F+ | 17 G+ | ▲29.5D | 59D | C |
| 6. | 39 F+ | ▲55.5C | 13 H+ | ▲21 F- | 0 i- | ▲22.5F+ | 20H ►12H- | | 0 i- | 26 F+ | 26H+ | F |
| 7. | 21 G- | ▲52.5C- | 11.5H | - | 13.5G | - | 2i | - | - | withdrawn | 12/4/78 | W |
| 8. | 58.5C+ | - | 42 B | - | 35 C | - | 54C- | | 25.5F+ | ▲5.5B+ | 65C- | C |
| 9. | 65 B | ▲66.5B+ | 40 B- | ▲46 A- | 40 B | ▲45.5A- | 83A+ | - | 46.5B+ | ▲48 A- | 92A | A |
| 10. | 66 B | ▲73.5A | 37.5C+ | ▲50 A+ | 46.5A | - | 62C+ | ▲71B+ | 30.5D | ▲42.5B- | 87B+ | A |
| 11. | 59.5C+ | ►58 C+ | 26.5D- | ▲41.5B | 20.5F | ▲35.5C+ | ►26G | ▲67B- | 5 i+ | ▲41 B- | 55D- | C |
| 12. | 68 B+ | ▲75 A | 41 B | - | 34 C | ▲49 A+ | 78A- | - | 38.5C+ | ▲47.5A- | 73C+ | B |
| 13. | 57 C+ | ▲68.5B+ | 33 C- | ▲46 A- | 27 D | ▲36.5C+ | 51D+ | ▲66B- | 21.5F- | ▲45 B+ | 65C- | B |
| 14. | 60.5B- | ▲72.5A- | 43 B+ | - | 49.5A+ | - | 66B- | - | 44.5B+ | - | 90B | B |
| 15. | 64 B | ▲76.5A | 37 C+ | ▲47 A | 42.5B+ | ▲45 A- | 66B- | ▲80A | 46.5B+ | ▲53 A+ | 94A | A |
| 16. | 64 B | - | 29 D | ▲38.5B- | 25.5D- | ▲32.5C- | 52C+ | ▲66B- | 38.5C+ | - | 80B | B |
| 17. | 64 B | ▲66.5B+ | 28 D- | ▲50 A+ | 42 B+ | - | 65B- | ▲73B+ | 35 C- | ▲44.5B | 66C- | B |
| 18. | 38 F- | ▲63 B- | 29.5D | ▲47.5A | 25 D- | ▲34.5C | 25G | ▲59C | 10 H+ | ▲19 G+ | 52D- | C |
| 19. | 35.5F | ▲48 D+ | 32.5C- | ▲36 C | 29.5D+ | - | 22G | - | - | withdrawn | 12/4/78 | W |
| 20. | 43.5D | - | | 15.5G- | 9.5H+ | - | - | - | - | withdrawn | - | W |
| 21. | 57.5C+ | ▲68 B+ | 42 B | ►41.5B | 45.5A- | ▼42 B+ | 42D- | ▲77A- | 44.5B+ | ▲48.5A- | 85B+ | A |
| 22. | 72.5A- | ▲77.5A+ | 50 A+ | - | 47.5A | - | 77A- | ►78A- | 40 C+ | ▲55 A+ | 77B- | A |
| 23. | 60.5B- | | 30 D | ▲41 B | - | - | 29G+ | - | - | - | 56D | D |

CALCULUS 10: 151 test / retest results

increases = 64 decreases = 4

no change = 6

1 = test 1; 1R = retest 1; etc.
arrows indicate direction of
retest results

| TEST 1 | | RETEST 1 | TEST 2 | | RETEST 2 | TEST 3 | | RETEST 3 | TEST 4 | | RETEST 4 | FINAL | COURSE |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| A | > | A+ | C | > | B+ | A | | | | | | | W |
| D | > | B- | F- | > | D | H+ | > | F+ | D- | > | B+ | C | C |
| B | < | B- | D | > | B+ | D+ | > | B | B+ | | C | A | B |
| F- | > | B- | F | > | C | | | D+ | | | | F+ | C |
| | | C+ | C- | < | D- | | | B | A- | | | B+ | B |
| A | > | A+ | A+ | | | B+ | < | B | B+ | > | A- | A | A |
| C | | | | | G | D | > | C | C | O | C | C | C |
| B+ | | | C | > | A | A- | > | A | | | B | A | A |
| A+ | | | C- | > | B- | | | A- | A- | | | A+ | A |
| F+ | > | C | | | D- | F | > | C | D+ | > | B+ | C | C |
| | | B+ | C+ | | | B+ | > | A | C+ | | | B | B |
| A- | | | D- | > | A+ | D | > | C | B- | | | A | B |
| B | > | B+ | C- | > | D | C- | > | B+ | C- | O | C- | C+ | B |
| A+ | | | A+ | | | A- | > | A+ | A | | | excused | A |
| G+ | > | F- | | | | | | | | | | | W |
| A- | | | A+ | | | | | B- | B- | > | A- | B+ | B |
| B- | > | A- | A- | | | B | | | B- | | | A- | B |
| | | A- | A- | | | A- | | | D | > | B | | A |
| B | | | C | | | B- | | | C- | > | C | B- | B |
| B+ | | | | | C- | B- | > | B+ | | | B | B- | C |
| B | > | A | B+ | > | A- | B- | O | B- | B+ | O | B+ | B | B |
| A | | | A+ | | | A | | | C | | | A+ | A |
| F | > | C+ | F- | > | C | | | D | F | > | A- | D | C |
| A- | | | B+ | | | C- | | | B- | | | A- | B |
| A+ | | | A+ | | | A | | | A | | | A- | A |
| F | > | C+ | F- | > | C | | | D | F | > | A- | D | C |
| | | D | | | G | C- | > | A- | D+ | > | B- | B- | C |
| B+ | | | | | C- | D | > | B | B+ | > | A- | B+ | B |
| | | G- | | | C | | | F | G- | > | B- | | I |
| B- | > | A+ | C+ | > | B+ | C- | > | A | C | > | B+ | B | B |
| D | O | D | D | > | D+ | | | B | G | > | B | B- | B |

CALCULUS 10:152 TEST - RETEST RESULTS

INCREASES = > = 47 DECREASES = < = 4 SAME = O = 5

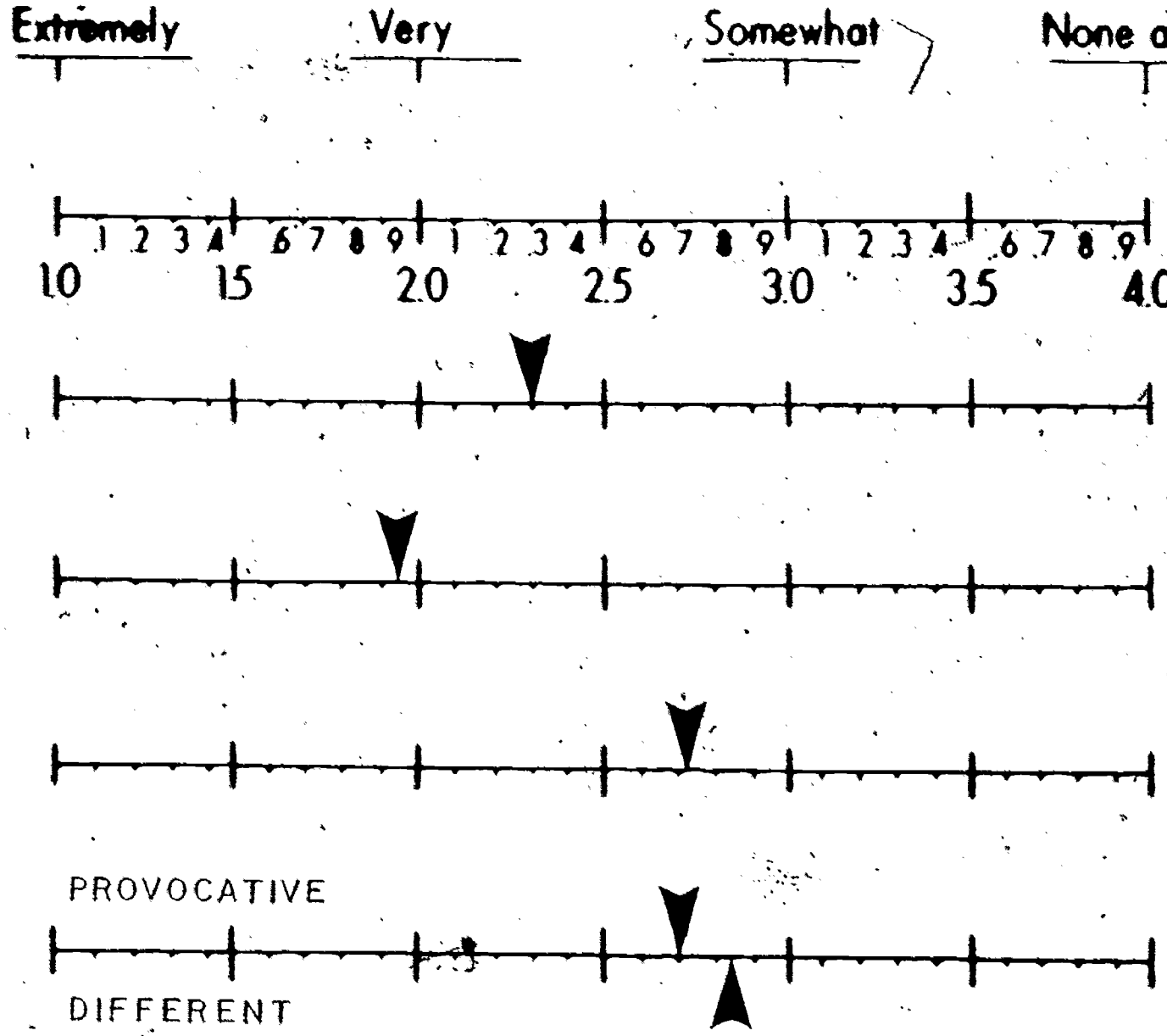
ADJECTIVE RATING SCALE
FACTOR STRUCTURE

10:150

FACTOR SYSTEM FOR NU ADJECTIVE RATING SCALE

| scale | item | scale mean | alpha |
|---|---|---|---|
| worth | | 1.935 | .944 |
| | informative | | |
| | enlightening | | |
| | good | | |
| | worthwhile | | |
| | necessary | | |
| | practical | | |
| | valuable | | |
| | rewarding | | |
| | relevant | | |
| | useless | | |
| | dull | | |
| | a waste | | |
| | boring | | |
| | irrelevant | | |
| cognitive appeal | | 2.30 | .754 |
| | interesting | | |
| | enjoyable | | |
| | exciting | | |
| | stimulating | | |
| difficulty | | 2.72 | .723 |
| | difficult | | |
| | demanding | | |
| | challenging | | |
| provocativeness | | 2.7 | |
| difference | | 2.83 | |

## ADJECTIVE RATING SCALE PROFILE




| | GROUP MEAN SCORE | ALPHA |
|---|---|---|
| COGNITIVE APPEAL (AFFECT) | 2.30 | .754 |
| WORTH | 1.93 | .944 |
| DIFFICULTY | 2.72 | .732 |
| OTHER | 2.70<br>2.83 | |

Course 10:150

Instructor FILGO

Date Collected 7/19

Group Size N = 24

COMBINED TVI AND NON-TVI

"ADJECTIVE RATING SCALE"

FACTOR STRUCTURE

10:151

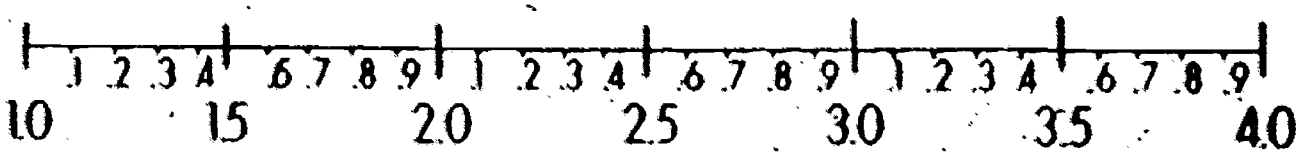
## ADJECTIVE RATING SCALE
## FACTORS(1)

| Scale I(Interest) | Scale II(Worth) | Scale III(Difficulty) |
|---|---|---|
| interesting | worthwhile | different |
| informative | practical | difficult |
| enlightening | valuable | demanding |
| enjoyable | relevant | challenging |
| exciting | useless | |
| stimulating | dull | |
| provocative | a waste | |
| good | boring | |
| rewarding | irrelevant | |
| alpha=.890 | alpha=.862 | alpha=.802 |
| $\overline{X}$=2.58 | $\overline{X}$=1.76 | $\overline{X}$=2.47 |

(1) N=111

# ADJECTIVE RATING SCALE PROFILE

Extremely — Very — Somewhat — None at all




| | $\bar{X}$ | alpha |
|---|---|---|
| worth | 1.76 | .862 |
| interest | 2.58 | .890 |
| difficulty | 2.47 | .802 |

Course combined tvi/no-tvi
Instructor all
Date Collected dec. 1978

Group Size 111

ADJECTIVE RATING SCALE

FACTOR STRUCTURE

10:152

## ADJECTIVE RATING SCALE FACTORS

(n = 31)

| SCALE | ITEM | SCALE MEAN | ALPHA |
|---|---|---|---|
| INTEREST/ AFFECT | INTERESTING | 2.40 | .784 |
| | ENJOYABLE | | |
| | EXCITING | | |
| | GOOD | | |
| | REWARDING | | |
| WORTH | INFORMATIVE | 1.81 | .863 |
| | WORTHWHILE | | |
| | NECESSARY | | |
| | PREATICAL | | |
| | VALUABLE | | |
| | RELEVANT | | |
| NEGATIVE ASPECTS | USELESS | 3.60 | .814 |
| | DULL | | |
| | A WASTE | | |
| | BORING | | |
| | IRRELEVANT | | |
| DIFFICULTY | DIFFICULT | 2.44 | .741 |
| | DEMANDING | | |
| | CHALLENGING | | |
| ____ | PROVOCATIVE | 3.11 | _ |
| | DIFFERENT | 2.47 | - |
| ____ | ENLIGHTENING | 2.52 | |
| | STIMULATING | 2.82 | - |

# ADJECTIVE RATING SCALE PROFILE

| | Extremely | Very | Somewhat | None at all | $\bar{X}$ | alpha |
|---|---|---|---|---|---|---|
| interest/ affect | 1.0 | 1.5 | 2.0 | 2.5 | 2.40 | .784 |
| worth | | | | | 1.81 | .863 |
| negative aspects | | | | | 3.60 | .814 |
| difficulty | | | | | 2.44 | .741 |
| other | | | | | — | — |

Course 10:152

Instructor Filgo

Date Collected _____

Group Size n = 31

COMPARATIVE RANKS OF ATTRIBUTION ITEMS

FOR 10:151 TVI,

10:151 NON-TVI, & 10:152

RANKS OF ATTRIBUTION ITEMS

| ITEM | 10:151 TVI RANK (n = 24) | 10:151 NON-TVI RANK (n = 87) | 10:152 RANK (n = 31) |
|---|---|---|---|
| subject difficulty | 3 | 5 | 3 |
| personal effort | 2 | 1 | 1 |
| the classroom | 12(10) | 10 | 12(10) |
| performance of other students | 11(9) | 9 | 9 |
| personal ability | 1 | 2 | 2 |
| course design (excluding extra assistance) | 5 | 6 | 4 |
| personal moods, physical condition etc. | 7 | 7 | 5 |
| available extra assistance (TVI) | 8 | 8 | 7 |
| luck | 13(11) | 11 | 13(11) |
| instructor personality | 6 | 4 | 8 |
| instructor teaching ability | 4 | 3 | 6 |
| tutor personality | 9 | - | 10 |
| tutor teaching ability | 10 | - | 11 |

Notes: items in parenthesis above are the adjusted ranks of those items .. that is, in the TVI and 10:152 lists, if the two items about tutors are removed then other item ranks increase as shown

GRADE DISTRIBUTIONS IN CALCULUS

10:150 - 10:152 FROM WINTER 1976

TO SPRING 1979

# CALCULUS 10:150 - 151 - 152

## % GRADES

| QUARTER | | COURSE | n | A | B | C | D | F | I/U |
|---|---|---|---|---|---|---|---|---|---|
| W | 76 | FB151 | 34 | 18 | 29 | 24 | 6 | 15 | 9 |
| SP | 77 | 151 | 180 | 13 | 18 | 27 | 14 | 14 | 13 |
| SUM | 77 | 150 | 33 | 18 | 15 | 21 | 12 | 19 | 10 |
| F | 77 | 150 | 585 | 27 | 25 | 24 | 12 | 8 | 10 |
| F | 77 | 151 | 70 | 14 | 24 | 21 | 20 | 7 | 13 |
| W | 78 | 150 | 144 | 27 | 11 | 16 | 13 | 23 | 11 |
| W | 78 | 151 | 527 | 24 | 25 | 24 | 13 | 6 | 9 |
| SP | 78 | 151 | 154 | 13 | 22 | 25 | 9 | 7 | 23 |
| SUM | 78 | F150 | 35 | 26 | 37 | 14 | 3 | 3 | 17 |
| F | 78 | 150 | 781 | 22 | 23 | 25 | 10 | 10 | 10 |
| F | 78 | F150 | 24 | 30 | 26 | 17 | 9 | 4 | 13 |
| F | 78 | 151 | 61 | 36 | 34 | 21 | 2 | 2 | 5 |
| F | 78 | F151 | 28 | 18 | 36 | 29 | 11 | 0 | 7 |
| SP | 79 | 150 | 19 | 5 | 32 | 26 | 16 | 5 | 6 |
| SP | 79 | 151 | 157 | 13 | 17 | 28 | 23 | 6 | 14 |
| SP | 79 | F152 | 31 | 19 | 42 | 26 | 0 | 0 | 12 |
| SP | 79 | 152 | 480 | 19 | 21 | 20 | 12 | 6 | 14 |

NOTE: Underlined items indicate Prof. Filgo's classes

The item listed first is a class co-taught by Prof. Filgo and Prof. Bridger in the winter 1976 quarter

The items which are not designated as Prof. Filgo's classes are the combined figures for all other classes/sections

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