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Effects of journal writing on mathematics anxiety

Kevin J. Pelton
Rowan College of New Jersey

Effects of Journal Writing on Mathematics Anxiety

by
Kevin J. Pelton

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John Sooy

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ABSTRACT

Kevin J. Pelton, Effects of Journal Writing on Mathematics Anxiety, 1996, Thesis Advisor: John Sooy, Mathematics Education.

The purpose of this study was to determine the effects of journal writing on mathematics anxiety in developmental algebra classes at the college level. Two classes of "Elementary Algebra," comprised of twenty-three college level students, were used for this experiment. During the six week study, the experimental group, consisting of ten students, wrote in math journals on various mathematics topics assigned by the researcher. The control group, consisting of thirteen students, did not keep a journal. Both groups were pretested and posttested using the Mathematics Anxiety Rating Scale for Adolescents. Independent t-tests were used to analyze the results. It was concluded that there was no significant difference in the levels of mathematics anxiety between the control group and the experimental group.

MINI-ABSTRACT

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There was no significant difference in the levels of mathematics anxiety between the control group and the experimental group.

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CHAPTER 1

Introduction to the Study

Introduction

In the spring of 1989, the National Council of Teachers of Mathematics developed the Curriculum and Evaluation Standards for School Mathematics. The council recommended that all math students should be encouraged to keep journals describing their mathematical experiences. Since the Standards were released, a significant amount of research has been conducted, which has focused both on journal writing and its effect on math achievement at the elementary, middle school, and high school levels. Studies have indicated that journal writing is the most effective method of using writing in the mathematics classroom to improve mathematical achievement (Grossman and Miller, 1993; Bagley and Gallenberger, 1992). Journals enhance student/teacher dialogue, individualize instruction, build student self-esteem, and improve achievement in the math classroom (Olson and Deming, 1994).

Few research studies have been done on the effects of journal writing with underprepared college students. "It is well documented that the need for remediation in mathematics is the most common problem at public colleges and that the

number of college students who enroll in remedial mathematics classes has increased extensively over the past decade" (Ganguli, 1995). This study focuses on the effects of journal writing on mathematics anxiety in developmental algebra classes at the college level.

Statement of the Problem

The purpose of this study is to determine the effects of journal writing on mathematics anxiety in developmental algebra classes at the college level. The following hypothesis will be tested.

H_0: There is no significant difference in the level of mathematical anxiety between the control group and the experimental group.

Significance of the Problem

Mathematics anxiety has always been recognized as a serious problem in math education. Although researchers define it in a variety of ways, it refers to a feeling of dread that people have when they try to understand and do mathematics (NCTM, 1994; Tobias, 1976). For years, studies have consistently shown us the relationship that exists between mathematics anxiety and mathematical achievement. Higher

levels of mathematics anxiety are related to lower mathematics achievement test scores (Bessant, 1995; Martinez, 1987; Richardson and Suinn, 1972).

Mathematics anxiety has also been linked to students' career decisions. Researchers have found that many intellectually capable students avoid taking math courses in high school and college (Shodahl and Diers, 1984). "Math anxiety becomes a critical factor in a students' educational decisions and may influence the students' achievement of his or her career goals" (Betz, 1978). Research has continued to show us the importance of mathematics anxiety as a problem area, and the need to develop appropriate treatment methods.

This researcher has focused on the effects of journal writing on mathematics anxiety. Recent research has demonstrated that strong writing skills improve performance in the mathematics classroom (Abel, 1988). Specifically, studies have shown that the most effective method of using writing to help students learn mathematics is through the use of journals (Stuart and Chance, 1995; Peterson and Nahigang, 1986). But most of the research that has recently been conducted on journal writing has focused on achievement in the elementary and high school levels. Additional research needs to be done on the effects of journal writing on mathematics anxiety in developmental math courses at the college level.

Limitations

This study was conducted at Camden County College, located in southern New Jersey, over a six week period from November to December of 1995. Student enrollment is approximately 15,000 students, comprised of a minority enrollment of 22 percent. Two classes of "Elementary Algebra" were used for this experiment. This was a total of 23 students out of a possible 1400 students that were enrolled in this course during the fall semester of 1995. The experimental group met at 8:00 a.m., and the control group met at 12:00 p.m.

Definition of Terms

Control Group

those students in the Elementary Algebra class not subjected to the journal writing sessions.

Experimental Group

those students in the Elementary Algebra class subjected to the journal writing sessions three times a week.

Journal

a diary-like series of writing assignments. Each assignment or entry is a short written response to

an instructor's question, statement, or set of instructions (Peterson and Nahigang, 1986).

MARS-A

a 98-item test specifically designed for adolescents to measure the degree of mathematics anxiety.

Mathematics Anxiety

feelings of tension and anxiety that interfere with the manipulation of numbers and the solving of mathematical problems in a wide variety of ordinary life and academic situations (Betz, 1978).

Procedures

The population to be tested for this experiment was comprised of students from Camden County College. The sample used included two sections of "Elementary Algebra." Both of these classes were taught by the researcher for the entire 1995 fall semester. Each class met three times per week for 50 minutes. The experimental group, which met at 8:00 a.m., was comprised of ten students. The control group, which met at 12:00 p.m., was comprised of thirteen students.

A mathematics anxiety pretest, the Mathematics Anxiety Ratings Scale for Adolescents (MARS-A), was given to both groups immediately following the mid-term examinations. During

the next six weeks, the experimental group wrote in math journals on specific topics assigned by the researcher. At the conclusion of the semester, both classes completed the same MARS-A. The results from the posttest were then used to determine if there was a significant difference in the levels of mathematics anxiety between the control group and the experimental group. An independent t-test was used to analyze the results.

CHAPTER 2

Related Research and Literature

Introduction

When the Curriculum and Evaluation Standards for School Mathematics was released by the National Council of Teachers of Mathematics (NCTM) in 1989, journal writing began to receive an enormous amount of attention. NCTM recommended that "students should be encouraged to keep journals describing their mathematical experiences, including reflections on their problem solving thought processes. . . These activities can foster students' positive attitudes about mathematics. . ." (142). Since the release of the Standards, a large amount of research and literature has been published on the potential benefits of writing in the mathematics classroom. Unfortunately, most of this has been limited to elementary, middle school and high school students. This researcher will focus on the related research and literature on both journal writing and mathematics anxiety at the college level.

Related Research on Journal Writing

Carolyn B. Stewart conducted a study at Memphis State

University in 1993 involving 110 college algebra students. The purpose of this study was to examine the effects of journal writing on both mathematical achievement as well as mathematical anxiety. Four algebra classes participated in this study. Two classes wrote in journals daily (the experimental group), two classes did not (the control group). Pretest and posttest scores from the Tennessee Comprehensive Assessment Program (TCAP) and the Mathematics Anxiety Rating Scale for Adolescents (MARS -A) were used to determine if there was a significant difference in the levels of achievement and anxiety between the control group and the experimental group. The results from the TCAP scores found that "the journal writing group's gains were significantly higher than the non-journal writing groups" (42). Although this study found that journal writing had a positive effect on mathematical achievement, the results indicated no significant differences in the levels of mathematical anxiety.

In 1991, a study was conducted at the University of Minnesota involving 25 college algebra students. During a 12-week period, students were asked to complete in class writing assignments on a variety of math concepts as well as procedures for solving problems. The researchers concluded that these journals helped remedial students think mathematically. "The writing-to-learn-mathematics teaching strategy helped students not only to reexamine their mathematical understandings but also to apply previously

learned concepts to analyzing new problems" (50). In addition, all 25 students responded very positively when asked if they thought that the writing assignments helped them to understand mathematics better. Ganguli concluded from these responses that additional research should be done to determine the effects that journal writing may have on mathematical anxiety.

In 1993, one of the largest studies ever done on journal writing at the college level was conducted at the University of Southern Mississippi. Over 14 college algebra classes participated in this study over a 15-week period. Half of the classes wrote in journals daily. The remaining students did not participate in any writing assignments. The purpose of this study was to look at the effects of journal writing on both mathematical achievement as well as mathematical anxiety. Unlike many of the previous studies, this one specifically focused on differences in achievement and anxiety between male and female students. The researchers found that there was a significant difference in the levels of mathematical anxiety between the control group and the experimental group involving the male students only. They found no significant difference with the female students. The researchers concluded that at the college level, daily journal writing is more beneficial to male students than to female students (216).

Frances Jo Grossman, Brenda Smith, and Cynthia Miller conducted a study at Georgia State University in 1993 involving 70 intermediate algebra college students. In

addition to keeping daily journals, students were given writing questions for homework and on in-class quizzes and tests. During this 14-week period, writing about mathematical concepts became a regular activity during class instruction and was presented as a part of the learning process (2). This study also focused on what effects journal writing would have on mathematics anxiety. The researchers concluded that "when students were given regular opportunities to participate in a dialogue with their teacher through the journal, mathematics anxiety was lessened" (4). The journals helped students build their self-esteem and self-confidence which plays a vital role in the learning process.

In 1988, a study was conducted at Hofstra University by Kathleen Schatzberg-Smith. She felt that "prior researchers on dialogue journal writing traced the development of language and reasoning abilities in elementary students, but few researchers focused on college learners, none on underprepared students" (436). During this 15-week study, 38 college students exchanged dialogue journals daily with their mathematics instructor. The researchers concluded that journal writing appeared extremely promising for reducing levels of mathematics anxiety in underprepared college students.

Carolyn Stewart continued her research at Memphis State University in 1995. Her previous studies had linked journal writing to higher achievement, but could not show a statistical relationship to decreasing mathematics anxiety. In

this study, students from four college algebra classes wrote in journals three times a week during the last five minutes of the class. This time however, the teacher collected and responded to the journals each time. Using the MARS -A, Stewart found that "similar tests performed on the changes-in-anxiety scores suggested for dialogue journal-writing students a decrease in anxiety that approached significance" (93).

Related Literature on Journal Writing

Much has been written on the numerous benefits of having students write in the mathematics classroom. Writing has long been recognized as a valuable learning tool that helps to promote thinking (Abel, Davison and Pearce, Ganguli, Grossman, Wilde). Students who are required to write must do considerable thinking and organizing of their thoughts before they write (Johnson). In "Using Writing To Learn Mathematics," Nahrang and Peterson argue that writing should be used in all mathematics classrooms to improve learning. It provides the student with the opportunity to formulate, organize, internalize, and evaluate concepts (461). Many educators would agree that the most effective method of using writing to help students learn mathematics is through the use of math journals (Bagley and Gallenberger, NCTM, Olson, Stewart and Chance). "Our experience in college-level classes, from algebra through calculus, makes us feel confident that these short but powerful writing exercises enhance learning" (461).

In "Assessing Students' Dispositions: Using Journals to Improve Students' Performance," Bagley and Gallenberger also discussed the many benefits of using journals in the mathematics classroom. Journal writing allows students to:

1) participate by communicating ideas, questions, or suggestions when they are too shy or intimidated to do so in front of the entire class.

2) write freely without concern about spelling, punctuation, style and so on.

3) summarize, organize, relate and associate ideas.

4) define, discuss or describe an idea or concept.

5) experiment with, create, or discover mathematics independently.

6) review topics.

7) reflect on class by summarizing goals, strategies, reactions, accomplishments, or frustrations.

8) openly express positive and negative feelings and frustrations. (661)

In their college classrooms, Bagley and Gallenberger felt that journal writing encouraged their students to articulate their thoughts which helped them to better understand many algebra concepts. "Our students learned to internalize and reflect on what we did in algebra class: they learned to make connections, relate information, synthesize, organize their thoughts, and analyze" (462). The journals helped the students to realize what they know and what they don't know.

Raffaella Borasi and Barabara Rose's "Journal Writing and Mathematics Instruction" also addresses the many potential

benefits of having students write in math journals during class. In addition to increased learning of mathematical content, they found that journal writing helps students to increase their problem solving skills. It is a device that can greatly aid in the problem solving process and stimulate create thought by the students (Johnson). It helps to clarify the "process" as well as makes students aware of how they do mathematics. "By asking the students to report in their journals how they solved the problem or approached the study of a topic, they can become encouraged to become introspective of how they do and learn mathematics, and consequently to identify more general heuristics to solve mathematical problems as well as to realize the possibility of alternative approaches to the same learning task" (356).

One of the most obvious benefits of mathematical journals is the drastic increase in student/teacher interaction and dialogue (Abel, Bagley, Borasi, Ganguli, Grossman, Olson, Stewart). In "Dialogue Journals: Barometers for Assessing Growth in Developmental Learners," James Olson points out that it is almost impossible for instructors to give heavy, individualized instruction to all of their students. Many students are too shy to ask questions or to meet one-on-one with the teacher, and journals provide the opportunity to bridge that gap of communication. "The dialogue journal is individualized instruction par excellence. The private, thoughtful nature of the interaction allows students to

express ideas and ask questions that they would not have in the open classroom" (27). Olson further argued that journal writing should be used in all math classrooms because they help to:

1) enhance student/teacher dialogue.
2) build students self esteem.
3) give personal attention to students.
4) individualize instruction.
5) assess student perceptions of instruction.
6) adjust instruction as needed.
7) investigate metacognitive aspects of learning.
8) uncover "social and emotional baggage."
9) confront student learning problems (28).

Related Research on Mathematics Anxiety

One of the largest studies ever done on mathematics anxiety at the college level was conducted by Nancy Betz at Ohio State University in 1978. Over 650 students in developmental algebra classes at Ohio State participated in this study. Researchers concluded that a very high percentage of college students are math anxious, and that women reported significantly higher levels of mathematics anxiety than did men. In addition, researchers found a relationship between low math achievement and high anxiety, as well as the number of years in high school math and mathematics anxiety. Nancy Betz concluded that "the relatively high prevalence of math anxiety

in the college students studied strongly suggests the need both for increased awareness of math anxiety as a potential problem area and for the developmental of appropriate treatment methods" (447).

In the summer of 1995, a study was published in the Journal For Research in Mathematics by Kenneth Bessant. 173 students enrolled in introductory statistics courses at Brandon University in Manitoba participated in the study. The researchers focused on the Mathematics Anxiety Ratings Scale (MARS) and specific types of anxieties and attitudes. They identified six factors labeled as General Evaluation Anxiety, Everyday Numerical Anxiety, Passive Observation Anxiety, Performance Anxiety, Mathematics Test Anxiety, and Problem Solving Anxiety (327). The researchers concluded that "first and foremost, mathematics anxiety is a multidimensional concept" (342). Bessant recommended that further research should be done to perhaps expand the meaning of mathematics anxiety.

James Rounds and Darwin Hendel conducted an experiment at the University of Minnesota in 1980. 350 female students, all enrolled in a mathematics anxiety treatment program at the university, were the subjects of the study. The focus of the study was on the reliability of the Mathematics Anxiety Rating Scale and whether it should be used in identifying math-anxious individuals and in evaluating treatment programs. The results were very similar to Kenneth Bessant's study. The

researchers concluded that mathematics anxiety as measured by the MARS is not a unidimensional construct (145). "The domain of mathematics anxiety by the MARS is best described not as anxiety about everyday numerical manipulation, but primarily as test anxiety and secondarily as anxiety associated with mathematics courses" (145). Researchers also concluded that mathematics anxiety is not limited to females but is common to all students who are poorly prepared in mathematics.

In 1969, Ralph Anttonen conducted a study at Western Reserve University in Cleveland, Ohio. Over 1,000 students participated in this study over a six-year period from 6th grade to 12th grade. The purpose of this study was to establish a relationship between mathematics anxiety and mathematics achievement. The students were tested in the spring of 1960, and were retested in the spring of 1966. The results clearly showed a strong relationship between high mathematical anxiety and low mathematical achievement. They also recommended that "future studies could make an attempt to change students who have expressed "mathemaphobia" so that their attitudes toward mathematics would become more positive. This overcoming of "emotional blocks" to mathematics would hopefully lead to better performance and great comfort in mathematics" (470).

In 1983, Robert Frary and Jeanne Ling conducted "A Factor-Analytic Study of Mathematics Anxiety" at the University of Virginia. This particular study collected the

responses of over 500 university students focusing on personality measures as well as mathematics anxiety. More specifically, the purpose of the study was to determine to what extent the attitudes towards math could be viewed as reflections of other personality characteristics as opposed to a single underlying attitude (985). The researchers showed that "the results support viewing mathematics anxiety as a unidimensional and, unfortunately, rather global construct independent of the other personality variables and underlying other, more distinct attitudes towards mathematics" (992). Frary and Ling concluded that low ability leads to low performance which leads to mathematics anxiety which leads to avoidance and low achievement.

In 1972, Frank Richardson and Richard Suinn, the creators of the Mathematics Anxiety Rating Scale, conducted one of the most well known studies on mathematics anxiety. Over 400 freshmen and sophomores participated in this study at the University of Missouri. The researchers were concerned with analyzing different types of mathematics anxiety as well as establishing the reliability of the MARS -A. The researchers concluded that "mathematics anxiety is a very common problem in the college population and the MARS could serve as a diagnostic tool" (552). They also concluded that the MARS could be used in research to determine the effectiveness of different treatment approaches to mathematical anxiety problems (552).

Related Literature on Mathematics Anxiety

Mathematics anxiety has long been recognized as one of the most serious problems being faced in math education today. The relationship between high mathematics anxiety and low math achievement has been well documented and researched (Anttonen, Bessant, Richardson and Suinn, Tobias, Wigfield and Meece). In "Preventing Math Anxiety: A Prescription," Joseph Martinez argues that "mathematics anxiety may be a greater block to math learning than any supposed deficiencies in our school curricula or teacher preparation programs" (125). Unfortunately, experts still do not fully understand why some students develop mathematical anxiety and others do not. Even when students are diagnosed with this disease, recovery seems to be marginal at best. (117)

Much of the literature argues that the math teacher plays the leading role in causing mathematical anxiety. In "My Anxieties About Math Anxiety," Jay Greenwood points out that "the principle cause of math anxiety lies in the teaching methodologies used to convey the basic mathematical skills to our youngsters, be they computational skills or these involving algebra or geometry" (662). The traditional "explain-practice-memorize" teaching style, which is based entirely on memorization, not on understanding and reason, is the real source of mathematics anxiety. Greenwood argues that students have misconceptions, as well as teachers and parents, that you must master the basic skills (usually through rote

memorization) before you can engage in higher level problem solving. He concludes by recommending that additional research needs to be conducted on the benefits of using the problems solving process to teach computation skills.

Susan Shodahl and Cleon Diers also believe that teachers play a significant role in causing math anxious students. In their article, "Math Anxiety in College Students: Sources and Solutions," they also identify five myths about mathematics that help to contribute to the problem of mathematics anxiety.

1) There is only one way to do a problem.

2) You must be able to solve problems quickly in your head.

3) You must always know how you got the answer.

4) Math requires logic and not intuition.

5) Men are naturally better at math than women. (33)

Shodahl and Diers believe that the best way to reduce mathematics anxiety in college students is through the use of intervention programs. They both teach a semester long course at San Bernadino Valley College called "Our Math Without Fear." This is a two-hour class that meets once a week which focuses on psychological techniques that help the students reduce their mathematics anxiety.

In 1995, the National Council of Teachers of Mathematics published their own report on mathematics anxiety. The council agreed with Martinez that the causes of mathematics anxiety are still very much unknown. Although much of the literature points to the relationship between the student and the

teacher, many experts believe that the leading cause of mathematics anxiety can be linked to the relationship between the student and his or her parents (Tobias). NCTM does not provide reasons for the causes of mathematical anxiety. The council is concerned with strategies to help reduce anxiety. Although the council mentions math anxiety centers and intervention programs as one method of dealing with mathematical anxiety, they point out that very little research and literature exists about the long-term success of these programs. NCTM does provide a list of specific classroom practices that math teachers should use to alleviate mathematical anxiety from their classrooms. A few of these are listed below:

1) Accommodate different learning styles.

2) Create a variety of testing environments.

3) Emphasize that everybody makes mistakes.

4) Design the experience so that students feel positive about themselves.

5) Make math relevant.

6) Emphasize the importance of original, quality thinking rather than the rote manipulation of formulas.

7) Allow for different social approaches to learning mathematics.

CHAPTER 3

Procedures

Introduction

The purpose of this study was to determine the effects of journal writing on mathematics anxiety in developmental algebra classes at the college level. This chapter will focus on the procedures used by the researcher to conduct this study. It will also provide a brief description of the student population and the testing instruments used throughout the experiment.

Population

This study was conducted at Camden County College in Blackwood, New Jersey. Camden County College is an open-door, comprehensive two-year public institution with an enrollment of over 15,000 students. It presently ranks as the largest community college in the state of New Jersey. Minority enrollment comprises twenty-two percent of the total college population.

This study occurred during a six week period in the fall semester of 1995. Two classes of "Elementary Algebra" were

used in the experiment. Each class met three times a week for fifty minutes. The experimental group, which met at 8:00 A.M., was composed of ten students, six female and four male. The control group, which met at 12:00 P.M., was composed of thirteen students, eight female and five male. All twenty-three students that participated in the study had recently graduated from high school in either June of 1994 or 1995. A variety of ethnic groups were represented in both classes.

Testing Instruments

Mid-term examination grades were used to determine if the control group and the experimental group were equivalent in their academic achievement. The scores that the students achieved on this exam were used to determine if a significant difference existed in their mean scores. An independent t-test was done for both classes using these scores.

Immediately following the mid-term examinations, the Mathematics Anxiety Rating Scale for Adolescents (MARS- A) was administered to both the experimental group and the control group. The MARS-A is a 98 item test specifically designed for adolescents to measure the degree of mathematics anxiety. A copy of the MARS-A can be found in Appendix A. This scale was used to determine if the control group and the experimental group were equivalent in their mathematical anxiety. Although this researcher examined many different anxiety scales, numerous studies have shown that the MARS-A is a valid and

reliable measurement of mathematical anxiety (Richardson and Suinn, Rounds and Hendell, Wigfield and Meece). In "Factors Associated With Types of Mathematics Anxiety in College Students," the National Council of Teachers of Mathematics stated that "the MARS-A has proven an extremely reliable measure of mathematics anxiety" (328). The scores that the students achieved on the MARS-A were used to determine if a significant difference existed between the mean scores of the experimental group and the control group. An independent t-test was once again used for both classes using these scores.

Six weeks later, the MARS-A was re-administered to both groups on the final day of the experiment. The same procedure described above was once again used to determine if a significant difference in the level of mathematics anxiety existed between the control group and the experimental group.

Conducting the Study

During the course of the six week study, the experimental group was allowed time during each class to complete journal entries on assigned topics by the researcher. The first five minutes of class were provided to the students to complete these writing assignments. This time was also used for taking attendance and reviewing any homework problems that the class may have had. Since the control group was involved in these same procedures (other than journal writing), the time allotted for the daily presentation of lessons was

approximately the same for both classes.

The specific journal writing assignments were based on a wide variety of mathematical topics. Students were asked to respond to problem solving questions, concepts learned from previous lessons, as well as any feelings, emotions or anxieties they may have toward mathematics. A list of these topics can be found in Appendix B. After the students completed each assignment, the journals were then collected by the researcher. In addition, the researcher responded to each written assignment to establish a "dialogue-journal" with each student. No grades were given for these assignments.

CHAPTER 4

Analysis of Data

Introduction

The purpose of this study was to determine the effects of journal writing on mathematics anxiety in developmental algebra classes at the college level. Two classes of "Elementary Algebra" were used for this experiment. The researcher taught both the experimental group, consisting of ten students, and the control group, consisting of thirteen students.

Pre-Comparison of Academic Achievement

The first procedure performed was to ensure that the control group and the experimental group were equivalent in their academic achievement. The scores on a mathematics department mid-term examination were used for this task. The mean score for the ten students in the experimental group was 78.4. The mean score for the thirteen students in the control group was 77.85 (refer to Table 1). The standard deviation was 14.849 for the experimental group and 13.101 for the control group. Given 21 degrees of freedom, the t-value at the .05

level of significance for a two-tailed test was found to be 2.08. Since the t-value for the experiment does not fall in the rejection region ($-2.08 < .094 < 2.08$), the researcher concluded that there was no significant difference in academic achievement between the control group and the experimental group.

Table 1

A Comparison of Mid-Term Examination Grades
Between Experimental Group and
Control Group

Experimental Groups		Control Group	
X_1	$(X_1-\overline{X}_1)^2$	X_2	$(X_2-\overline{X}_2)^2$
82	12.96	68	97.023
46	1049.76	66	140.423
72	40.96	81	9.923
65	179.56	90	147.623
81	6.76	91	172.923
97	345.96	90	147.623
75	11.56	54	568.823
91	158.76	96	329.423
90	134.56	82	17.223
85	43.56	79	1.323
		72	34.223
		59	355.323
		84	37.823
$\overline{X}_1=78.4$		$\overline{X}_2=77.85$	
$S_1=14.849$		$S_2=13.101$	

$$t = \frac{\overline{X}_1 - \overline{X}_2}{S_p \sqrt{(1/n_1) + (1/n_2)}} \quad \text{where } S_p=13.877$$

Therefore, t = .094

Pre-test of Mathematics Anxiety

The next procedure performed was to ensure that the control group and the experimental group were equivalent in their mathematics anxiety. During the class immediately following the mid-term examinations, the Mathematics Anxiety Rating Scale for Adolescents (MARS-A) was administered to both the experimental group and the control group (refer to Appendix A). The mean score for the ten students in the experimental group was 175.8. The mean score for the thirteen students in the control group was 211.46 (refer to Table 2). The standard deviation was 55.689 for the experimental group and 37.733 for the control group. Given 21 degrees of freedom, the t-value at the .05 level of significance for a two-tailed test was found to be 2.08. Since the t-value for the experiment does not fall in the rejection region ($-2.08 < -1.832 < 2.08$), the researcher concluded that there was no significant difference in the levels of mathematics anxiety between the control group and the experimental group.

Journal Writing

During the six weeks following the administration of the MARS-A pre-test, the experimental group was allowed time during each class to complete journal entries on topics assigned by the researcher (refer to Appendix B). The first five minutes of class were provided to the students to complete these writing assignments. This time was also used

Table 2
A Comparison of MARS-A Pre-test Scores
Between Experimental Group and
Control Group

Experimental Groups		Control Group	
x_1	$(x_1-\bar{x}_1)^2$	x_2	$(x_2-\bar{x}_2)^2$
110	4329.64	272	3665.09
236	3624.04	177	1187.49
220	1953.64	176	1257.41
261	7259.04	196	239.01
109	4462.24	230	343.73
136	1584.04	193	340.77
148	772.84	269	3310.85
140	1281.64	266	2974.61
227	2621.44	222	111.09
171	23.04	198	181.17
		209	6.05
		178	1119.57
		163	2348.37
$\bar{x}_1$=175.8		$\bar{x}_2$=211.46	
s_1=55.689		s_2=37.733	

$$t = \frac{\bar{x}_1 - \bar{x}_2}{S_p \sqrt{(1/n_1) + (1/n_2)}} \quad \text{where } S_p=46.289$$

Therefore, t = -1.832

for taking attendance and addressing any difficulties that the class may have had with homework problems. Since the control group was involved in these same procedures, the time allotted for the daily presentation of lessons was approximately the same for both classes. After the ten students in the experimental group completed each writing assignment, the journals were then collected by the researcher. The researcher also responded to each entry to establish a "dialogue-journal" with each student.

Post-test of Mathematics Anxiety

On the last day of the experiment, the Mathematics Anxiety Rating Scale for Adolescents (MARS-A) was re-administered to both the experimental group and the control group. The mean score for the ten students in the experimental group was 165.4. The mean score for the thirteen students in the control group was 193.38 (refer to Table 3). The standard deviation was 59.37 for the experimental group and 57.15 for the control group. Given 21 degrees of freedom, the t-value at the .05 level of significance for a two-tailed test was found to be 2.08. Since the t-value for the experiment does not fall in the rejection region ($-2.08 < -1.14 < 2.08$), the researcher concluded that there was no significant difference in the levels of mathematics anxiety between the control group and the experimental group.

Table 3

A Comparison of MARS-A Post-test Scores
Between Experimental Group and
Control Group

Experimental Groups		Control Group	
x_1	$(x_1-\bar{x}_1)^2$	x_2	$(x_2-\bar{x}_2)^2$
114	2641.96	229	1268.78
225	3552.16	159	1181.98
244	6177.96	121	5238.86
247	6658.56	156	1397.26
113	2745.76	256	3921.26
103	3893.76	193	.14
131	1183.36	332	19215.50
113	2745.76	220	708.62
210	1989.16	183	107.74
154	129.96	173	415.34
		209	243.98
		134	3525.98
		149	1969.58
$\bar{x}_1$=165.4		$\bar{x}_2$=193.38	
s_1=59.37		s_2=57.15	

$$t = \frac{\bar{x}_1 - \bar{x}_2}{S_p \sqrt{(1/n_1) + (1/n_2)}} \quad \text{where } S_p=58.11$$

Therefore, t = -1.14

CHAPTER 5

Summary, Conclusions, and Recommendations

Introduction

The purpose of this study was to determine the effects of journal writing on mathematics anxiety in developmental algebra classes at the college level. The experiment was conducted at Camden County College in Blackwood, New Jersey during the fall semester of 1995. Two sections of "Elementary Algebra" were used for the study and both classes were taught by the researcher. The experimental group, comprised of ten students, wrote in math journals on specific topics assigned by the researcher. The control group, comprised of thirteen students, was not required to write in the journal. The hypothesis to be tested was to determine if there was a significant difference in the levels of mathematics anxiety between the control group and the experimental group.

Summary of the Findings

A pre-comparison was made of the mid-term examination grades of the control group and the experimental group to ensure that both groups were equivalent in their academic

achievement. The mean score of the control group was 77.85. The mean score of the experimental group was 78.4. Statistically, there was no significant difference between these two means.

A pre-comparison was also made of the scores on the MARS-A pre-test of the control group and the experimental group to ensure that both groups were equivalent in their mathematics anxiety. The mean score of the control group was 211.46. The mean score of the experimental group was 175.8. Statistically, there was no significant difference between these two means.

After six weeks of writing in math journals, the MARS-A was re-administered to both the experimental group and the control group. The mean score of the control group was 193.38. The mean score of the experimental group was 165.4. Statistically, there was no significant difference between these two means.

Conclusions

Since the Mathematics Anxiety Rating Scale for Adolescents (MARS-A) post-test scores did not indicate a statistically significant difference in the mean scores of the control group and the experimental group, a conclusion can be drawn that journal writing does not improve mathematics anxiety in developmental algebra classes at the college level.

Recommendations

The last journal topic that the researcher assigned to the students was to express their feelings and attitudes about the journal writing process. All of the journal entries were very positive. Some students even wrote that writing in the journal was their favorite part of the class. Although not statistically evident in this experiment, this researcher feels that journal writing did have a positive effect on mathematics anxiety. Additional research should be done on the positive effects of journal writing.

Future experiments should involve a larger sample of students and should be conducted over a longer period of time. Researchers should also be aware of the attendance problems that exist in developmental math classes at the college level. In addition to the poor attendance rate of the students in the experiment, fifteen students dropped out of the study during the six week period. This researcher also recommends that future experiments use a test other than the MARS-A to measure mathematics anxiety. During the re-administering of the MARS-A, some students seemed to have a very negative attitude about completing the 98-item test all over again. Many students filled it out very quickly and obviously did not give it much thought.

Appendix A

Mathematics Anxiety Rating Scale - A

Name _____ Total Score _____

MATHEMATICS ANXIETY RATING SCALE (MARS-A)

The items in the questionnaire refer to things and experiences that may cause tension or apprehension. For each item, place a check (✓) in the circle under the column that describes how much you would be made anxious by it. Work quickly, but be sure to think about each item.

	How anxious . . .	Not at all	A little	A fair amount	Much	Very much
1.	Deciding how much change you should get back from buying several items.	O	O	O	O	O
2.	Having someone watch you as you add up a column of numbers.	O	O	O	O	O
3.	Having someone watch you as you divide a five digit number by a two digit number.	O	O	O	O	O
4.	Being asked to add up 976 + 777 in your head.	O	O	O	O	O
5.	Adding up 976 + 777 on paper.	O	O	O	O	O
6.	Figuring out a simple percentage, like the sales tax on something you buy.	O	O	O	O	O
7.	Figuring out how much you will get paid for 6½ hours of work if you get paid $3.75 an hour.	O	O	O	O	O
8.	Listening to a person explain how your share of expenses on a trip was figured out (including meals, transportation, housing, etc.).	O	O	O	O	O
9.	Counting a pile of change.	O	O	O	O	O
10.	Adding up a bill for a meal when you think you have been over-charged.	O	O	O	O	O

How anxious . . .	Not at all	A little	A fair amount	Much	Very much
11. Telling the cashier that you think the bill for the meal was wrong and watching the cashier add up the bill again.	O	O	O	O	O
12. Being asked to make change.	O	O	O	O	O
13. Adding up the dues received and the expenses for a club you belong to.	O	O	O	O	O
14. Reading a formula in a science class.	O	O	O	O	O
15. Doing a word problem in algebra.	O	O	O	O	O
16. Solving a problem such as: If x = 11, and y = 3, then the result of x/y is equal to _____?	O	O	O	O	O
17. Solving the problem such as: If x = 12, and y = 4, then the ratio of x to y is equal to _____?	O	O	O	O	O
18. Figuring out your grade average for last term.	O	O	O	O	O
19. Reading an article on the basketball team, showing what percentage of free throws each player made, the percentage of field goals made, the total number attempted, etc.	O	O	O	O	O
20. Reading a novel with many dates in it.	O	O	O	O	O
21. Being asked to remember the telephone numbers of three people you met.	O	O	O	O	O
22. Being asked to guess at the number of people at a large gathering you are attending.	O	O	O	O	O
23. Receiving a math textbook.	O	O	O	O	O

	How anxious . . .	Not at all	A little	A fair amount	Much	Very much
24.	Watching a teacher work an algebra problem on the blackboard.	O	O	O	O	O
25.	Figuring out whether you have enough change to pay for the gum and magazine you want to buy, plus the sales tax.	O	O	O	O	O
26.	Signing up for a math course.	O	O	O	O	O
27.	Listening to another student explain a math formula.	O	O	O	O	O
28.	Walking into a math class.	O	O	O	O	O
29.	Having to figure the miles per gallon of gas for a car.	O	O	O	O	O
30.	Watching someone work with a calculator.	O	O	O	O	O
31.	Looking through the pages of a math text.	O	O	O	O	O
32.	Signing up for a course in Algebra.	O	O	O	O	O
33.	Being called on to put a problem on the board when you are not sure your answer is right.	O	O	O	O	O
34.	Studying for a math test.	O	O	O	O	O
35.	Starting to read a new chapter in a math book.	O	O	O	O	O
36.	Walking to class and thinking about a math course.	O	O	O	O	O
37.	Meeting your math teacher while walking in the hall.	O	O	O	O	O
38.	Reading the word "Statistics".	O	O	O	O	O

How anxious . . .	Not at all	A little	A fair amount	Much	Very much
39. Sitting in a math class and waiting for the teacher to begin.	O	O	O	O	O
40. Solving a square root problem.	O	O	O	O	O
41. Signing up for a course in Geometry.	O	O	O	O	O
42. Collecting money for admission tickets to a show or a game at the door.	O	O	O	O	O
43. Taking the math section of a standardized test, like an achievement test.	O	O	O	O	O
44. Measuring how much border to leave and how to place five pictures on a bulletin board.	O	O	O	O	O
45. Raising your hand in a math class to ask a question about something you do not understand.	O	O	O	O	O
46. Reading and interpreting graphs or charts.	O	O	O	O	O
47. Reading a cash register receipt after you buy something.	O	O	O	O	O
48. Figuring the sales tax for something that costs more than $1.00.	O	O	O	O	O
49. Having to know how to balance a checkbook by adding up every amount that was spent and subtracting it from the amount you started with.	O	O	O	O	O
50. Figuring how you would make more money by taking a job that has a lower salary, but includes, room, meals, and travel; or a job that has a higher salary, but no other benefits.	O	O	O	O	O
51. Having someone explain bank interest rates while describing savings accounts.	O	O	O	O	O

	How anxious . . .	Not at all	A little	A fair amount	Much	Very much
52.	Hearing a lecture in a social studies class where the teacher is commenting on some figures, like the percentage of each socio-economic group who voted Republican.	O	O	O	O	O
53.	Taking an examination (quiz) in a math course.	O	O	O	O	O
54.	Taking an examination (final) in a math course.	O	O	O	O	O
55.	Hearing two of your friends talking about the best way to figure out the actual cost of a product.	O	O	O	O	O
56.	Having someone ask you to recheck the numbers in a simple calculation, such as division or addition.	O	O	O	O	O
57.	Being asked by a friend to answer the question: "How long will it take to get to the state capital if I drive at 30 miles per hour?"	O	O	O	O	O
58.	Studying for a driver's license test and memorizing the numbers involved, such as the distances it takes to stop a car going at different speeds.	O	O	O	O	O
59.	Hearing friends quote the odds on a game as they make bets.	O	O	O	O	O
60.	Playing cards where numbers are involved, like poker or blackjack.	O	O	O	O	O
61.	Having a friend try to teach you how to do a math problem and finding that you cannot understand what is being said.	O	O	O	O	O
62.	Making a schedule for your daily routine, setting aside times for classes, study time, meals, recreation, etc.	O	O	O	O	O

	How anxious . . .	Not at all	A little	A fair amount	Much	Very much
63.	Learning the part of a game dealing with scoring and remembering numbers.	O	O	O	O	O
64.	Deciding which courses to take in order to come out with enough credit hours for promotion or graduation.	O	O	O	O	O
65.	Working a math problem that is important in your life, like figuring out how much you can spend on recreational activities such as movies after buying other things you need.	O	O	O	O	O
66.	Working on a math problem which seems less important in your life, such as "If x = outstanding bills, and y = total income, calculate how much is left for recreational purposes."	O	O	O	O	O
67.	Being given a set of addition problems to solve on paper.	O	O	O	O	O
68.	Being given a set of subtraction problems to solve on paper.	O	O	O	O	O
69.	Being given a set of multiplication problems to solve on paper.	O	O	O	O	O
70.	Being given a set of division problems to solve on paper.	O	O	O	O	O
71.	Picking up your math textbook to begin working on a homework assignment.	O	O	O	O	O
72.	Being given a homework assignment of many difficult math problems, which is due the next time the class meets.	O	O	O	O	O
73.	Thinking about an upcoming math test one week before.	O	O	O	O	O

	How anxious . . .	Not at all	A little	A fair amount	Much	Very much
74.	Thinking about an upcoming math test one day before.	O	O	O	O	O
75.	Thinking about an upcoming math test one hour before.	O	O	O	O	O
76.	Thinking about an upcoming math test five minutes before.	O	O	O	O	O
77.	Checking the time and figuring out whether or not you can stop in two more stores and still meet a friend at the exact time you said you would.	O	O	O	O	O
78.	Waiting to get a math test returned on which you expected to do well.	O	O	O	O	O
79.	Waiting to get a math test returned on which you expected to do poorly.	O	O	O	O	O
80.	Asking your math teacher after class about something you did not understand.	O	O	O	O	O
81.	Realizing that you have to take a certain number of math classes to meet the requirements for graduation.	O	O	O	O	O
82.	Picking up a math textbook to begin a difficult reading assignment.	O	O	O	O	O
83.	Being called on to answer a question in a math class on a topic you have spent some time studying.	O	O	O	O	O
84.	Not knowing the formula needed to solve a particular problem.	O	O	O	O	O
85.	Receiving your final math grade on your report card.	O	O	O	O	O
86.	Figuring out how much material you will need to do a project so that you will waste as little as possible.	O	O	O	O	O

	How anxious . . .	Not at all	A little	A fair amount	Much	Very much
87.	Being responsible for collecting the dues for a club and keeping track of the amount received.	O	O	O	O	O
88.	Opening a math or statistics book and seeing a page full of problems.	O	O	O	O	O
89.	Watching someone use a graph to explain something.	O	O	O	O	O
90.	Listening to a lecture in a math class.	O	O	O	O	O
91.	Being given a "pop" quiz in a math class.	O	O	O	O	O
92.	Seeing a computer printout.	O	O	O	O	O
93.	Having to use the tables in the back of a math book.	O	O	O	O	O
94.	Comparing the prices of two brands of soft drinks that are different sizes and deciding which is cheaper.	O	O	O	O	O
95.	Deciding how much of a tip to leave in a restaurant after a meal.	O	O	O	O	O
96.	Being asked to explain how you arrived at a particular answer for a problem.	O	O	O	O	O
97.	Adding up the results of a vote, such as for class or student body representative.	O	O	O	O	O
98.	Acting as secretary, keeping track of the number of people signing up for an event.	O	O	O	O	O

Appendix B

Journal Topics

Journal Topics

Nov. 6 I _____ Algebra because _____ ... (express attitudes and feelings about algebra and explain why)

Nov. 8 Explain in your own words (in paragraph form) the steps that you would use to factor $x^3 + 7x^2 - 18x$. How do you know that you have factored it correctly?

Nov. 10 The worst math teacher that I ever had was _____ because _____ ... (give reasons for your choice)

Nov. 13 The square of a number minus three times that same number is four. Explain in your own words (in paragraph form) the steps that you would use to solve this equation. How do you know that you have solved it correctly?

Nov. 15 What do you think your grade is in this class? Why? What do you think your final grade will be? Why?

Nov. 17 The best math teacher I ever had was _____ because _____ ... (give reasons for your choice)

Nov. 20 The length of a rectangle is 5 cm more than its width. If the area of the rectangle is 150 cm^2, find the dimensions of the rectangle.
Explain in your own words (in paragraph form) how you would solve this problem. How do you know that you have solved it correctly?

Nov. 22 The (best/worst) thing about this class is _____ ... (express your attitudes and feelings about this course)

Nov. 27 $\frac{2x^2 + 3x - 5}{2x^2 + 11x + 15}$
Explain in your own words how you would write this fraction in simplest terms.

Nov. 29 Why are you at Camden County College? Where do you see yourself in five years?

Dec. 1 Explain in your own words (in paragraph form) the steps you would use to solve the following problem.

$$3/x + 4/y$$

Dec. 4 How do you think you did on Friday's test? Were you prepared? What grade do you expect?

Dec. 6 $x - 2y > 4$
Explain in your own words the steps you would use to graph this inequality. Then graph it.

Dec. 8 Explain in your own words the difference between a consistent, and inconsistent, and a dependent system. (Include examples if you wish)

Dec. 11 $x + 2y = -2$
$3x + 2y = -12$
We have discussed two ways to solve this system. Solve this system both ways and explain which method is better and why.

Dec. 13 Find the square root of 64.
Find the square root of -64.
Explain in your own words the difference between these two problems. Give answers for each.

Dec. 15 Express your attitudes and feelings about writing in the journals. Would you mind keeping journals in your next math class? Do you think they helped?

Dec. 18 List any suggestions you may have for improving this course.

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