A STUDY OF THE EFFECTIVENESS OF REMEDIAL MATHEMATICS AT OKLAHOMA STATE UNIVERSITY TECHNICAL INSTITUTE

By

DAVID HENRY SEEGER

Bachelor of Science

Central State University

Edmond, Oklahoma

1965

Submitted to the Faculty of the Graduate College
of the Oklahoma State University
in partial fulfillment of the requirements
for the Degree of
MASTER OF SCIENCE
July, 1972

OKLAHOMA
STATE UNIVERSITY
LIBRARY

FEB 7 1973

A STUDY OF THE EFFECTIVENESS OF REMEDIAL MATHEMATICS AT OKLAHOMA STATE UNIVERSITY TECHNICAL INSTITUTE

Thesis Approved:

Donald S. Phillips
Thesis Adviser

Lloyd Wiggins

Cecil W. Dugger

D. Durham
Dean of the Graduate College

837121

ACKNOWLEDGMENTS

The writer wishes to express his appreciation to many people who were important to the successful completion of this study.

My sincere appreciation to Dr. Donald S. Phillips for his enthusiastic help during the study as well as to Dr. Cecil Dugger and Dr. Lloyd Briggs for their valued advice and criticism during the preparation of this manuscript.

Acknowledgement of assistance is also extended to the staff of the Admission's Office at Oklahoma City; to the staff of the computer center, Mr. James Costain, Mr. David Scheidel and in particular for her assistance in the preparation of the data, Mrs. Kay Llapak, and to Judy Lacy for typing the final copy.

And lastly but most important to my wife, Juanita, my deepest gratitude for steadfast confidence and her continuing encouragement, and to our children Stephen, Katherine, Betty, and Janice for their patience with the unknown quantity "Daddy's Master's."

TABLE OF CONTENTS

LIST OF TABLES

CHAPTER I

INTRODUCTION

Two-year colleges of all types--community colleges, junior colleges, and technical institutes--have been beset with the problem of how to effectively serve students with inadequate backgrounds. Most such colleges operate under the "open door" concept and thousands of poorly prepared students are taking advantage of this opportunity to enter higher education. Whether it is, in fact, an opportunity for the student or just a deadend path depends, to a certain extent, on the remedial activities the institution is prepared to provide and the effectiveness of their efforts. Remedial programs vary widely across the nation, from offering high school equivalent courses to developmental programs involving time periods of up to a year and a half. Each institution must assess the effectiveness of the program it selects in light of the expenditure of the resources of both the student and the institution. Unfortunately, the review of the literature indicates that little effort has been made to document the effectiveness of remedial course work.

Some have found that the majority of students who enroll in remedial courses will fail to complete the course satisfactorily, and consequently, are doomed to failure and finally forced to terminate their education.

Statement of Problem

The problem considered in this study is the effectiveness of remedial courses in mathematics. The questions asked are:

1. What degree of success do students attain in remedial courses?

2. Are the students who have successfully completed remedial courses able to progress satisfactorily through the sequence of required mathematics courses?

3. Are the students who have successfully completed remedial courses able to progress successfully towards meeting the requirements for graduation?

Purpose of the Study

The purpose of this study is to analyze the academic records of students who have completed remedial courses in mathematics at Oklahoma State University Technical Institute in Oklahoma City, Oklahoma, and to determine the degree of success or lack of it that they have experienced as compared with other students who were not required to take remedial mathematics courses.

Need for the Study

The philosophy of "open door" admissions has created new problems for the two-year institutions operating under this concept. One of these is that, along with the four-year colleges and universities, the two-year colleges must show that their investment of human and material resources has been effectively spent.

The "open door" policy has brought large numbers of inadequately prepared students into the two-year colleges and technical institutes.

In light of the high dropout rates of from 50 to 80 percent after the first semester, it is obvious that an examination of the methods of preparing these students for college work should be made.

Limitations

This study was limited to students enrolled in at least one mathematics course at Oklahoma State University Technical Institute in Oklahoma City, Oklahoma. The study was further limited to students whose first enrollment at the Institute occurred during the period beginning with the fall semester of 1968 and continuing through the spring semester of 1970, and who took their first mathematics course during the same period.

Large numbers of students from other colleges and universities enroll at Oklahoma State University Technical Institute in Oklahoma City, Oklahoma, during the summer sessions. At the beginning of the fall semester these students return to their home colleges. Therefore, students who were enrolled only during the summer sessions were left out of all sample populations in order to avoid any bias which they might cause in the data.

Assumptions

The students in each year of this study are assumed to be similar to the students of each of the other years. This assumption is based on Astin's (1) study which indicated that the characteristics of students at an institution remain essentially the same through a period of years.

The teaching methods and materials used in any semester were assumed to be equivalent to those used in any other semester.

Hypothesis

The null hypothesis for this study is that for each of the seven variables studied, there will be no significant difference between the students who successfully complete a remedial mathematics course and those students who do not take such courses. The variables are:

1. Mean grade point average in first mathematics course.
2. Mean grade point average during first semester of enrollment.
3. Mean grade point average on all mathematics courses attempted.
4. Mean grade point average on all courses attempted.
5. Mean total hours successfully completed.
6. Mean persistency factor (T/L)

   T = Total semesters student is enrolled

   L = Number of semesters between first enrollment and last.
7. Mean total number of semesters enrolled.

Because of the importance of a successful program, in terms of the benefits to the individual and to society, a significance level of .20 was considered acceptable for this study. It is important to recognize, however, that any measure of success must be established in terms of the objectives and philosophy of each institution undertaking a remedial program.

The Technical Institute

Oklahoma State University Technical Institute in Oklahoma City is one of three technical institutes administered by the Oklahoma State University. The other two are the School of Technology at Stillwater and the Oklahoma State Technical School at Okmulgee. The Technical Institute is a division of the College of Engineering at Oklahoma State University in Stillwater. It was formed in Oklahoma City in 1961 when Oklahoma City University elected to discontinue their technical institute and offered it to Oklahoma State University. The institute opened in 1961 with 91 students, and in the spring of 1971 the enrollment had increased to 1400.

The institute originally opened in an unused elementary school building at 1900 N. W. 10th. Since that time a new campus has been developed at 900 North Portland although the old building is still being used for overflow. Final movement of all classes to the new campus should occur before the spring semester of 1974.

The Technical Institute is a two-year college offering the associate degree, primarily in the following engineering technology areas:

Architectural and Structural Drafting and Design Technology
Civil Technology
Electronic Engineering Technology
Instrumentation and Process Control Technology
Industrial Drafting Technology

The institute also offers the associate degree in technological areas which are not engineering related. These are:

Computer Programming
Fire Protection
Nurse Science (RN)
Police Science

Technical Writing
Urban Planning

Under instructions from the State Board of Regents for Higher Education, the Technical Institute operates as an "open door" institution. Consequently it has a vital concern for the effectiveness of remedial programs.

General Student Characteristics

Students come to the Institute from a wide area, including most of the states of the Union and several foreign countries. The majority of the students, however, are residents of the metropolitan Oklahoma City area. The Institute does not maintain residence halls for students.

The location of the Institute and the fact that the average age of its students is 27 years make it unsurprising that 80 percent of the students are employed and that 70 percent are married. These two factors have a strong influence on the average course load which is 7.9 credit hours. For the same reasons the Institute has offered, since its beginning, a full evening schedule of classes which enroll about 55 percent of the total student population. The evening students average about six credit hours per semester though the day students average about ten credit hours per semester.

Basing an estimate on the average credit hours carried per semester, it might be expected that the typical student would need eight semesters to complete the course work required for an associate degree. Over a period of several years, however, it has been found that students normally complete the requirements for the associate degree after five semesters of work excluding the summer sessions they might have attended. The average is six semesters if summer sessions are included.

Because of financial or family obligations, many of the students do not attend successive semesters but dropout and return at a later date. Some students will not continue in a technical program because of the long period of time required by part-time enrollment. Other students, as they approach graduation, will be able to obtain employment in their field of study. Since these students are probably more career- than academic-minded, they will sometimes discontinue their education after obtaining the desired technical employment for which they were training. As a consequence of all these factors, the drop-out rate is higher for part-time students than for full-time students. A small proportion of part-time students, however, do receive the associate degree.

CHAPTER II

REVIEW OF THE LITERATURE

A review of the literature relating to the field of remedial courses for junior college students revealed several interesting points. One of the more notable was that so little information on this subject can be found. This fact can be explained perhaps by the fact that the problem is relatively new to higher education in this country.

In the last 15 to 20 years most of the two-year institutions in this country have accepted the philosophy that every person is entitled to a change at two years of education beyond high school regardless of his high school record. That this philosophy is a popular concept has been evidenced by the proliferation of two-year institutions that have been established by the state legislatures of many states and by the imposition on these colleges of the "open door" admissions policy.

It is not germane to the subject of this study to argue whether the "open door" admissions policy is educationally, sociologically or economically defensible. The "open door" policy is here to stay, barring a major and dramatic demonstration of its errors (if there are any) or an economic collapse. It is necessary, therefore, that the two-year institutions placed under this policy face and solve the problems which it has created.

The principle problem created has been the flood of students who have reached the two-year colleges with little or no preparation for college work. "Of the 60,500 students enrolled in junior college mathematics in the fall 1964 three out of four were taking courses offered in high school (12)."

Remedial instruction programs vary from campus to campus. At Greenfield Community College, Massachusetts, a summer remedial program was offered (9). Forest Park Community College, Missouri, provides a two-semester remedial program (13). A three-semester program is provided at Northampton County Area Community College, Pennsylvania, for students with extreme deficiencies (6). These have been highly structured attempts at remediation. The results of these studies, which have been generally favorable, have been documented. Most colleges, however, seem to have taken a different route--that of simply offering individual high school level courses in the areas of deficiency. Principally these areas have been mathematics and English. These courses are offered to any student showing a need for them and are not part of a structured remedial program. The extent to which this is done cannot be determined with any precision because of the almost total lack of literature devoted to research on this type of approach.

The principal measures of success, most frequently used, are persistency, grade point average in remedial courses, and overall grade point average. Using these measures, the reports from different research workers have shown mixed results for the success of remedial programs.

Hartman (5) made a rare type of study which concerned remedial students not enrolled in a highly structured remedial program. Hartman at Florissant Valley Community College, Missouri, found that "As opposed to the 'successful' remedial student, this study has provided some evidence that the present remedial program is relatively ineffective for the younger students, especially males, just out of high school, and who ranked in the lowest 20% of their high school classes... ." The prognoses of success seemed to improve linearly as the high school record was improved. That is, a student in the 20 to 25 percentile of his high school class had only a slightly improved prognosis over the student in the 15 to 20 percentile of his high school class. Another variable, that of age, made a major difference in the prognosis of success. A difference of one year in age produced a much improved probability of success.

At Fresno City College students who fall below a certain score on an entering examination were required to take the complete one semester structure of remedial courses. After a two-year (1965-1967) study, Gaither (3) reported that persistence among students enrolled in remedial courses was the same after two years as for students not so enrolled. He did note, however, that the grade point average of the remedial student at the end of two years was lower than that of other students by .25 on a 4.00 scale.

While not specifically described, the Developmental Studies program at Los Angeles Community College seems to be a structured one-semester program with all students in the program required to take the same courses. Godl (4) says of the results of the program, "Persistence at L.A.C.C. of Developmental Studies students is clearly greater than that of comparable students who were not in the program, and compares favorable with available 'all college' persistence statistics." This statement may be contrasted to one attributed to Bossone (2) that "only 20% of the students enrolled in remedial courses later in California Junior College enrolled in college credit courses."

Of the summer (1965) program at Greenfield, Shea (9) says "...less than 40% did not complete that semester [Fall]." The reader is reminded that theoretically <u>none</u> of the 40 percent, which amounted to 33 adults, should have been successful.

Thelen (13), in her report of the Forest Park experience, shows significant improvement for remedial students in all areas except science.

At Northampton, Krupka (6) concluded that those students whose deficiencies were so great that they required the full three semesters of remedial work were unlikely to finish. The dropout rate for all remedial students was approximately doubled that of students in the college at large.

From the reports mentioned, some degree of success has been obtained in the structured programs. Hartman's (5) study indicates that other factors, such as age, play an important role in success.

The reports of structured programs do not mention age as a factor. This may be because older students are less likely to be able, because of job and family commitments, to fit into this type of program.

It is to be hoped that many more colleges will study and publish the results of their experience with remedial students.

CHAPTER III

PROCEDURE AND METHODOLOGY

As stated in Chapter I, the purpose of this study is to determine if students who are required to take remedial courses in mathematics, after successful completion of the courses, can perform well in further work as compared with students who were not required to take a remedial course in mathematics.

Students of Oklahoma State University Technical Institute in Oklahoma City, Oklahoma, (OSUTIOC) during the period of the study were advised to enroll in specific mathematics courses on the basis of their backgrounds and the entrance test scores. The principal guide for placement in mathematics was the American College Test (ACT) mathematics scores. Using this test, cut-off points were established by the Institute as follows:

ACT SCORE	REQUIRED FIRST COURSE
0 - 15	General Technical Mathematics
16 - 24	Intermediate Algebra
25 -	Algebra and Trigonometry

Course descriptions will be found in Appendix C.

All of the technology curriculums at OSUTIOC require Algebra and Trigonometry as the entry point in mathematics. At this institution both General Technical Mathematics and Intermediate Algebra are considered to be remedial.

According to the American College Testing Program's Student's Booklet, 1970-1971 (11), the standard error of measurement is 2.0 for the raw mathematics score. This means that a score of 15 can be thought of as indicating a true score in the range of 13 to 17. This fact was used to draw similar groups of students from those who had taken intermediate Algebra and those who had taken General Technical Mathematics.

The Sample Groups and Relationships

Seven groups of students were selected from the student population whose first enrollment was in the period from fall 1968 through spring 1970 and their performance through spring 1972 was examined. These groups were categorized by ACT scores and first mathematics enrollment.

GROUP	ACT SCORES	FIRST ENROLLMENT
I	All Students	General Technical Math
I_a	No ACT Score	General Technical Math
I_b	0 - 12	General Technical Math
I_c	13 - 17	General Technical Math
II	All Students	Intermediate Algebra
II_a	13 - 17	Intermediate Algebra
III	All Students	Algebra and Trigonometry

The following seven variables were examined as they relate to each of the seven groups.

1. Mean grade point average in first mathematics course.
2. Mean grade point average during first semester of enrollment.
3. Mean grade point average on all mathematics courses attempted.
4. Mean grade point average on all courses attempted.

5. Mean total hours successfully completed

6. Mean persistency factor (T/L)

   T = Total semesters student is enrolled

   L = Number of semesters between first enrollment and last.

7. Mean total number of semesters enrolled.

Table I shows the manner in which groups were paired to determine relationship and the level of significance. In Table I it can be seen that Group III (all Algebra and Trigonometry) was compared to all other groups using the seven variables which are the basis of this study. Group I (all General Technical Mathematics), on the other hand, was compared with only Groups II (all Intermediate Algebra) and III.

The test used to determine the significance of the relationship was the Standard t test. It was assumed that the populations were distributed normally; therefore, the t test was made accordingly.

The data on ACT scores, associate degrees, and dates of graduation were supplied by the OSUTIOC Admissions and Registrar's Office. The academic records for the students were obtained from the transcript files maintained by the OSUTIOC Computer Center on magnetic computer tape for the Admissions and Registrar's Office.

The test scores were punched into data processing cards along with student identification data. The tape records and the card records were matched, and each student was assigned to an appropriate classification group. The necessary statistics were then compared for each group. The relationships as outlined in Table I were examined for significant differences.

TABLE I

GROUP PAIRINGS TO BE EXAMINED

	I All General Technical Mathematics	II All Intermediate Algebra	II_a Intermediate Algebra (ACT 13-17)	III All Algebra and Trigonometry
All Gen. Tech. Math.		X		X
Gen. Tech. Math. (No ACT)				X
Gen. Tech. Math. (ACT 0-12)				X
Gen. Tech. Math. (ACT 13-17)			X	X
All Inter. Algebra	X		X	X
Inter. Algebra (ACT 13-17)		X		
All Alg. & Trig.	X	X	X	

CHAPTER IV

RESULTS

A file of the course records of the students enrolled at Oklahoma State University Technical Institute in Oklahoma City (OSUTIOC) has been maintained since the fall semester of 1969. The records contained the student identification data plus course numbers, course descriptions, and credit hours. The records also include the grade the student earned, grade point for that course, and the semester and year the course was taken. The format of the course record is given in Appendix A. In addition to these records, the records for fall 1968, spring 1969, and summer 1969 were keypunched and added to the file, for this study.

These records were examined and summarized, utilizing an IBM 360/25 computer in the computer center at OSUTIOC.

Two principal criteria were applied to the student population to select those to be made a part of the summary file. The students had to be acceptable under both rules.

1. The student's first enrollment at Oklahoma State University was in the period of fall 1968 through fall 1970.

2. He was enrolled for his first mathematics course during the period fall 1968 through fall 1970 in one of the three courses used in this study.

The imposition of time limits was to ensure that all of the student's records were available and that sufficient time elapsed after the initial enrollment to determine subsequent progress.

As the summary file was built the scores from the ACT tests, which had previously been key punched into data processing cards, were matched and added to the summary records. While building the summary file the student was assigned a class designation based upon the criteria outlined in the chapter on procedure and methodology. After the summary file was built the year of graduation and technical area were added where applicable.

To facilitate the matching of ACT scores and graduation data the summary file was arranged in ascending order by the OSU student number. The format of the summary report is shown in Appendix B.

Another computer program was used to compute the mean, standard deviation and variance for each of the seven variables of each of the seven classes of students. In addition, the number who had graduated and the number currently enrolled were computed for each group. These statistics were paired as t values were needed and key punched into data processing cards. These cards were then processed by the computer to compute the t values for each pair of statistics.

The mean, standard deviation and variance were computed to four decimal places. The formula used for the variance was (7):

$$S^2 = \frac{\Sigma X^2 - \frac{(\Sigma X)^2}{N}}{N - 1}$$

The t values were also computed to four decimal places using the formula (7):

$$t = \frac{\overline{X}_1 - \overline{X}_2}{\sqrt{\frac{S_1^2}{N_1} + \frac{S_1^2}{N_2}}}$$

The level of significance of the resulting t value was determined by the use of Steel's (12) table for a two-tailed t test.

The total student population for the sample was 928. Of these 66 percent enrolled in remedial courses. The breakdown by first mathematics course was

Group I	General Technical Math	402
Group II	Intermediate Algebra	213
Group III	Algebra and Trigonometry	313

An additional 62 students entered at a higher level than Algebra and Trigonometry because of transfer credits or exceptional work in high school. They were not included in the study.

In Table II are displayed the mean, standard deviation and t values for the remedial students (Groups I and II) and the Algebra and trigonometry students (Group III). The values in the table were rounded to two decimal places.

It will be noted from Table II, that for the first mathematics course, there is no significant difference among the three groups. The same thing is true for the Grade Point Average (GPA) for the first semester. There is, however, a significant difference between the remedial students and the Algebra and Trigonometry group on GPA for all mathematics, number of successful hours completed and semesters enrolled.

TABLE II

STATISTICS FOR GROUPS I, II, AND III

		GPA First Math.	GPA First Sem.	GPA All Math.	GPA Overall	Successful Hours	Persistency Factor	Semesters Enrolled
Group I								
(Gen. Tech.	Mean	2.09	2.29	1.80	2.02	18.99	.97	2.87
Math.)	Std. Dev.	2.14	1.72	1.30	1.11	18.32	.11	1.91
N = 402	t_1	.82*	.87*	.95*	1.84	.25*	2.12	.70*
	t_2	.92*	.29*	2.70	2.29	5.68	1.46	3.01
Group II								
(Inter.	Mean	2.18	2.43	1.90	2.19	18.60	.94	2.75
Algebra)	Std. Dev.	1.28	1.85	1.22	1.05	18.29	.15	1.94
N = 213	t_3	.05*	.60*	1.49	.31*	5.24	.91*	3.22
Group III								
(Alge. &	Mean	2.19	2.33	2.07	2.22	28.34	.95	3.34
Trig.)	Std. Dev.	1.41	1.76	1.33	1.16	24.28	.12	2.18
N = 313								

t_1 = t for Groups I and II; t_2 = t for Groups I and III; and t_3 = t for Groups II and III

*Indicates acceptance of the null hypothesis at the .20 level.

The statistics show no significant difference, between the remedial courses in any category except persistency and overall grade point average. The Intermediate Algebra group had a significantly higher GPA and a lower persistency factor than the General Technical Mathematics group.

The Intermediate Algebra group was not significantly different from the Algebra and Trigonometry group in persistency. The General Technical Mathematics group was significantly more persistent than the Algebra and Trigonometry group.

Group I (General Technical Mathematics) and Group II (Intermediate Algebra) were further separated into sub-groups on the basis of ACT mathematics scores in order to determine the performance of different segments of these two major groups.

The General Technical Mathematics group was divided into three groups: Groups I_a, I_b, and I_c. The students in Group I_a were those for whom no ACT scores were available in mathematics. Students in Group I_b had scores from 13 to 17. The means, standard deviations and t scores for these groups are shown in Table III.

In Table III it can be seen that Group I_a is significantly different from Group III (All Algebra and Trigonometry) in four variables but there is no difference in the GPA for the first semester, the grade earned in the first mathematics course or persistency. Group I_b, which is the General Technical Mathematics students with low ACT scores, is equivalent to Group III in semesters completed and GPA for the first semester. Group I_b has significantly lower scores than Group III in Grade Point for the first mathematics course, GPA for all mathematics courses and overall GPA.

TABLE III

RELATIONSHIPS OF THE GROUP I SUB-GROUPS WITH GROUP III

		GPA First Math.	GPA First Sem.	GPA All Math.	GPA Overall	Successful Hours	Persistency Factor	Semesters Enrolled
Gen. Tech. Math. Sub-groups								
Group I_a	Mean	2.16	2.30	1.88	2.04	17.00	.96	2.71
(No ACT)	Std. Dev.	1.51	1.73	1.37	1.17	16.52	.12	1.75
N = 204	t_4	.20*	.20*	1.56	1.63	6.32	.62*	3.59
Group I_b (ACT	Mean	1.95	2.28	1.71	2.00	21.62	.97	3.13
0 - 12)	Std. Dev.	1.40	1.71	1.27	1.08	20.84	.10	2.20
N = 103	t_5	1.49	.23*	2.50	1.76	2.72	1.56	.84*
Group I_c (ACT	Mean	2.00	2.29	1.66	1.98	20.95	.98	3.06
13 - 17)	Std. Dev.	1.43	1.67	1.19	.97	19.30	.08	1.96
N = 77	t_6	1.04*	.18*	2.68	1.83	2.85	1.87	1.06*
Group III (Alg. &	Mean	2.19	2.33	2.07	2.22	28.34	.95	3.34
Trig.)	Std. Dev.	1.41	1.76	1.33	1.16	24.28	.12	2.18
N = 313								

t_4 = t for Groups III and I_a; t_5 = t for Groups III and I_b; and t_6 = t for Groups III and I_c

*Indicates acceptance of the null hypothesis at the .20 level.

Group I_c, which is General Technical Mathematics students with high ACT scores, has about the same relationship to Group III as the students with low ACT scores except that the students with the higher ACT scores had a similar grade point in the first mathematics course to that earned by those students in the Algebra and Trigonometry group.

Group II_a was a group composed of students who took Intermediate Algebra and who had ACT scores in the range of 13 to 17. The purpose of the formation of this group was to provide a comparison with the group with the same mathematics scores on the ACT but who had taken General Technical Mathematics (Group I_c). The results can be seen in Table IV. Table IV also shows the comparison of Groups II_a with all students taking Intermediate Algebra (Group II) and with all students taking Algebra and Trigonometry (Group III).

The comparison of Group I_c and Group II_a shows that there is no significant difference between the two groups in any of the seven variables examined. That is, there is no significant difference between students who took General Technical Mathematics and students who took Intermediate Algebra when their ACT mathematics scores were in the range of 13 to 17.

When the Intermediate Algebra students with low ACT scores relative to their group were compared to all Algebra and Trigonometry students there was no difference found except that the Algebra and Trigonometry students had a significantly higher GPA for all mathematics.

When the total group of Intermediate Algebra students is compared with the sub-groups of low scores on the ACT mathematics score significant differences are only found in the credit hours successfully

TABLE IV

RELATIONSHIPS OF GROUP II_a WITH GROUPS I_c, II, AND III

		GPA First Math.	GPA First Sem.	GPA All Math.	GPA Overall	Successful Hours	Persistency Factor	Semesters Enrolled
Group I_c (Gen. Tech. Math.) ACT 12-17 N = 77	Mean	2.00	2.29	1.66	1.98	20.95	.98	3.06
	Std. Dev.	1.43	1.67	1.19	.97	19.30	.08	1.96
	t_7	.35*	.22*	.37*	.35*	.99*	1.14*	1.20*
Group II (Inter. Algebra) N = 213	Mean	2.18	2.43	1.90	2.19	18.60	.94	2.75
	Std. Dev.	1.28	1.85	1.22	1.05	18.29	.15	1.94
	t_8	.39*	.16*	.73*	.68*	1.54	.04*	1.92
Group III (Alge. & Trig.) N = 313	Mean	2.19	2.33	2.07	2.22	28.34	.95	3.34
	Std. Dev.	1.41	1.76	1.33	1.16	24.28	.12	2.18
	t_9	.42*	.13*	1.52	.84*	.46*	.38*	.72*
Group II_a (Inter. Algebra) ACT 12-17 N = 32	Mean	2.09	2.37	1.75	2.06	26.09	.94	3.69
	Std. Dev.	1.20	1.80	1.14	1.01	26.62	.15	2.66

t_7 = t for Groups I_c and II_a; t_8 = t for Groups II and II_a; and t_9 = t for Groups III and II_a

*Indicates acceptance of the null hypothesis at the .20 level.

completed and the total number of semesters enrolled. In both variables the sub-group had higher scores.

Graduates and Current Students

Table V shows the numbers of graduates and current students by group and sub-group. The graduates are those who graduated during or before the spring 1972. Current students are those who were enrolled during the spring 1972. The reader is reminded that all of the subjects of this study were enrolled for the first time not later than the Fall of 1970 nor earlier than the fall of 1968.

From Table V it can be seen that Group III, the Algebra and Trigonometry students had the highest percentage of students while Group II, Intermediate Algebra, had the lowest. For those currently enrolled, Group II_a, the sub-group of Intermediate Algebra students, was the highest and again the total group of Intermediate Algebra students was the lowest.

Persistency Factor

This variable is designed to quantify the consistency of enrollment. It was formed by dividing the number of semesters a student is enrolled by the number of semesters occurring between the students first enrollment and his last. Summer sessions are ignored in the computation. As an example, a student who enrolled two successive semesters and did not later return would have a persistency factor of 1.0. If the student was enrolled during two fall semesters but not the intervening spring semester the persistency would be computed as

$$\frac{2 \text{ (The number of semesters enrolled)}}{3 \text{ (The number of semesters in the period)}} = .67$$

TABLE V

TABLE OF GRADUATES AND CURRENT ENROLLEES

Group	N	Graduates	%	Currently Enrolled	%	Total	%
Group I	402	19	4.7	66	16.4	85	21.1
Group I_a	204	8	3.9	32	15.7	40	19.6
Group I_b	103	7	6.8	20	19.4	27	26.2
Group I_c	77	4	5.2	14	18.1	18	23.3
Group II	213	5	2.3	28	13.1	33	15.4
Group II_a	32	2	6.3	8	25.0	10	31.3
Group III	313	50	16.0	75	24.0	125	40.0
Total	928	74	8.0	169	18.2	243	26.2

The lowest possible persistency factor for a student in this study would be for a student who enrolled in the fall 1968 and who did not return until he re-enrolled in the spring 1972. This would give him a persistency factor of 2/8 or .25.

The persistency patterns for the students who first enrolled in the fall of 1968 can be seen in Table VI. The table shows the enrollment pattern and the number of students who fit that pattern. For example, eleven students were enrolled continuously from fall 1968 through spring 1972. For those students who did not have a persistency factor of 1.0 the average was 0.72.

Among all of the students in this study, the lowest persistency factor was computed for a student who was enrolled in the spring 1969 and spring 1972 and none of the intervening semesters. His persistency factor was 0.285.

TABLE IV

ENROLLMENT PATTERNS FOR FALL, 1968 STUDENTS

	Pattern							
Number	F '68	S '69	F '69	S '70	F '70	S '71	F '71	S '72
11	*	*	*	*	*	*	*	*
7	*	*	*	*	*	*	*	
1	*	*	*	*	*	*		*
11	*	*	*	*	*	*		
1	*	*	*	*	*		*	*
2	*	*	*	*	*			*
11	*	*	*	*	*			
1	*	*	*	*		*	*	*
1	*	*	*	*			*	*
1	*	*	*	*			*	
16	*	*	*	*				
1	*	*	*		*	*	*	*
2	*	*	*		*	*		
2	*	*	*		*			
1	*	*	*		*			
2	*	*	*				*	*
1	*	*	*				*	
21	*	*	*					
1	*	*		*	*	*	*	*
4	*	*		*				
1	*	*				*		
50	*	*						
3	*		*	*	*	*	*	*
4	*		*	*	*	*		
1	*		*	*	*		*	*
1	*		*	*	*		*	
3	*		*	*				
8	*		*					
2	*			*	*	*	*	*
1	*			*	*	*	*	
1	*			*				
1	*				*	*	*	*
1	*				*		*	
1	*				*			
1	*					*		
97	*							

CHAPTER V

SUMMARY, CONCLUSIONS, AND RECOMMENDATIONS

In the problem statement for this study, three questions were asked:

1. What degree of success do students attain in remedial courses?

2. Are the students who have successfully completed remedial courses able to progress satisfactorily through the sequence of required mathematics courses?

3. Are the students who have successfully completed remedial courses able to progress successfully towards meeting the requirements for graduation?

To answer these questions this study attempted to determine the degree of success students at OSUTIOC who have completed a remedial mathematics course experienced as compared with students who were not required to take such a course.

The records of the students enrolled at Oklahoma State University Technical Institute were examined and the records of those students who were enrolled in a mathematics course within the period of fall 1968 to fall 1970 were summarized. The number of students who were included in this study was 928. Of these, 66 percent, or 615, had enrolled in a remedial course. The summary records were classified according to which mathematics course the student was first enrolled and his ACT mathematics score. From this summary file the mean, standard deviation and variance were computed for each of the seven variables for each group. The variables selected for study were:

1. Mean grade point average in first mathematics course;
2. Mean grade point average during first semester of enrollment;
3. Mean grade point average on all mathematics courses attempted;
4. Mean grade point average on all courses attempted;
5. Mean total hours successfully completed;
6. Mean persistency factor; and
7. Mean total number of semesters enrolled.

In addition, the number of graduates and the number of currently enrolled students were computed for each group. From the original records the enrollment patterns for all students who first enrolled in the Fall of 1968 were developed. These patterns are shown in Table VI.

The seven groups formed were compared with each other on the seven variables used for the study and a two-tailed t test was used to determine the validity of the null hypothesis.

The null hypothesis for this study was that for each of the seven variables studied there will be no significant difference between the students who have successfully completed a remedial mathematics course and those students who did not take such courses.

Findings

The findings of this study, as supported by the data gathered in this thesis, are summarized below.

A. All groups were similar in the measures of the first semester variables. The General Technical Mathematics group had a GPA of 2.09 for the first mathematics course and a GPA of 2.29 for all first semester work. The Intermediate Algebra group had 2.18 for the first mathematics course GPA and 2.43 for the first semester GPA. The Algebra and

Trigonometry had a GPA of 2.19 for the first mathematics course and a GPA of 2.33 for all first semester courses.

B. The progress, after the first semester, of the group composed of students who took General Technical Mathematics and of the sub-groups was found to be significantly poorer when compared with the group of Algebra and Trigonometry students. Those students who took General Technical Mathematics successfully completed an average of 18.99 credit hours in 2.87 semesters. The students taking Algebra and Trigonometry as their first mathematics course typically completed 28.34 credit hours in 3.34 semesters. The Intermediate Algebra group averaged 18.60 credit hours in 2.75 semesters.

C. The General Technical Mathematics group had a graduation rate of 4.7 percent. The graduation percentage for Intermediate Algebra students was 2.3 percent. For the Algebra and Trigonometry students the graduation rate was 16.0 percent.

Conclusions

The fact that both the group of General Technical Mathematics students and the Intermediate Algebra students had grade point averages of "C" indicates that the students in these groups can do the necessary work for successful completion of the remedial courses. The answer to the first question of the study, therefore, is that the students do attain an adequate level of success in remedial courses.

The second question asked in the study was: Are the students who have successfully completed remedial courses able to progress satisfactorily through the sequence of required mathematics courses? The data indicates that the response to this question must be no. For the typical remedial student, these courses do not provide adequate preparation for required mathematics courses.

The third question must also be answered negatively. The data indicates that the typical remedial student is not able to progress successfully to completion. This conclusion is indicated by the comparison of the four variables which indicated the level of the student's progress. These variables are: GPA in all mathematics; GPA overall; successful hours completed; and semesters enrolled. In these four variables the General Technical Mathematics students were found to be significantly lower than the Algebra and Trigonometry students. The Intermediate Algebra students were also significantly lower than the Algebra and Trigonometry students except in the overall GPA where they were found to be the same.

The null hypothesis for this study was that for each of the seven variables studied there will be no significant difference between the students who successfully completed a remedial mathematics course and those students who did not take such courses. The null hypothesis as it applied to the two remedial groups was rejected for almost all variables. The exceptions were in the overall GPA and the persistency factor, where the Intermediate Algebra group was found to be similar to the Algebra and Trigonometry group, and in the first semester GPA and first mathematics course GPA where all three groups were found to be similar.

An additional question of considerable importance is: Are the remedial courses justifiable? In Table V it is shown that 4.7 percent of the General Technical Mathematics students graduated. While this is a low graduation percentage, it should be noted that it is unlikely that any of these 19 students would have been awarded the associate degree had they not participated in the remedial program. Another 16.4 percent of these General Technical Mathematics students are still active in the program at least two years after they began it. With that degree of tenacity, several more of this group can be expected to become graduates.

The comparison of Group II_a with Group I_c indicates that those students who took General Technical Mathematics achieved no advantage over those who took Intermediate Algebra. At least two possible explanations exist for this; (1) The General Technical Mathematics course was too similar to the Intermediate Algebra to establish a difference in progress or (2) the ACT score was not a sufficiently selective measure. The scope of the course content was indicated in the course descriptions of the two courses makes the first explanation unlikely. Further research should be performed before the second explanation is accepted.

The remedial courses are not as effective in preparing students as would be desirable, but they are preparing some successful students. The "open door" policy of the Institution and alternatives to a remedial program combined with the fact of a partial success make it reasonable to continue the program.

Two measures of the success of a remedial mathematics program are: the number of credit hours successfully completed and the overall GPA. If students entering the institution have so inadequate a background in mathematics that they are unable to begin the curriculum, then a remedial program which produces even one successful student has attained a degree of success. The critical value is the degree of success needed to justify the expenditure of the necessary resources for the remedial program. Each institution must determine this for its self.

On this basis, the program at Oklahoma State University Technical Institute should be considered a limited success, but serious and urgent work should be undertaken to improve the performance of the program and course.

Recommendations

On the basis of the information contained in this study the following recommendations for additional studies in the area are made:

1. A study of the effectiveness of ACT mathematics scores for placing students in mathematics courses is recommended.

2. Since the fall semester of 1971 the Technical Institute has begun to use the Cooperative Algebra Test as the principal tool for placing students in mathematics courses. It is recommended that the results of this change be studied.

3. A review of the material and methodology used in the remedial courses should be made with a view toward improving their effectiveness.

4. It is recommended that the population which was the subject of this study should be examined periodically at least as long as any of those students who first enrolled in the fall of 1968 continue to be enrolled at the Technical Institute.

5. A comparative study of the students used in this study and those students in similar institutions of surrounding states is recommended.

6. A study is recommended to determine why students did not return to the Institute and what their later employment and educational achievements were.

SELECTED BIBLIOGRAPHY

(1) Asten, A. W. *Who Goes to College?* Chicago: Science Research Associates, 1965.

(2) Bossone, Richard. "Remedial English Instruction in California Public Junior Colleges: An Analysis and Evaluation of Current Practice." Sacramento: California State Department of Education, 1966. (quoted by Roveche, *Improving College and University Teaching*, Vol. XVII, pp. 101-2).

(3) Gaither, Loren. "A Study of 'Remedial' Students." (unpub. report, University of California, Los Angeles, 1968).

(4) Gold, Ben K. "The Developmental Studies Program: Some Scholarship and Persistence Statistics." (unpub. report, Los Angeles City College, report no. LACC-RS-68-11, 1968).

(5) Hartman, Neal E. "Correlates of Educational Outcome for Junior College Remedial Students. (unpub. report, University of California, Los Angeles, 1968).

(6) Krupka, John. "A Community College Remedial Program: A Description and Evaluation." (unpub. report, Clear House for Junior College Information, 1969).

(7) Popham, W. James. *Educational Statistics*. New York: Harper and Row, 1967.

(8) Roveche, John E. and Allen S. Hurlbert. "The Open Door College. The Problem of the Low Achiever." *Journal of Higher Education*, XXXIX (November), 101-2.

(9) Shea, J. J. "PREP - A Program for Recovering and Extending Academic Potential for High School Underachievers Seeking Entrance at a Regional Community College." (unpub. report, Greenfield Community College, 1966).

(10) Steel, Robert G.D. and James H. Torrie. *Principles and Procedures of Statistics*. New York: McGraw-Hill, 1960.

(11) American College Testing Program. *Students' Booklet*. Iowa City: American College Testing Program, 1970.

(12) "Student Majors by Curriculum Fields and Other Related Data in California Junior Colleges." Sacramento: California State Department of Education, 1964. (quoted by Roveche, Improving College and University Teaching, XVII, 101-2).

(13) Thelen, Alice. "A Study of Academic Characteristics of General Curriculum Students After One Semester, One Year, in the General Curriculum Program." (unpub. report, Clearing House for Junior College Information, 1969).

APPENDIX A

STUDENTS' COURSE RECORD

STUDENTS' COURSE RECORD

Position	Description
1-6	OSU Student number
7-24	Student Name
25-33	Course Department and Number
34-36	Unused
37-38	Credit Hours
39-81	Unused
82-84	Semester and Year Course Taken
85	Unused
86-67	Recorded Grade
87-89	Earned Grade Points
90-91	Unused
92-100	Social Security Number

APPENDIX B

STUDENTS' SUMMARY RECORD

STUDENTS' SUMMARY RECORD

Position	Description
1-6	OSU Student Number
7-24	Student Name
25-33	Social Security Number
34-38	First degree and date
39-43	Second degree and date
44	Classification code
45-48	Unused
49-50	ACT Mathematics Scores
51-52	Unused
53-55	Date of First Enrollment
56-58	Date of Last Enrollment
59-60	Number of semesters Enrolled
61-62	Number of Summers Enrolled
63-65	Earned Grade Points
66-67	First Semester Grade Point Average
68-70	Total Hours Attempted
71-73	Total Hours Successfully Completed
74-76	Earned Grade Points in Mathematics
77-78	Total Hours in Mathematics
79-80	Grade Point in First Mathematics Course
81-89	First Mathematics Course
90-92	Date of First Mathematics Course

APPENDIX C

COURSE DESCRIPTIONS

COURSE DESCRIPTIONS

<u>General Technical Mathematics</u>. Review of arithmetic, beginning algebra, and geometry and instruction in intermediate algebra with applications.

<u>Intermediate Algebra</u>. Fundamental operations of algebra, exponents and radicals, simple equations, graphs, systems of simultaneous equations, quadratic equations and logarithms.

College <u>Algebra and Trigonometry</u>. Quadratic equations, progressions, the binomial theorem, mathematical induction, theory of equations, logarithms and determinants. Trigonometric functions, solution of right and oblique triangles and applications to engineering.

VITA

David Henry Seeger

Candidate for the Degree of

Master of Science

Thesis: A STUDY OF THE EFFECTIVENESS OF REMEDIAL MATHEMATICS AT OKLAHOMA STATE UNIVERSITY TECHNICAL INSTITUTE

Major Field: Technical Education

Biographical:

Personal Data: Born in Mena, Arkansas, October 4, 1932, the son of Mr. and Mrs. Henry V. Seeger.

Education: Graduated from Central High School, Oklahoma City, Oklahoma, June, 1950; enrolled at Oklahoma State University in Chemical Engineering in 1950-52; received Bachelor of Science degree in mathematics from Central State University in June, 1965; enrolled in Master's program at Oklahoma City University, 1969; completed requirements for the Master of Science degree at Oklahoma State University in July, 1972.

Professional Experience: Computer Programmer, U. S. Air Force, Tinker Air Force Base, 1965-67; Instructor, Oklahoma State University Technical Institute, 1967 to present.

Professional Organizations: Oklahoma Technical Society, Data Processing Management Association, Holder of Certificate in Data Processing awarded by DPMA 1972.