R E P O R T   R E S U M E S

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A REPORT ON EXPERIMENTATION IN THE TEACHING OF THE FIRST COURSE IN ALGEBRA AT EL CAMINO COLLEGE.

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DESCRIPTORS- *JUNIOR COLLEGES, *MATHEMATICS INSTRUCTION, *PROGRAMED MATERIALS, *LARGE GROUP INSTRUCTION, *ALGEBRA, CLASS SIZE, INSTRUCTIONAL INNOVATION, EXPERIMENTAL TEACHING, EL CAMINO COLLEGE, CALIFORNIA,

AN INITIAL ATTEMPT TO EVALUATE PROGRAMED INSTRUCTIONAL MATERIAL IN ALGEBRA CLASSES LED TO FURTHER EXPERIMENTATION WITH A VARIETY OF PROCEDURES. IN 1964-65, NO SIGNIFICANT DIFFERENCES WERE FOUND IN THE PERCENT OF STUDENTS SUCCEEDING IN PROGRAMED AND CONVENTIONAL CLASSES, THOUGH STUDENTS IN PROGRAMED SECTIONS DID NOT SEEM MOTIVATED TO WORK AT THEIR OWN PACE TO COMPLETION OF THE COURSE. IN THE NEXT YEAR, USE OF LARGE CLASSES FOR PROGRAMED INSTRUCTION, WITH NO CHANGE IN AVAILABLE TEACHER TIME, SHOWED NO SIGNIFICANT DIFFERENCES IN THE PERCENT OF SUCCESSES, WITH GREATER MOTIVATION IN THE LARGE GROUPS, AND WITH MORE EFFECTIVE INSTRUCTION WHEN A VARIETY OF INSTRUCTIONAL EXPERIENCES WAS USED. DURING THE NEXT TWO YEARS, WITH LARGE GROUPS FOR PROGRAMED INSTRUCTION, A REDUCTION IN TEACHER TIME, AND AN INCREASE IN CLERICAL ASSISTANCE, (1) NO SIGNIFICANT CHANGES IN ACHIEVEMENT RESULTED, (2) A UNIFORM TESTING, EVALUATION, AND GRADING PROGRAM WAS ESTABLISHED, (3) A COMPLETE ITEM ANALYSIS WAS MADE FOR EACH TEST, AND (4) THE PROGRAM WAS SYSTEMATIZED TO A POINT WHERE INSTRUCTOR TIME COULD BE FURTHER REDUCED AND EVEN LARGER NUMBERS OF STUDENTS COULD BE ACCOMMODATED. (WO)

A Report on Experimentation in the Teaching of The First Course in Algebra at El Camino College

A Report Prepared for
Education 261D

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University of California, Los Angeles
School of Education

Henry Mansfield, Jr.
El Camino College
March 2, 1968

A Report on Experimentation in the Teaching of
The First Course in Algebra at El Camino College

Introduction

This is a report of experimentation in teaching remedial mathematics. While it started as a rather simple project designed to evaluate programmed instructional material, it has progressed through experimentation with large class instruction, team teaching, and the development of machine-scored multiple choice examinations with complete item analysis. It is thus not a single, isolated research project but a continuing effort by a group of ten to fifteen instructors directed toward the improvement of instruction. This effort has and will continue to examine many facets of the education process; ie. course objectives, student characteristics, teaching methods, course standards, testing methods and procedures, and grading practices.

Each teacher or team of teachers has operated in a somewhat unique manner, reported successful, unsuccessful and interesting results as well as suggest many directions for future experimentation.

Among the ideas for the future are:

1. Presentation of the course via closed-circuit or open-circuit television

2. To try to establish the existence of a relation

$$y = \sum_{i=1}^{n} a_i f_i(x_i)$$

   where the a_i are constants and at least one is not zero, the x_i are student or course characteristics, and y is the student's grade. Of course it is implicit that values of the parameters need to be determined. This is an application of the method of least squares or multiple curvilinear regression and factor analysis.

3. To attempt to determine if some students are uneducable (in mathematics) at this level. While this is basically an unsolvable problem, the direction of some thought in this direction may have valuable consequences.

While it would be desirable to include much additional information on such items as a philosophy for experimentation and research, it is felt that it is more desirable at this time to give a statement of the problem.

Purpose

The problem is essentially a simple but major problem in remedial courses at all junior colleges with an open-door policy. To be specific, a study of the grades of the students enrolled in the First Course in Algebra (which we call Mathematics A) over a five year period (about 8000 students) revealed that approximately 50% of the students withdrew before the end of the semester. Of those remaining, approximately 50% pass with a C or better grade (i.e. 25% of the students originally enrolled). Also, enrollment trends indicated that within a very short time this course could require from 40-50% of the total staff time assigned to mathematics instruction. Thus a large percentage of the load of a highly qualified staff was being used at 25% efficiency. The purpose of the study was therefore two-fold; (1) the improvement of instruction (or learning), and/or (2) effective use of instructor time.

Justification or Need for the Study

1. The low percentage of student success in the course

It was stated in the previous section that approximately 25% of the students originally enrolled achieve a "C" or better grade. The actual figures are:

Percent of original students achieving an A or B grade was 13.1%

Percent of original students achieving an A, B, or C grade was 30.0%

Percent of original students achieving an A, B, C or D grade was 46.4%

It should also be mentioned that unlike many similar courses in other junior colleges, this course has no prerequisites. This may account for differences in percentages which may exist in other junior colleges.

A reasonable criteria on which to evaluate this problem is that any student who is permitted to enroll in a course should have at least a 50% chance of success. However, regardless of the criteria any improvement in the percentages will result in significant savings in student time and educational expenses.

2. The improvement of instruction (learning)

This is certainly an objective of any experimentation in instruction. The achievement by a student of a "C" or better grade is defined to be the measure of instruction. Implicit in this of course is the statement of course objectives in measurable terms.

3. Between 75-90% of the students enrolled in the course had taken an equivalent course before and had either not succeeded or had forgotten much of what they knew. It was felt that perhaps a different approach might provide more motivation and a greater percentage of successful students.

4. The small penalty for the failure of experimentation at this level

While the significance of the possible results may warrant experimentation where the chances of success are small or where the penalties for failure are high, serious consideration should always be given to the impact of failure. If there is a choice, experimentation should be conducted where the penalties for failure are minimal.

5. To develop a philosophy on our obligation to students at this level under the open-door policy

Of the students who typically enroll in this course, 75-90% have had the same or an equivalent course at least once before. Since large numbers of students are involved it is expensive to allow each student several chances.

Do we adopt the position that each student should be entitled to one (or some other number) opportunity to pass the course or do we adopt the position that an uneducated person may soon be unemployable in our scientific society and therefore we not only provide the opportunity for learning but must be responsible for learning?

6. To find how to teach large numbers of students at this level

This course constitutes approximately 30% of the total assignment in the Mathematics Department and involves about 2000 students each year. We need to be concerned about the effectiveness and efficiency of instruction.

7. To find how to relieve a highly qualified staff from too much involvement at a remedial level and to more efficiently use their capabilities.

8. To investigate the appropriateness of programmed materials for remedial mathematics courses in the junior college.

9. To investigate the effects of variations in class size on the effectiveness of instruction.

10. To investigate the effects of team teaching on the effectiveness of instruction.

11. To investigate the application of a systems approach to the teaching of junior college mathematics.

Importance of the Problem

In addition to the items mentioned in the previous section, there have already been several results of importance to El Camino College. First it has been beneficial to the entire staff and staff morale in permitting a much larger percentage of time to be devoted to more personally rewarding instruction and in the challenge associated with experimentation. The staff attitude and particularly the effort and enthusiam displayed by the instructors involved in the project has been most rewarding. Another result has been the development of a uniform testing procedure and the consequent uniformity of course standards and grading practices. We thus guarantee each student that regardless of the section in which he enrolls, he will receive the same grade that he would have received if he had enrolled in any other section. This result, incidentally, has provided some insight into the relation between the time at which a class meets and the success of the student.

While not one of the objectives of the study, one of the important results has been a significant reduction in the per student cost for instruction in this course. Upon the recommendation of the teachers, the equivalent of two full time teachers was replaced with 40 hours per week of student help. The savings could have been larger except for space limitations of our present facilities. The staff has recommended further reductions, but we have deferred action on this. The present savings are at least $30,000 per year.

Perhaps more important than these local benefits is the fact that this problem is only one case of a general problem common to other mathematics courses, other subject areas and other junior colleges. The same results could be attained in most other fields if it was desired.

Criteria or Philosophy

This section of the report is quite lengthy and includes statements on many subjects. In addition to some rather imprecise statements on operating philosophy and procedures, it includes some objectives and criteria of programmed instruction and educational systems as well as some comments on the growing demands to educate more students at a reasonable cost.

Our operating philosophy and procedures can be summarized by the following:

1. If you have a problem and don't know how or in what direction to proceed, don't just sit there, do something! This usual advise for students is also valid for educational problems.

2. The purpose of research is not the collection of data but to provide insight into the problem and its possible solution or to suggest directions for further research.

3. Educational research is, like any research, an effort to acquire knowledge and to enlarge understanding.

4. It is hoped that the results of research will be capable of generalization and applicable to other areas or useful for prediction or extrapolation.

5. The place to experiment is the place when there is the least penalty for failure.

6. While some may feel that it is best to design an experiment with the assumption of a hypothesis and the use of one or more of the usual models for experimental design, rigid adherence to a format should not interfere with experimentation. One of the best methods to stifle instructor creativity is to ask them to write a description of their proposal or to experiment in a manner basically different from the one they propose. Faculty enthusiasm is a necessary ingredient and its value will outweigh many factors.

7. We in science education can no longer assume that the extent of our responsibility for learning is to provide the opportunity for an education. In our increasingly technological and scientific society, an uneducated person may soon be unemployable. We must assume a greater responsibility for both the opportunity to learn and that learning does occur.

Without defining educational programming or programmed learning, the following will list some of the objectives of linear (Skinner), branching (Crowder), or eclectic programming. It is assumed that most will be aware of studies verifying the claims, therefore some negative arguments will be presented here. They come largely from "Programed Learning and Mathematical Education" by K.O. May and "Systems Approaches to Curriculum and Instruction in the Open-Door College" by B. Lamar Johnson.

> One essential fact has been established without a doubt: Students do learn from programed materials. On the other hand, there is no conclusive evidence that students learn significantly more or with greater efficiency. ...
>
> (a) Do programed materials perform a tutorial function? ... programed materials lack the essential feature of the tutoring situation — the interaction of two human beings in all its intellectual and emotional complexity. ... We conclude that programed materials do not perform the tutorial function, though they may perform the drill sometimes done in the name of tutoring.

(b) Do programed materials provide for individual differences? ... The fact is that Skinner programing removes all individualization except in pacing. Crowder programing has a better claim to individualization because of branching, but the variety of paths is rather limited compared with that permitted by the usual text book. ... We conclude that programed materials (Skinner, Crowder, eclectic) are less adaptable to individual differences than are hybrid, problem, and Pressey programs.

When stressing the importance of self-pacing, programing enthusiasts seem to be contrasting the individual studying a program with the group listening to a lecture or studying together. A comparison with an individual studying a text and doing problems would be more appropriate. ... As long as the group pace is not too far from the average, learning is not significantly impeded. ... It appears that pacing is not a very important issue and that self-pacing has no necessary or unique connection with programed materials. ...

(c) Does programing provide greater control of the learning process? This claim is certainly justified. ... This has obvious advantages for research in the psychology of learning. It enables the programer to locate poor frames and to improve the program. It likewise helps the diagnostic work of the teacher. ... But it does not follow that it is best for the student. ... One of the goals of college mathematics is to teach the student to "work on his own"— to "write his own program" in the professional jargon. He will certainly not learn to do this if he is fed ideas intravenously drop by drop instead of having to get out and grub for them. ... We conclude that programed materials inhibit initiative, independence, and responsibility in the learning process, and do not contribute to the achievement of related educational objectives. ...

(d) Do programed materials provide greater motivation? ... Experience at the college level tells us that students have two prime drives in studying mathematics: their belief that mathematics will be useful to them, and the joy that comes from mathematical insight and accomplishment. ... We infer that programed materials cannot provide adequate motivation at the college level.

(e) Does programing lead to better specification of content and objectives? ... The potential of programing for improving content has not been realized.

(f) Are programed materials better designed to achieve their objectives? ... There is no convincing evidence that better design is a concomitant of programed materials.

(g) What is the importance of overt response? ... Pressey ... condensed a Skinner type program in psychology into an expository passage followed by a few multiple choice questions. The result was better learning and an 80% saving in study time (and paper!). ... One of the great disadvantages of excessive programing is that it enables the student to "succeed" without extensive or intensive thought. ...

(i) Does programing reduce educational costs? In certain situations in industry and the military, where teachers are lacking and goals narrowly defined, programed materials and teaching machines have accomplished tasks not otherwise possible. But in the typical college situation there is no indication that programed learning is more economical. ...

(j) Do programed materials save teacher time? ... There is no reason to think that programed materials will displace teachers. As supplements to text books they may, however, bring about shifts in the teacher's role by taking over some routine drill. ... (7)

In 1958, we started a project to explore programed-instruction technology. It appeared that existing programs provided for individual differences in rate of learning but did not provide for differences in the level of component skills of students during the course of instruction. A computer-based teaching machine was developed to provide for such individual differences. Students doing well would skip instructional segments while those having difficulty on a particular concept would be branched to remedial segments necessary to successful performance on the concept. Experience with this machine quickly revealed that its effect on learning depended mostly on the effectiveness of the instructional materials used by the machine. One study effort, in an attempt to design improved instructional materials, surveyed the research literature on learning and made a series of experimental comparisons. The most notable result of the formal hypothesis-testing activities was that no statistically significant differences among experimental treatments were obtained. Different sequencing procedures, cueing techniques, response modes, display formats, and reinforcement procedures had but limited effect. Variables suggested by different learning theories were manipulated but again with little practical impact on student learning. The formal hypothesis testing and the literature search were abondoned and popular, new, commercially produced, programmed instructional material was tried. Considerable publicity had been given this material as the latest in modern instructional technology. It also failed to produce its advertised objectives.

Finally a procedure was tried that did succeed. This consisted of a careful specification of learning objectives in behavioral and measurable form, followed by a succession of evaluation-revision cycles. Each defect in the instructional material was detected, the behavioral components involved were reanalyzed, and specific changes were made in the defective segment. Ideas for possible changes were obtained from interviews and individual tutorial sessions with students. Repeated evaluation-revision cycles were conducted until new students exposed to the materials consistently achieved the desired objectives. Thus the developing package of materials was continually improved in the direction of a given set of absolute objectives.

This technique is quite different from a one-time evaluative comparison of the first version of the new package with so-called "conventional" procedures ("conventional" is that used by the other school). The evaluation-revision cycle is more like the engineering process, where the development activity is followed through to the final stage of implementation, and is much more costly in time and effort than the one-shot comparative study. However, the engineering approach, which begins with system objectives and uses self-correction procedures, culminates in workable tools and procedures that are guaranteed to do certain specified things for the instructor, while the traditional comparative-assessment study seldom goes further than a research report having little impact on a classroom practice. The engineering approach implies a commitment to make a new product or procedure work, rather than merely making a single evaluation for the purpose of deciding whether or not to adopt it — almost all new developments fail on the first try.

> It has been pointed out that the educational system requires for its operation at least the following different actions: (a) selecting the learners, (b) choosing the objectives, (c) designing a program of learning experiences, (d) executing the plan, (e) assessing the results, and (f) comparing the accomplishments with the objectives for purposes of further optimization of the system. Furthermore, item (c), the devising of a plan or strategy, might be shown to require: (a) determining the characteristics of the learners, (b) mastering the relevant scientific knowledge, (c) identifying the available resources, and (d) accounting for applicable boundary conditions. ... (5)

Perhaps the most important reason for a philosophy of commitment to experimentation is contained in the statement

> It is becoming clear that the junior college will be called upon to assume sharply increasing responsibility as enrollments in higher education skyrocket during the years immediately ahead. Junior college enrollments now approach one and a quarter million and are expected to double, or even treble, within the next decade. This expansion will inevitably be accompanied by a demand for greater efficiency in all aspects of operations—an efficiency that will make it possible for junior colleges to offer high-quality instruction to unprecedented numbers of students at a cost commensurate with that which society is able and willing to pay. Taxpayers and private donors to higher education can be expected to insist upon getting the highest possible value for every dollar spent on colleges and universities. ...
>
> Society will not wait for any institution reluctant to change. ...
>
> In recent educational history there are clear warnings that when the problems of education are not solved within the system they are appealed to the public arena. When this happens the decision is ultimately in favor of the majority. In other words, "if the educators will not change education, the politician will." ... (6)

> Persistent use of the evaluation-revision cycle will eventually produce high-quality self-instructional materials that can be used to provide individualized instruction. ... (6)

The above quotation provides a good transition from programmed instruction to the systems approach.

The following excellent comments are from Effective Teaching and the Educational System by Harold Foecke in the October 1967 issue of the "Journal of Engineering Education."

> To begin by offering a definition, an educational system is a self-correcting activity in which a deliberate attempt is made to establish the conditions which seem most suitable, in the light of the relevant factors, for assisting one or more learners in achieving desired learning objectives. ...
>
> Learners differ widely in intellectual ability, maturity, motivation, age, sex, emotional health and stability, physical health and/or handicaps, vulnerability to "outside demands" (job, family, etc.), previous educational experience, previous work experience, etc. Considering the apparent disregard which some educators manifest for the individual differences among learners, it is worth pointing out that an educational system could hardly be expected to function optimally without a thorough knowledge of the characteristics of the learners. Just because educators do not fully understand all of the consequences of the observable differences among students does not mean that they can be ignored. ...
>
> It seems reasonable that any "theory of learning" must provide distinctions between fundamentally different kinds of things that can be learned, things which in lay language might be described as concepts, principles, skills (motor, mental, etc.), facts, attitudes, etc. ...

Description

For reasons listed earlier under justification, the experimentation began in a discussion in a department meeting during the spring of 1964. While they recognized that there was a problem, most of the staff of twenty did not want to participate in any study involving the teaching of this course. However, they did agree that if several wanted to experiment they should be allowed to do so. Thus our first attempts in the fall and spring of 1964-5 were to try programmed instruction in the normal classroom situation with four teachers involved in the experiment.

A study of the methods and results for 1964-5 and part of 1965-6 is contained in An Investigation of the Achievement of Students in Mathematics Classes Using Programmed Materials at El Camino College, a report by Sam Schauerman for a similar UCLA seminar. The material contained in that report will not be duplicated here.

The results for 1964-5 were: (1) There was no significant difference between the percentage of students who succeeded in the programmed sections and those in the conventional sections even though the tests used in the programmed sections were somewhat more difficult. Consideration was given to the idea of developing examinations which could be given to both the experimental and control sections. This was not done as the control sections were basically traditional mathematics and the experimental sections were modern mathematics. The programmed material used was that prepared by the School Mathematics Study Group (SMSG) and the results of their extensive research was available to us. (2) the students did not have enough self-motivation to proceed at their own pace and complete the work successfully.

Experiments during 1965-6 involved putting half of the total students enrolled in the course into sections of 120 students each, using the same programmed materials, and with an allotment of teacher time equal to what there would have been if the classes were all of the usual size (35). Our results were: (1) There was no significant difference between the success of these students and the others, (2) the students were better motivated in the larger sections than in the small sections which had used programmed texts, and (3) the use of a variety of instructional experiences was more successful than a single laboratory situation with the student using the programmed text.

During 1966-7 and 1967-8 all students in the course (approximately 1000 each semester) have been placed in classes of 100-120 with an instructor assignment of somewhat more than half of what it was before. This was upon the recommendation of the teaching staff. They are also given 40 hours per week of clerical staff time. The results were: (1) There was no significant difference between the success of these students and the others, (2) 150 errors have been found in the programmed text, (3) a uniform testing, evaluation, and grading program has been established, (4) a complete item analysis is made for each test, and (5) the program has been systematized to the place where the instructor time could be drastically reduced and thousands of students could be handled with very little extra effort. At this stage, the programmed text is an incidental and not an essential part of the program.

To provide a little more insight into the problem and our experimentation a memorandum is attached.

Directions for the Future

After a start which was a very small attempt to do something about a persistent problem, at this stage there seem to be two distinct directions which might be taken in the future. Attempts have been made to start in both directions.

The first is described somewhat in the attached memorandum and its attachment. It involves open-circuit television. Two statements define the feasibility of this approach.

1. If open-circuit television is going to be economically feasible as an instructional media, courses which are required by very large numbers of students should be presented.

2. Our method of teaching the First Course in Algebra has been systematized to the extent that, except for space limitations, thousands of students could be handled with very little extra effort or cost.

While some attempts have been made to start an inter-district feasibility study, some administrators in the southern California area feel that the first adventures of the junior colleges into open-circuit television should be with college level courses and not remedial instruction. This project has, therefore, temporarily stopped.

The second direction for the future is in the use of systems methods. As noted in an earlier section "The engineering approach implies a commitment to make a new product or procedure work, rather than making a single evaluation for the purpose of deciding whether or not to adopt it — almost all new developments fail on the first try."

Since an educational system could hardly be expected to function optimally without a thorough knowledge of the characteristics of the learners, the following research proposal is expected to give some insight into this area.

EL CAMINO COLLEGE
Inter-Office Memorandum

Subject: Teaching Mathematics A	Date: November 18, 1965

To: All Mathematics Instructors	From: Henry Mansfield, Jr.

I would like to devote the next department meeting to a discussion of what we should do about the teaching of Mathematics A.

The following is somewhat of a progress report and some of my opinions of the problem and what should be done. I hope they will provide some background for discussion.

If you have ideas which you would like to present to the group for consideration prior to the meeting, please let me know.

Background Information

1. Student Success

Over the past five year period, approximately 50% (comparison of first and last class counts) of the Mathematics A students have withdrawn before the end of the semester. Of those remaining, 50% pass with a C or better grade. For the regular (35) size classes using programmed instruction last year, there was a somewhat higher retention and, including those who continued and finished the course in the second semester, the two semester percentage of passing students was the same using either method.

2. Student Characteristics

For the Spring Semester of 1964-65 and the Fall Semester 1965-66, we have the following information:

Percentage by Declared Major

Year	Total No. of Students Responding	Phys.Sci. Math.Engr.	Nat.Sci.	T & I	Bus.	Soc.Sci.	Undecided or not Indicated	Other
S'65	413	9.9%	10.7%	6.3%	25.9%	12.8%	26.2%	8.2%
F'65	885	10.2%	16.3%	6.4%	22.0%	9.5%	32.5%	3.1%

Approximately 65% are from Business, Soc. Sci. and undecided fields.
Approximately 60% are enrolled in 9 or more units.
Approximately 70% work 21 or more hours/week.

3. Enrollment Data

For the past several years all of the sections of Mathematics A opened during registration were closed with a minimum of 38 students per section. The number of sections offered was limited so that the ultimate need for this course was not known. This fall an attempt was made to determine this need by keeping several sections open at all times during registration. However, after increasing the number of sections from 18 (the usual number for fall) to 27 and the enrollment from approximately 600 to over 900 with all sections still closed, the enrollment was restricted and the ultimate need has still not been determined.

4. Future Needs

For the future, if we are to provide for the needs of students at this level, we should have at least 30 sections for the fall of 1966, with 40 sections being perhaps a more realistic estimate. The staff involvement would be the equivalent of from 8 to 11 full time instructors or somewhere from 40 to 50% of the total staff time in mathematics.

Need for the Study

1. The low efficiency of student success
2. The improvement of instruction (learning) if possible
3. The low penalty for failure of experimentation at this level
4. To develop a philosophy on our obligations to students at this level under the "open-door" policy.
5. How to teach large numbers of students at this level
6. How to relieve a highly qualified staff from too much involvement at a remedial level and to make better use of their capabilities

Purpose and Criteria

The improvement of instruction and the effective use of instructor time should be the prime objectives of any study of this nature.

Results to Date

With regular sized classes last year, there was no significant difference between the programmed and traditional sections of Mathematics A.

In reviewing last years methods we have the following observations:

1. The students were given too much freedom. They were not self-reliant enough to be allowed to proceed at their own rate. More stringent requirements are being used this year (attachment 1).
2. The examinations in the programmed sections were too difficult last year. We were expecting higher levels of achievement than in the regular sections. This has been changed this year.

This year with the two large sections (120 students in each), stricter requirements for student work and attendance, easier machine scored examinations and a more experienced staff, there has been less of a drop-out and indications that more students will pass.

Recommendation

We would recommend that

1. insofar as possible (the availability of large rooms being a limitation) Mathematics A be taught in large sections (120-150 students)

2. two instructors be assigned 2 sections together with 8 units of load each. (roughly half the staff involvement as with small sections)

3. adequate clerical help be provided (A recommendation on this will be made by Mrs. Bodman, Mr. Ivens, and Mr. Schwartz)

4. Assignments should probably be made on a rotational basis with one experienced and one new instructor for each 2 sections, unless there are some who prefer to have these sections.

   If it were possible to teach all of Mathematics A this way, 4 day sections and 4 night sections should be sufficient. The assigned teacher time would be approximately 4 and approximately half of that normally assigned.

Implications for the Staff

1. The use of programmed instructional material is not very challenging or rewarding from a teaching standpoint, however, it is probably not any worse than teaching the large number of sections which would be required the other way (each instructor with half a load in Mathematics A).

2. I am sure there is some concern within the department as well as school-wide as to whether this will set a precedence for large size classes in other courses. I don't believe that any changes in the established instructional pattern should, or would, be made without adequate study. Within the division we have made two studies of this nature, both of which happened to lead to larger class sizes. One, Engineering 11, Engineering Orientation, in the fall semester, was for the convenience of instructors in allowing them to give one lecture instead of having to repeat it 4 or 5 times during a week. It also made it more convenient for the instructors to secure eminent guest lecturers. I believe this arrangement has the complete approval of the Engineering staff.

   With the two-fold objective of the study in Mathematics A,

   1. improvement of instruction (as measured by the percentage of students passing) and

   2. relief from the increasing numbers of students at a basically remedial level; we have not had too much success with the first but have a method where the results are at least as good and the staff obligations are about half as much.

3. Although teacher load has not been specifically mentioned, it is implicit in the recommendations that a section of 120, with adequate student help, is equivalent to a section of 35 taught in the traditional manner. This is based on the recommendations of Mrs. Bodman, Mr. Ivens, and Mr. Schwartz.

Other Alternatives

It has been suggested that another possible solution to this problem would be to not offer Mathematics A (and perhaps Mathematics B) at El Camino and to ask that they be taught in the Adult Education programs of our affiliated high school districts (it has been reported that they would be willing to do this under any conditions we would desire to impose).

I personally do not like this solution for the following reasons:

1. At the present time, Adult Education programs are not accredited (there are indications that this may be done within the next few years). Students enrolled in such courses, applying for admission to the University of California, certain state colleges and private schools, may find the credit not acceptable. Although we could cooperate in setting standards and verify the equivalence of these courses with our present courses, we would, in essence, be acting as an accreditation agency. This is not a function of the junior college and might lead us into an untenable position with relation to the high schools.

2. Historically, and under the Master Plan for Higher Education in California, the teaching of these courses is properly the function of the junior college and no other segment. We should provide this program, but the nature and extent of our obligations needs to be examined.

3. If we delegate this responsibility to the adult aschools, I feel we would just increase our problems at the Mathematics D, 25A level. We would not eliminate our problems but have them at a different level.

4. If this problem is to be solved, I would certainly rather rely on the quality and abilities of our staff to solve it.

Directions for the Future

Attachment II indicates at least one thought I have had on directions for future experimentation. I think the letter is not clear to the extent that by "participate with us in planning" I mean a feasibility study and possible implementation.

Concluding Comments

I anticipate that there may be some differences of opinion and some disagreement with the proposal. So far I haven't been able to think of any data or other evidence which would make the implementation of this recommendation detrimental to the interests of the students or the faculty. I hope that you will give this some critical thought, and if possible, present your ideas to me in writing so that we can distribute them to the staff for consideration prior to the meeting.

HM:ca

Attachment I

- copy -

Inter-Office Memorandum
EL CAMINO COLLEGE

To: Dr. Marsee Dr. Harless

From: Henry Mansfield, Jr.

Subject: Inter-district Coordination for Television Presentation of Mathematics A (Elementary Algebra)

Date: October 28, 1965

I recommend that we invite the Los Angeles junior colleges to participate with us in planning for television presentation of Elementary Algebra (our Mathematics A).

The attached report indicates some advances in TV presentation by Los Angeles County and Los Angeles City using Channel 28. I believe that Channel 28 is the proper facility for the program, and the coverage could be augmented by closed circuit video-tape presentations on several of the campuses.

For procedure I would suggest:

(1) Form a committee of representatives (in mathematics) from each of the Los Angeles junior colleges and El Camino College to make a feasibility study, determine the course content, and develop institutional and evaluation methods and procedures.

(2) Inform all of the other junior colleges, and in some cases, separate adult education schools in Los Angeles and Orange County of our detailed plans and invite them to participate.

With the large number of students involved and our experience with large classes using programmed material, I believe that this approach is both educationally and economically feasible. Although I believe that our original planning should be limited to this one course, the area of college arithmetic, including minimum graduation and mathematical literacy requirements, warrants future consideration. In other fields, I believe that courses which are basically remedial in nature and involve large numbers of students warrant serious consideration for large scale presentation.

HM:ca
attachment

Junior College Research
Training Institute
Rieber Hall, UCLA, 1967

Henry Mansfield, Jr.
El Camino College, Calif.
Research Proposal

The Application of the Method of Least Squares and Some Other Techniques to the Analysis of Factors Relating to the Instructional Process.

I. Statement of the Problem

While the figures may very somewhat for different courses and for different institutions, it is generally true that of the total number of students who initially enroll in a junior college mathematics course, approximately 50% will withdraw prior to the penalty date (usually 4-6 weeks) and of those who remain approximately 50% will pass with a C or better grade. In other words, success is achieved by only 25% of the students in a course. It is believed that students in any course should have at least a 50% (and hopefully a higher) chance of success, and while the process of education is not necessarily an efficient process, the use of instructor time at 25% efficiency is wasteful and expensive.

In particular we need to (1) study the measurements of success, (2) find something to predict success, and (3) systematically study all facets of the problem of student success and failure. In addition studies of individual factors and their predictions of success have been limited in application and capable of little generalization. A systems approach in a particular area of instruction may provide some insights into the problem.

The problem of student success in courses is of concern to all schools and in all courses. The degree to which the results of this experiment can be generalized and applied to other schools and courses, depends on the strength of the relationships and the degree to which the independent variables are influenced by local factors. In addition, if any results are obtained within the framework of this problem, the methods may be applicable whether or not the results are.

The problem may be stated concisely in the following hypothesis.

II. Hypothesis

There exists a relation $y = \sum_{i=1}^{n} a_i f_i(x_i)$

where (a) the a_i are constants and at least one is not zero,
(b) the x_i are student or course characteristics,
and (c) y is the student's grade.

III. Assumptions

Since the real concerns are the percent of students who successfully complete a course and the efficient use of instructor time, the primary assumption is that the establishment of the hypothesis will provide a means to achieve these results. Other assumptions which seem appropriate for this study are:

(1) Unreasonable restraints or artificial or capricious barriers should not impede a student's progress toward his goal,

(2) Experimentation in education should be conducted where the effects (on students) of failure will be minimal,

(3) The student is entitled to reasonable standards and to the same chance of success regardless of the section of the class in which he happens to enroll,

(4) Reasonable criteria may be used to restrict entry into a course,

(5) The grading standards must be realistic in terms of the objectives of the course, and

(6) A quality program must be maintained.

IV. Related Research

While there are many studies relating to a single or a few predictors of student success, a brief search has not uncovered any broad studies of the type attempted in this study. As the study progresses, further review of related research will be made to compare the correlations of some of the single factors.

V. Procedure

For a problem of this type, which is basically multiple curvilinear regression and factor analysis, the sample needs to be as large as possible. The initial effects will use the data on students in three different courses which enroll 1500, 1000, and 500 students each semester. Data on all mathematics courses and all students in mathematics courses is available from 1960 to the present.

The steps that will be followed are:

(1) Select Variables and Criteria

The information available is (a) High School and High School grade point average, (b) grades in previous El Camino College mathematics courses, (c) scores on Mathematics Placement Test, (d) SCAT - Q, L, and T Scores, (e) English Placement Test score, (f) age, (g) marital status, (h) sex, (i) veteran's status,

(j) full time or part time student, (k) the student's major, (l) the teacher in the course, (m) the distribution of grades in the course, and (n) the hour of the day (or night) at which the course was offered.

Additional information on students may be easily obtained and processed through the IBM 1230 optical scanner and its card output. Information on the success of students who transfer to a state college or branch of the University of California is routinely available and could be used with some effort.

(2) Code in IBM cards

This has been done for most of the data.

((3) Computer Run

(a) correlation matri

(b) distribution data

(c) scatter plots

(4) Computer Run

For all reasonable predictors, get a step-wise regression with a listing of the β -weights for each variable for each correlation.

(5) Cross - Validation and analysis of residuals.

While the procedure and analysis described here is in a brief form, there are decisions involved at each stage of the process which will determine the direction of further investigations. While this could be included by statements covering all possible directions taken after all possible decisions, it is not included in this brief outline.

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The reader is also referred to the bibliographies in (7) and (8) above. These contain excellent sources of information.