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ABSTRACT

A study was conducted at Rochester Community College, in Minnesota, to compare pass rates in a college-level mathematics class for mathematically underprepared students who enrolled in developmental courses and those who did not. The study population consisted of 73 students enrolled in Math 103, while data were collected on the student's final grade, math placement level, whether or not they had enrolled in the prerequisite math class, and the grade they received in the prerequisite course. The study found that 35 of the 73 students were appropriately placed, following a counselor's advice, and passed Math 103, while 15 students had also followed a counselor's advice but did not pass. In addition, of those who disregarded placement advice, 13 did not pass and 10 did. The results of the study showed a statistically significant relationship between passing the course and following placement advice given by counselors based on math skill assessment scores. Three conclusions were drawn from the results: students should heed their counselor's advice; the advice does make a difference if students are to pass college math; and counselors at the college can feel confident that their mathematics placement recommendations are valid. Contains 21 references. Graphs and tables are appended. (HAA)

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ED 400 014

A COMPARISON OF STUDENTS WHO FOLLOWED MATHEMATICS ADVISEMENT RECOMMENDATIONS AND STUDENTS WHO DID NOT AT ROCHESTER COMMUNITY COLLEGE

Research Methodology Seminar

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Rochester Community college

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International Cluster

A practicum report presented to Programs for Higher Education in partial fulfillment of the requirements for the degree of Doctor of Education

Nova Southeastern University

December, 1995

JC 960 613

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Abstract of a practicum report presented to Nova Southeastern University in partial fulfillment of the requirements for the degree of Doctor of Education

A COMPARISON OF STUDENTS WHO FOLLOWED MATHEMATICS ADVISEMENT RECOMMENDATIONS AND STUDENTS WHO DID NOT AT ROCHESTER COMMUNITY COLLEGE

by

Bonnie Mercer

December, 1995

The problem under investigation was that it was unclear whether students who followed the advice of the placement test in mathematics and enrolled in a developmental math class had higher pass rates than students who disregarded the advice and enrolled in math classes of their choice. The purpose of this experimental research study was to determine the relationship of the pass rate in college level math classes of mathematically under prepared students who enrolled in developmental courses and mathematically under prepared students who do not enroll in developmental courses. The research question was, "Do students

who do not heed math placement advice, pass college level math courses at the same rate as those who are appropriately placed?"

After a review of the literature, data collected from the class lists included assessment test scores, enrollment in the prerequisite math class and final grades from 73 students in the college level math class, Math 103.

The data were tabulated using a Chi Square statistical test to test the independence of passing Math 103 and the appropriateness of the placement.

The results show that with a Chi Square of 4.687, the null hypothesis was rejected at the .05 level of significance. This study has found that there is a relationship between passing a college level math course and the appropriateness of the advice given by counselors based on students' math skill assessment scores.

It is recommended that this study be shared with counselors and that they integrate the findings with their advice to developmental math students.

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Chapter 1

INTRODUCTION

RCC counselors meet with new students to interpret their placement test scores and to suggest that they take the indicated pre-college level courses. Some students have followed the advice and have taken the needed developmental math course before enrolling in a college level math course, but other students have elected not to follow the recommendation. The counselors would like to be able to tell students that the developmental math course will definitely prepare them for college level math. The problem was that it was unclear whether students who followed the advice of the placement test in mathematics and enrolled in a developmental math class have higher pass rated than students who disregard the advice and enroll in classes of their choice.

The purpose of the study was to compare the pass rate (grade of "C" or higher) in college level math classes of mathematically under prepared students who enrolled in developmental courses and mathematically under prepared students who do not enroll in developmental courses.

Many mathematically under prepared students who choose to enroll in classes for which they are not prepared, as indicated by the skills assessment, have to withdraw from classes during

the quarter because of failing grades. In order to increase their success, RCC wanted evidence that students who do complete the developmental courses do, in fact, experience greater success.

This practicum was directly related to the Research Methodology seminar according to Grizzle, Ligas, and Rankin (1994,p.13) in that it demonstrates competency in at least two seminar objectives. First, the procedures required to conduct research were used. They included: description of the problem, formulation of a solution (through the statement of purpose, the research question, and research hypothesis), evaluation of other research, collection of data, presentation of the results, interpretation, conclusions, and recommendations. The second competency was to recognize the influence of this study on educational policy, practice, and decision making at RCC.

Research Question

The research question for this study was, "Do students who do not heed math placement advice, pass college level math courses at the same rate as those who are appropriately placed?"

Research Hypothesis

Rochester Community College students who place into, but do not enroll in a developmental math course will have the same passing rates in Math 103 as developmental enrollees.

Definition of Terms

ASAP. The Academic Skills Assessment Program is standardized math, English and reading tests published by ACT for use by the Minnesota Community College System.

College level class. College level classes are those classes offered to students who score above a pre-determined cut off score on a standardized skills assessment. The classes are generally accepted as transferable to other colleges.

Dependent Variable. The dependent variable in this experimental research study is passing the college level math class, Math 103, with a course grade of "C" or higher.

Developmental. Developmental level courses are those classes offered to students who score below a pre-determined cut off score on a standardized skills assessment. The classes are often considered remedial and generally do not transfer to other colleges.

Independent Variable. The independent variable in this experimental research study was whether or not students heed math ASAP placement advice given by counselors. There were two levels. The student was either appropriately placed or not appropriately placed.

Chapter 2

REVIEW OF THE LITERATURE

The review of the literature was focused on two areas for this research report. First, mathematical competencies were identified for success in college, and second, remediated students' pass rates in higher level math courses were studied. These two main areas were further defined by the following five subheadings: early alert, women and math, students at risk, success in subsequent courses, and retention.

Mathematical Competencies

Garofalo (1990, p.75) reports on the mathematical competencies that are needed for success in college. He recommends developmental mathematics competencies including problem solving, reasoning, connections, communication, number and operation sense, relationships, probability, and measurement. He states that these are requisite math skills.

Blais (1995, p.2) agrees when he says that the only really effective way to carry out remediation in mathematics is to get mathematically weak students to use their minds the way mathematical experts use theirs. Research dealing with how capable math students think provides insights on pedagogical models designed to empower mathematically weak students.

There are several groups of prospective students (recent high school graduates and women) that the literature suggests need special attention to math competencies.

Early Alert

Moffat (1991,p.1174) states that even though students are inclined to relax during their senior year of high school, they don't like the idea of spending the first year of college taking noncredit math courses. And, their parents don't like paying for it. School districts in Ohio administer a test to juniors in high school to warn them of their math deficiencies in time for them to correct their shortcomings before graduation.

Bottge and Hasselbring (1993,p.55) agree that for adolescents with a history of difficulties with mathematics, achievement trends portray a gloomy picture. This group of students is at a great risk of finishing school without the skills necessary to function in everyday life.

The dismal math skills of high school graduates is also addressed by Rouche and Roueche (1993,p.20). They state that today's students are leaving high school no better prepared than they were in the mid 1960's. Despite higher grade point averages in high school, students' skills and competencies are at the lowest levels in American history.

Women and Math

The literature show that often mathematically weak students are women, but a number of innovative approaches are being developed that aim to draw more women into careers in engineering and science. Brennan (1993,p.43) discusses a high school program that sparks the interest in math for high school women. A summer camp that fosters interest in math and science involves mentoring, technical instruction and visits to manufacturing plants. Zaslavsky (1994,p.47) states that math programs that take place outside of the traditional school setting are generally successful with females and other minorities. She lists the following reasons for their success: well trained teachers with high expectations, cooperative student work groups, role models who provide career information and encouragement.

Remediated Students' Pass Rates

According to Armstrong (1991,p.4), a new system to provide objectiveness was implemented at Eastern New Mexico University to improve curriculum and programs. Among the various forms of outcome assessments, math pass rates were studied. She found that 54% of the new students needed developmental math and that 3 years later 88% of them passed the math course series.

Similar pass rates were found at Nassau Community College. Levine (1990,p.5) found that remediated students' pass rates in three of five higher level math courses were comparable to students who did not need remediation.

Perhaps, some of the instructors at Nassau community College used some of the instructional strategies that Hirsch (1994,p.10) mentions. He states that many developmental students come from family and educational backgrounds which do not prepare them well for academic success. Among his 16 teaching strategies, he suggests using successive approximations to emphasize student success. Introduce material at a level where the students experience success right away, then add new material gradually.

In addition, attention was focused on the literature in the areas of students at risk, success in subsequent courses, and retention.

Students at Risk

In addition to the literacy and preparedness problems of recent high school graduates, community colleges are faced with another population that expands the at risk pool, according to Roueche and Roueche (1993,p.20). Adult learners are characterized by economic, social, personal, and academic insecurities that threaten their chances for success in college.

They have found that learning-to-learn strategies and cooperative learning techniques have enabled these at risk students to perform college level work.

In addition, Kangas (1991,p.5) finds that all of the remediated students in his study of withdrawing students gave advice to new students to attend all classes, do all assignments, ask questions, and stick with school. The successful group of students had a degree or certificate as a goal.

Elifson, Pound, & Stone (1995,p.6) mention that developmental studies programs, including math classes, serve as guardians of standards. Students must be fully prepared for college, either on admission or through developmental course work, before engaging successfully in the college level core curriculum. In community colleges with open admission polities, the developmental courses serve this function of preparing students for college level work.

Success in Subsequent Courses

The literature reveals conflicting evidence of success in subsequent courses for developmental students. Petrowsky (1994,p.13) finds that completing a college level math course has a small but significant effect on the final term average in a college economics course. Whereas, Lyons (1990,p.27) states that

former developmental math students do not "do well" in target math classes. At Arapahoe Community College (1994,p.120), students who successfully completed pre-algebra subsequently performed at about the same level in algebra as students who tested directly into pre-algebra. Former developmental students had higher completion rates in algebra than student who tested into algebra. However, Leás (1993,p.20) finds that former developmental education students in intermediate algebra attained a lower gpa than students placed into intermediate algebra.

Retention

Retaining students in college is a complex issue that seldom has a single cause, but involves the interaction of different variables. Umoh, Eddy & Spaulding (1993,p.38) studied the relationship between six variables and students enrolled in developmental math programs. Their results show no statistically significant differences among the variables defined for the study. Factors such as age, gender, parents education, grade point average, academic goal commitment, academic integration, institutional experience, and placement grades were statistically not significant at the .05 level.

Belcher (1994,p.3), however, points out that a new model for student success juxtaposes academic programs and support services

so that they complement one another and improve their effectiveness. The model stresses a proactive approach, with administrators, faculty, and staff all involved to design intervention strategies for vulnerable under prepared students in community colleges. She feels that a failed education is often more social than intellectual in origin. Community college leaders must accept the challenge to invest resources to develop and implement such models.

The literature focusing on mathematical competencies and remediated students' pass rates in college level math courses raise some important issues. The complexity of the issues are as varied as the individual students and institutions they attend.

Chapter 3

METHODOLOGY AND PROCEDURES

Several procedures were followed to complete this ex-post-facto research study. First, a review of the literature was conducted on the mathematical competencies that are needed for success in college. Topics were clustered around the subheadings of early alert and women and math. A review of the literature was also conducted on mathematically remediated students' pass rates. Topics were clustered around students at risk, success in subsequent math courses, and retention in college.

Data Collection

Next, class lists from Math 103, winter quarter 1995 were secured from the admissions and records department which included each student's grade in Math 103. Then math placement levels were obtained from the testing office for students on the class lists. Next, the records office provided students' transcripts that showed if the students enrolled in the prerequisite math class or not and what grade they received. Not only did students need to enroll in the prerequisite math class but they must have passed (grade C or higher) to be considered to be appropriately

placed into the college level Math 103. This raw data is represented in chart form in Appendix A.

The population for this study consists of all current and future students at RCC who place into developmental math classes. Some students choose to follow their counselor's advice and enroll in a developmental class, other students disregard the advice. The sample for this study was defined as students enrolled in Math 103 for winter quarter, 1995.

The raw data was separated into four categories, pass (grade A, B, or C) or not pass (grade of D, F, or W) in Math 103, and appropriate (heeded placement advice) or inappropriate (did not heed advice) placement. This four cell chart is in Appendix B.

Data Analysis

The data were tabulated using a chi-square statistical test to test the independence of the two variables of passing Math 103 and the appropriateness of the placement. Chi square was used because it is a means of answering questions about data existing in the form of frequencies or categories according to Bluman (1995,p.419). The null hypothesis states that there is no significant difference in pass rates between Math 103 students who follow advice and those who do not follow advice. Or, stated simply, the pass rate is independent of the advice.

The alternative hypothesis, however, states that the pass rate is dependent on the advice. If the null hypothesis in not rejected, the test means that both groups of students (heeding advice and not heeding advice) pass Math 103, and differences are due to chance. If the null hypothesis is rejected, the test means that one group of students passes Math 103 differently than the other group.

The data were analyzed using Stat Star Software (McDougall & Stevens, 1992). The data were analyzed at the .05 level of significance and are presented in Appendix C.

Assumptions

It was assumed that this data tabulated in table form in term of frequencies meets the conditions required for using a Chi Square distribution to test independence of two variables. It was also assumed that students are demographically similar in the math classes. The samples were selected from classes taught by the same instructor to control for possible variation in grading/evaluation procedures.

Limitations

This study was limited to the math classes taught by one instructor at Rochester Community College and is not generalizable to another environment. Also, this study does not account for other factors that can influence student achievement, such as motivation or other affective qualities.

Chapter 4

RESULTS

The results, the outcomes of each of the procedural components presented in the previous section, are reported here beginning with the literature search.

The research question for this research practicum was, "Do students who do not heed placement advice pass college level math courses at the same rate as those who are appropriately placed?" This question, as well the seminar competency stated by Grizzle, Ligas, and Rankin (1994 p.13) that this study may influence educational policy, practice, and decision making at RCC, helped focus the literature review. Topics were clustered under the headings of mathematical competencies and remediated students' pass rates.

First, data was collected from 73 student participants. There were 35 students who passed the college level math class and were appropriately placed by heeding the counselor's advice. But 15 students also followed the counselors placement advice and did not pass. Of the students who were not appropriately placed 13 did not pass, but 10 students did pass Math 103. Next, the data were analyzed using the Stat Star statistical software package for Chi Square test. The degrees of freedom were

computed to be 1, df=1 and the Chi Square was computed to be 4.687, $x^2 = 4.687$. The explanation of the data analysis is in appendix D. Since the df=1, and the level of significance or maximum probability of committing a type 1 error in hypothesis testing is .05, the critical value is 3.841. Hence, the decision is made to reject the null hypothesis since 4.687 > 3.841. This means that the null hypothesis that states that the pass rate in Math 103 is independent of the counselor's advice is rejected. The results of this study support the hypothesis that there is a relationship between passing a college level math course, Math 103, and the advice given by counselors based on students' math skill assessment scores. Students who followed the placement advice given by counselors were more likely to pass a college level math course.

Chapter 5

DISCUSSION, CONCLUSIONS, IMPLICATIONS, AND RECOMMENDATIONS

Discussion

Three aspects of this practicum can be elaborated on in terms of discussion, conclusions, implications, and recommendations. These aspects include the need to disseminate the results of this study, provide new advising techniques to counselors and to follow-up with a new study after the techniques have been in place for two years.

First, the results of this study confirmed that students who followed the placement advice given by counselors were more likely to pass a college level math course. Issues of internal validity of research design were considered and it was decided to select class lists from classes taught by the same instructor to control for possible variation in grading/evaluation procedure. Extraneous variables such as motivation, seeking tutoring, and hours devoted to study can threaten the validity of this study, but it is assumed that these factors were equally distributed among the 73 participants of the study. Also, the results of this study are generalizable to all current and future math students at RCC.

Second, counselors then need to be informed about the results of this study and integrate the results into their advising sessions with students. Third, the literature revealed conflicting evidence of success in subsequent math courses for developmental students (Lyons, 1990, p.27; Leas, 1993, p.20), but this study supported the pass rates of former developmental math students in a college level math class.

Conclusion

There were three conclusions that were drawn from this discussion. First, the study supported the conclusion that students should heed their counselor's math advice. Second, the math advice does make a difference if students are t pass college math. Third, counselors can advise with confidence that students must follow the placement recommendation into math courses.

Implications

There are three implications that can be drawn from the conclusion. First, counselors can improve chances for student success with new advising techniques. Second, in-service training of counselors where the results of this study are shared will provide a new knowledge base for counselors. A third implication is that RCC will focus more on students passing math

classes which will allow them to progress smoothly through the math series.

Recommendations

Three recommendations flow from the implications. First, it was recommended that RCC make an effort to change the advising sessions that counselors conduct with math students. The Dean of Students of RCC should share this study with the counselors and provide them with opportunities for learning new advising techniques. Third, after the new advising system is in place for two years, this study should be replicated to study the math pass rates.

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APPENDIXES

APPENDIX A

Raw Data

Student #	Math Placement	Prerequisite	Prereq. Grade	103 Grade	Cell
4778	099, 103 or 107	099	C	D	app/not pass
3958	099,103 or 107	103	B	W	app/not pass
4738	098	098	B	W	app/not pass
4751	099,103	098	F	W	app/not pass
4759	098	098	C	D	app/not pass
4689	099, 103 or 107	103	D	D	app/not pass
3998	098	103	C	D	app/not pass
4749	099	NA	NA	W	app/not pass
4768	099, 103 or 107	NA	NA	D	app/not pass
4708	098	099	C	F	app/not pass
3889	099, 103 or 107	NA	NA	W	app/not pass
4698	099	NA	NA	D	app/not pass
4700	096	098	C	W	app/not pass
4769	099, 103 or 107	NA	NA	D	app/not pass
4708	099, 103 or 107	099	D	D	app/not pass
4729	099, 103 or 107	098	D	C	not app/pass
4758	098	098	D	C	not app/pass
4751	098 or 110	099	F	B	not app/pass
5275	098 or 110	NA	NA	A	not app/pass
4738	NA	NA	NA	A	not app/pass
4699	NA	NA	NA	A	not app/pass
0525	NA	NA	NA	C	not app/pass
4738	NA	NA	NA	B	not app/pass
4748	NA	NA	NA	C	not app/pass
4760	NA	NA	NA	A	not app/pass
4707	undecided/discuss with counselor	117	F	W	not app/not pass
4697	099,103 or 107	098	D	F	not app/not pass
4721	098	098	D	W	not app/not pass
3898	098	098	D	D	not app/not pass
4690	098	098	D	D	not app/not pass
4711	096	NA	NA	D	not app/not pass
2707	098	098	D	F	not app/not pass
4698	098 or 110	096	B	D	not app/not pass
4701	098	098	F	D	not app/not pass
4759	096	096	F	F	not app/not pass
4739	NA	NA	NA	W	not app/not pass
4728	096	096	C	F	not app/not pass
4719	098 or 101	099	D	F	not app/not pass

Student #	Math Placement	Prerequisite	Prereq. Grade	103 Grade	Cell
4708	NA	099	D	B	app/pass
4768	099,103 or 107	099	C	B	app/pass
4730	099, 103 or 107	099	C	C	app/pass
4720	099,103 or 107	NA	NA	B	app/pass
4759	127	127	C	A	app/pass
4688	120	208	B	A	app/pass
4698	098	098	C	C	app/pass
4728	098	098	B	A	app/pass
4699	106 or 117	NA	NA	A	app/pass
4729	099	NA	NA	A	app/pass
4765	098 or 110	098	A	B	app/pass
5226	099,103 or 107	099	B	B	app/pass
4741	NA	103	D	B	app/pass
4749	099, 103 or 107	099	C	B	app/pass
4688	098	099	D	B	app/pass
4750	099, 103 or 107	NA	NA	A	app/pass
4720	098	099	C	B	app/pass
4770	099, 103 or 107	NA	NA	B	app/pass
4730	106 or 107	106	F	B	app/pass
4738	099, 103 or 107	NA	NA	A	app/pass
3881	099, 103 or 107	NA	NA	A	app/pass
4741	099, 103 or 107	NA	NA	C	app/pass
4810	NA	099	A	A	app/pass
4700	098	NA	NA	C	app/pass
4741	106 or 117	NA	NA	B	app/pass
4618	098	098	A	C	app/pass
5232	099, 103 or 107	NA	NA	B	app/pass
4720	099, 103 or 107	099	C	B	app/pass
4699	106 or 117	NA	NA	B	app/pass
4727	099, 103 or 107	117	C	A	app/pass
4730	099, 103 or 107	099	C	C	app/pass
4800	099, 103 or 107	NA	NA	A	app/pass
4770	106 or 117	119	A	A	app/pass
4768	098	098	C	B	app/pass
4682	099, 103 or 107	NA	NA	B	app/pass

APPENDIX B

Four Cell Chart

	Not Pass	Pass
Appropriate	15	35
Not Appropriate	13	10

APPENDIX C

STAT-STAR Data Analysis

Name:_____ Date: 11/9/1995 Time: 13:16

Datafile: NONAME.SSC Procedure: Chi Square |Contingency

Obs f Exp f R prop.	A1	A2	R Tot/prop.
Cat B1	15	35	50
	19.178	30.822	
	0.300	0.700	0.685
Cat B2	13	10	23
	8.822	14.178	
	0.565	0.435	0.315
C Tot/ prop.	28	45	73
	0.384	0.616	1.000

df = 1
Chi Square = 4.687 prob = 0.03040
Phi Coefficient = 0.253

(W/ Yate's Correction)
Chi Square = 3.632 prob = 0.05668

APPENDIX D

STAT-STAR Explanation

Name:_____ Date: 11/13/1995 Time: 16:16

Datafile: NONAME.SSC Procedure: Chi Square |Contingency

```
+------------------- Explanation of Operators -----------------+
|   * = Multiply      SUM = Summation        SQRT = Square root |
|   / = Divide        ^SQ = Quantity squared                    |
+-----------------------------------------------------------------+
```

The TWO-WAY CONTINGENCY-TABLE CHI SQUARE tests whether two categorical variables are independent (uncorrelated). Let the column variable be "A" and the row variable "B." The quantity (fo-fe)^SQ/fe is computed for each A,B combination ("cell"), and then summed across all of the cells to yield chi square, i.e., SUM [(fo-fe)^SQ/fe]. In this expression, fo = the observed frequency for the cell, and fe = the "expected" frequency for the cell, based upon the Null Hypothesis of independence between the two categorical variables. When df = 1, Yate's correction is made according to the formula: SUM [(|fo-fe|-.5)^SQ/fe]

The fe for each cell is given by the following:

fe = (N.row * N.col) / N.tot

For the A1,B1 cell,

fe = (50 * 28) / 73
= 19.178
fo = 15

Thus, without Yate's correction, (fo-fe)^SQ/fe for this cell

= (15 - 19.178)^SQ / 19.178
= 17.456 / 19.178
= 0.910

Thus, with Yate's correction, (|fo-fe|-.5)^SQ/fe for this cell

= (| 15 - 19.178 |-.5)^SQ / 19.178
= 13.528 / 19.178
= 0.705

For the entire table, chi square equals 3.632 (with Yate's correction). This value is evaluated with respect to the sampling distribution of chi square having

df = (A-1) * (B-1)

= (2 - 1) * (2 - 1)
= 1

CRAMER'S V assesses the magnitude of the association between the two variables. It ranges from 0 (no association) to 1 (perfect association). V is defined as follows:

V = SQRT [chi square / (N.tot * (s-1))]

= SQRT [4.687 / (73 * 1)]

= SQRT [4.687 / 73.000]
= 0.253

where: s = the number of rows or the number of columns, whichever is smaller.