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ABSTRACT

This study sought to determine the effectiveness of augmenting instruction of "math-anxious" community college algebra students with a counselor. The control group, with about 25 students, was comprised of students in Term I (August-December 1984) who received algebra instruction in the traditional lecture method. The experimental group, also with about 25 students, contained students in Term I who were primarily self-identified as "math-anxious" and received counseling throughout the term in addition to the standard lectures. No significant difference was found between scores on the final examination, a standard college-wide test. The two groups performed about equally throughout the term. However, some success for counseling was indicated by the fact that even though experimental students had a lower grade point average, more control group students actually failed the course. Six recommendations are included. (MNS)

AN ANALYSIS OF A LOW-STRESS ALGEBRA CLASS DESIGNED FOR "MATH-ANXIOUS" COMMUNITY COLLEGE STUDENTS

LEARNING THEORY AND APPLICATIONS

by

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ABSTRACT

The purpose of this study was to determine the effectiveness of augmenting instruction of "math-anxious" Algebra students with a counselor. The study was done at the Judson A. Samuels Campus of Broward Community College in South Florida.

The control group was comprised of Beginning Algebra students in Term I (August-December, 1984) who received instruction for the course in the traditional lecture method. The experimental group was comprised of Beginning Algebra students in Term I who were primarily self-identified as "math-anxious" and received counseling throughout the term in addition to the standard lectures.

The Null Hypothesis stated that there would be no significant difference in the final examination scores obtained by each group. The final examination used was the standard college-wide multiple choice test. The statistical test chosen to compare the data results was an independent t-test. The level of significance was set at .05.

The results of this analysis failed to reject the Null Hypothesis. There was no significant difference regarding the exam results for either group. The study did establish the fact that the "math-anxious" group performed about as well as the control group not only on the final exam, but throughout the term.

When comparing the mean GPAs for both groups during the term (control = 2.039, experimental = 1.404) and considering that more control group students (31% vs. 26%) actually failed the course, these facts seem to indicate some measure of success for the method. Significantly, the "math-anxious" group was 70% female while the control group

was 55% female. Female noncompletors (audits, withdrawals) outnumbered males nine to sixteen.

The recommendations based upon these results are as follows:

1) Establish set criteria for identifying math-anxious students.

2) Carefully analyze all students' backgrounds in an effort to identify those who are "math-anxious."

3) Establish math help groups and workshops with special tutors for poor math students - particularly female.

4) Statistically evaluate the results of a newly formed math anxiety section of Beginning Algebra.

5) Expand anxiety math to include Intermediate Algebra.

6) Make all materials developed available to any math students.

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INTRODUCTION

The performance of students throughout a term is as significant as the percentage who actually complete a given course. Retention and success are inextricably linked. Ultimately, each institution may come to be evaluated and funded on its ability to produce results in these two critical areas. Although vocational educators are already familiar with this concept, academic programs are just beginning to sense the movement. One conspicuous example is the math and English requirement set by the state in the form of the "Gordon Rule."

Presently, a student seeking a degree from a two-year institution must complete six hours of mathematics at the Intermediate Algebra level or above. Yet, many students enter the junior college with little or no math background. Compounding the problem is the debilitating condition of math anxiety or math phobia exhibited by many of these students. Students who are simply deficient in math skills can be remediated. However, those with legitimate fears and anxiety have perhaps never experienced success in mathematics and thus they will most likely not be able to be retained by any instructor. The purpose of this study was to determine if success and consequently higher retention rates could be achieved with math-anxious students by placing them in a special section of Beginning Algebra.

In addition to standard mathematical instruction, the "math-anxious" student in the special section of Beginning Algebra was counseled and encouraged weekly by a psychologist in an effort to minimize or hopefully eliminate irrational fears of mathematics. The standard college-wide final examination was administered to both the special section and a

regular section of Beginning Algebra. The examination was a cumulative, 50-question, multiple-choice test with each question having equal weight. The results of this test were statistically examined to determine if greater learning had occurred in the special section of Beginning Algebra.

BACKGROUND AND SIGNIFICANCE

In conjunction with their efforts to increase learning, maximize student retention and provide opportunities for overall success in mathematics classes, many educators have discovered the existence of a barrier to learning called "math anxiety." The term, which was popularized by Shelia Tobias, author of Overcoming Math Anxiety (1980), can be defined as "an irrational and often debilitating fear of math" (Fiske, 1980). Henig (1983) remarks that the presence of such a condition may result in

> headaches, backaches and stomach problems. Those with less intense fears describe their brains as 'going on hold' when numbers appear; they say their minds become cloudy, unfocused, filled with a deadening hum.

Kogelman and Warren (1978) state that "many people react to math so strongly that their ability to memorize, concentrate and pay attention is effectively inhibited. This makes learning impossible." The purpose of this study was to determine whether math-anxious Algebra students can learn when instruction is augmented by a counselor.

The importance of identifying and correcting such a debilitating condition as math anxiety cannot be overstated. According to Tobias and Knight (1978), fields that were comfortably free of mathematics a decade ago are now more dependent upon computers and systems analysis. Fennessey (1978) states that math anxiety can be a serious career handicap. People who plan and administer large projects use mathematical models, cost-benefit analysis, and even cost accounting. In short, the avoidance of math on the job is becoming increasingly impossible. Sells (1978), in a study at the University of California at Berkeley,

found that without three-and-a-half years of high school math, entering students would have three-quarters of the college majors closed to them before they even began their college study. This precludes many people from entering such prestigious, high-paying careers as Engineering, Computer Science, Physics, Chemistry and Medicine. In terms of professional advancement, Henig (1983) points out that to obtain a graduate degree usually necessary to ensure a promotion, a standardized math exam must be passed before admission.

Although math anxiety usually occurs around adolescence (Louie, 1982), it is significant that many educational psychologists and math educators feel that it can be overcome or at least minimized. They believe learning can occur, regardless of age, sex, or past experience, with proper guidance and support. Tobias and Knight (1978) cite from experience with the math-anxious that elementary math can be taught differently the second time around, at a higher level of abstraction, and much more rapidly than before. Kogelman and Warren (1978) state that "since this is an emotional, not intellectual, inhibition, it can be overcome." In support of this theory, a series of math anxiety workshops have shown steady growth since 1975 when Shelia Tobias set up the first clinic at Wesleyan University in Middletown, Connecticut. Tobias estimates that 200 to 250 clinics now operate around the country. Typically, these classes are led by both a math instructor and a counselor who help participants focus on their emotional reactions to math (Henig, 1983). Several sessions may be held with the purpose of easing fear and overcoming anxiety so that learning may occur. Participants are encouraged to realize "that they are not inherently stupid at math but only anxious about it" (Louie, 1982). Several myths

about math are discussed and cast aside. Among the most common myths according to Tobias (1980) is the belief that a mathematical mind is one which you are born with. Another holds that adults who have not learned mathematics will never do so. Roy Hartkopf (1975) writes:

> The beginner - especially if he is an adult - feels ignorant and inferior and is strongly tempted to retreat to his own world where he will be among familiar surroundings and will be treated as an equal.

Kogelman and Warren (1978) refute that assertion with the statement, "...as an adult it becomes easier rather than harder for you to learn these things because of your years of practical experience. It becomes easier to relate what you are learning to your life." Probably the most significant myth is that women are not good at math - that men are better than women in math. Tobias (1978) states that there is ample evidence that avoidance of mathematics is disproportionate among girls and women. She continues by stating that "although men have math anxiety too, it doesn't trouble them quite as much." It is often felt that math is a male domain - that women should stay out and if they don't, there must be something strange about them. Tobias (1978) again states that:

> Early analysis of the autobiographies of women in mathematics concluded that these women either lacked a 'typical feminine identification' or were 'conflicted' over their female role.

Not all societies react the same way toward women in mathematics. Norton Dodge as quoted in Tobias (1978) cites that:

> Men in the Soviet Union are so accustomed to women participating in all fields of study, that the performance of girls is comparable to that of boys in Mathematics and Physics.

When a group of math-anxious students are ready and willing to attempt a math course, they are placed in a class directed by a counselor and a math teacher. The purpose of teaming these two professionals is to

offer psychological self-help and understanding along with mathematical training and to provide feedback to the math instructor as necessary.

In a project presented by Jean Cosgrove, instructor at Broward Community College, South Campus, a class of high-anxiety math students was taught by a team consisting of a math instructor and a counselor. This study was unanimously accepted, enthusiastically approved and fully funded by the South Campus Staff, Program and Development Committee. The effect of this learning method was studied and the results reported to college officials and other interested educators. The study provided useful information that can be used to improve both the instruction for this particular course and any other math course where anxiety is a factor. As for the students, Kogelman and Warren (1978) state that "when math anxiety has been overcome, both everyday tasks and work are easier."

PROCEDURES

The population consisted of a nonrandom sample of two classes. Each of the two classes of approximately 25 students was enrolled in Beginning Algebra during Term I (August-December, 1984) at Broward Community College, South Campus. The two classes were taught by the same instructor in identical fashion. Both groups had access to all the usual forms of extra help including the math lab and tutors. The group identified as math-anxious (experimental) also had the expertise of a counselor. Additionally, they met one extra hour per week to discuss problems related to math anxiety. They learned relaxation techniques and general problem-solving procedures. They did not receive any additional math-related assistance. During the term, the counselor and the math instructor met to discuss the class and its progress and adjustments were made accordingly.

At the end of the term, each class was given the same final examination and the results were compared. In the treatment of the statistical data, a t-test was used to determine any difference between the scores. A significance level of .05 was used. Class averages and retention rates were also discussed.

Research Hypothesis

There is no significant difference between the final examination scores obtained by students taking math-anxiety Beginning Algebra and those taking the regular Beginning Algebra.

Assumptions and Limitations

1) The sample is nonrandom.

2) The students have no other learning disabilities.

3) As a group, the math-anxious class has academic abilitites equal to those of the regular class.

4) The results are limited to students taking Beginning Algebra.

5) The method of determining math anxiety is accurate.

6) The degree of math anxiety was not determined.

RESULTS

The primary purpose of this study was to statistically determine whether the final examination results were significantly different between the anxiety (experimental) group and regular (control) group. A t-test with a significance level of .05 was used. The critical t-value according to the table is 2.045. The value obtained from the data in this study was .57. Therefore the study failed to reject the Null Hypothesis.

The mean scores on chapter tests as well as the final examination results (Table I) are similar for both classes.

TABLE I

Mean Score Comparison by Test

Test	Anxiety Class	Regular Class
Chapter 1	22.2	20.8
Chapter 2	13.2	15.2
Chapter 3	19.0	20.3
Chapter 4	18.7	19.4
Chapter 5	18.4	16.5
Chapter 6	13.8	13.4
Final Exam	24.0	25.4

Table II indicates retention rates and success were also comparable.

TABLE II

Success and Retention Percentages

Category	Anxiety	Regular
Pass	41%	48%
Fail	26%	31%
Noncompletors	33%	21%
Totals	100%	100%

Table III, however, clearly points out that the anxiety group was considerably lower in academic ability.

TABLE III

Mean GPAs

Group or Subgroup	Anxiety	Regular
All students (term)	1.404	2.039
All students (overall)	2.043	2.167
Completors (term)	1.545	2.204
Completors (overall)	2.026	2.250
Noncompletors (term)	1.122	1.407
Noncompletors (overall)	2.077	1.848

Last, Table IV indicates differences in sex and age between the two groups.

TABLE IV

Sex and Age Characteristics

Group	Male/Female (%)	Mean Age (all)
Anxiety	30/70	21.7
Regular	45/55	18.8

The control group had only one student over age twenty (27). The experimental group had seven students over twenty including two over the age of thirty.

DISCUSSION

The intent of this study was to verify that the aid of a counselor would result in higher achievement for the experimental group. The results, however, infer more equivalence than difference. Possible explanations are suggested from the compiled data. In particular, the experimental group was not academically equivalent in many instances to the control group. Placement in the math anxiety sections was determined primarily by student request. "Self-identified math-anxious" students requested information about the class from advisors. After an interview and math record check, the student was admitted if he was historically poor in math and expressed anxiety toward the course. It should also be noted that he was informed at this time of the requirement to spend one extra hour per week in class with the counselor. The commitment of additional time was thought to be a barrier to those students who were not serious about the project. Apparently, students who were poor in most every area--including math--were not weeded out at this time. Compounding the problem was the fact that almost half the anxiety class were first-time college students and had little academic background to check.

Of the seven students in the anxiety section who were over the age of twenty, four were noncompletors while five were taking the course for the second time. Interestingly, the mean age of completors in the anxiety group (22.06) was greater than the mean ages of both non-completors (20.89) and all students (21.67). This tends to corroborate the suggestion in the literature that age may not be a hindrance to learning.

The results of this study strongly support the literature regarding greater math anxiety among females than males. Although a large proportion of the anxiety class (70%) was female, a corresponding amount (64%) of the completors was also female.

RECOMMENDATIONS

Based upon an analysis of the data results, the following recommendations are offered with respect to the future of math anxiety courses at the Judson A. Samuels Campus of Broward Community College.

1) Formulate a precise definition of a "math-anxious" student.

2) Develop a strategy for identifying these students and coordinate resources for this purpose.

3) Continue offering Math-Anxious or Low-Stress Beginning Algebra with the more tightly controlled participants. Particular attention should be paid to females and older adults.

4) Institute a follow-up procedure to track completors' success in future math courses.

5) Devise a system whereby all math students could benefit from this research.

6) Articulate research findings with other departments campus-wide and math departments college-wide.

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