

Rowan University

Rowan Digital Works

Theses and Dissertations

5-1-1995

Journal writing for college students in a developmental mathematics class

Mary Anne Dorofee

Rowan College of New Jersey

Follow this and additional works at: <https://rdw.rowan.edu/etd>



Part of the [Science and Mathematics Education Commons](#)

Recommended Citation

Dorofee, Mary Anne, "Journal writing for college students in a developmental mathematics class" (1995). *Theses and Dissertations*. 2237. <https://rdw.rowan.edu/etd/2237>

This Thesis is brought to you for free and open access by Rowan Digital Works. It has been accepted for inclusion in Theses and Dissertations by an authorized administrator of Rowan Digital Works. For more information, please contact graduateresearch@rowan.edu.

JOURNAL WRITING FOR COLLEGE STUDENTS
IN A DEVELOPMENTAL MATHEMATICS
CLASS

by
Mary Anne Dorofee

A Thesis

Submitted in partial fulfillment of the requirements
of the Master of Arts Degree in the Graduate
Division of Rowan College in Mathematics
Education
(1995)

Approved by _____
John Sooy

Date Approved 5/1/95

ABSTRACT

Mary Anne Dorofee
Journal Writing for College Students in a Developmental Mathematics
Class
1995
Thesis Advisor: J. Sooy, Mathematics Education

The purpose of this study was to measure academic achievement in a developmental mathematics class through the use of journal writing. Twenty-seven college level students were part of the experiment. Two classes of "Introduction to College Math" were used. Their age levels ranged from students who had just graduated from high school to returning adults in their fifties. A variety of ethnic groups were represented in both classes. The experimental group consisted of eighteen students who kept a journal on various mathematics topics. The control group consisted of nine students and they did not keep a journal. The academic achievement variable that was used for pretest scores was a mathematics skills test administered the first day of the semester. Posttest scores from the mathematics department final examination were used for comparison. T-tests analysis was done on pretest scores, six chapter tests scores and posttest scores. It was concluded that there was no significant change in the mean level of achievement between the experimental group and the control group.

MINI-ABSTRACT

Mary Anne Dorofee
Journal Writing for College Students in a Developmental
Mathematics Class
1995
Thesis Advisor: J. Sooy, Mathematics Education

The purpose of this study was to measure academic achievement with college-level students in a developmental mathematics class through the use of journal writing.

There was no significant change in the mean level of achievement between the experimental group and the control group.

TABLE OF CONTENTS

Chapter	Page
1. Introduction to the Study.....	1
Introduction.....	1
Background.....	2
Statement of the Problem.....	2
Significance of the Problem.....	3
Limitations and Assumptions.....	4
Definition of Terms.....	5
Procedures.....	6
2. Review of Literature and Research.....	8
Introduction.....	8
Review of the Literature.....	8
Review of Research.....	12
3. Procedures.....	19
Introduction.....	19
Preparation for the Study.....	20
Explanation of the Study.....	21
Conclusion of the Study.....	22
4. Analysis of Data.....	25
Introduction.....	25
Pre-Comparison of Academic Achievement.....	25
Journal Writing.....	28

Comparison of Six Chapter Tests.....	28
Post-Comparison of Academic Achievement.....	32
5. Summary, Conclusions and Recommendations.....	35
Introduction.....	35
Summary of the Findings.....	35
Conclusions.....	36
Recommendations.....	36
Appendixes	
A. Journal Questions.....	39
B. Survey to Students.....	44
Bibliography.....	45

TABLES

Table	Page
1. A comparison of pretest scores between the control group and the experimental group.....	27
2. A comparison of six chapter tests between the control group and the experimental group.....	31
3. A comparison of posttest scores between the control group and the experimental group.....	34

CHAPTER 1

Introduction to the Study

Introduction

Community colleges in New Jersey are open-door, comprehensive two-year public institutions dedicated to meeting the needs of area residents and employers for educational advancement and career training. Increasing enrollments and a changing student population have resulted in a new set of problems for community colleges. Community colleges' open door policy attracts thousands of highly motivated high school graduates, high school drop-outs, and adults who lack skills needed for academic success. Many of the incoming students are required to take remedial courses in english, reading, and mathematics because of scores they received on their New Jersey College Basic Skills Placement Test (NJCBSPT). This study was designed to measure academic achievement in a developmental mathematics class through the use of journal writing. The academic achievement variable that was used for pretest scores was a mathematics skills test administered the first day of the semester. Posttest scores from the mathematics department final examination were used for comparison.

Background

Little research has been done on writing in a mathematics class with college-level students. Supporters of writing in a mathematics class indicate that if a student can write about mathematics, they are able to understand the concepts (Miller and England 299). Writing gives students the chance to look inside their minds and see the logic that was used to solve the problem. Students often view a mathematics class as a class where you memorize rules and formulas without understanding the meaning or concepts behind the rules. The students often ask "when am I ever going to use this?". This study encouraged the students to see how writing, not only in an english class or history class, but also in a mathematics class represented a paradigm shift towards a more reflective and analytical way of learning in all content areas (Goffman and Dunston 35).

Statement of the Problem

The purpose of this study is to determine if there is a significant difference in achievement between college-level students in a developmental Algebra class who write in a journal weekly and those students who do not write in a journal. The null hypothesis to be tested H_0 : there is no significant difference in achievement between college-level students in a developmental Algebra

class who write in a journal weekly and those students who do not write in a journal.

Significance of the Problem

There are four basic parts to learning: listen, speak, write, and read (Capps 10). Reading and writing together can help students extend their thinking and acquire multiple perspectives on a topic (Tierney, Soter, O'Flahavan 135). Through writing students learn to organize and describe ideas. "Writing unfolds truths which the mind then learns." (Mandel 1978). Writing contributes to thinking and learning in two ways. First, language allows us to examine thoughts; it allows us to think about thoughts. Secondly, the digressive character of writing generates further thought as words draw out other words. Writing is central to the understanding process in general (Crossman, Smith, Miller 3).

The researcher is conducting an experiment in an "Introduction to College Math" course in which one class (experimental group) is required to keep a journal on various types of mathematics questions, definition questions, exploratory questions, research questions and problem-solving questions. The other class (control group) is not required to keep a journal. Writing helps the students to "see" the steps involved and to immediately reflect on the process (6). The researcher

has found that students perceive a mathematics class as rote memorization of rules and formulas with little understanding of the thought process that is involved. The writing activity provides opportunities for students to analyze their own thinking. By writing about mathematics students are able to understand what it means to do mathematics by discovering for themselves (Countryman 45). In addition, personal communication is established between the instructor and the student. Frequently, students are not comfortable to say they do not understand a concept. Through writing the instructor can alleviate some of these anxieties and explain proper procedures to the student.

Limitations and Assumptions

Cumberland County College is an open-door, comprehensive two-year public institution dedicated to meeting the needs of area residents and employers for educational advancement and career training. Student enrollment is approximately three-thousand students. Minority enrolled is 27.6 percent of the total college enrollment. Students from Africa, Mexico, Jamaica, South America, Japan, Korea, India, and Kuwait attend the college. Two classes of "Introduction to College Math" were used to conduct the experiment. This was a total of twenty-seven students out of a population of two hundred

sixty-five students who were required to take this course. The experiment was limited to college-level students enrolled in a developmental Algebra course who were placed in this class by the score they received on the NJCBSPT. An assumption was made that all students in the experimental group would keep a mathematics journal. Pretest scores from a mathematics skills test, administered the first day of the semester, were used to determine the normal distribution of the experimental group and the control group. Achievement was measured by scores on a mathematics department final examination.

Definition of Terms

Experimental group - the class that was exposed to the influence of journal writing in a mathematics class.

Journal - students' record of what they know, what they feel, what they do or how they do it, and why they do it.

Control group - the class that was not exposed to the influence of journal writing in a mathematics class.

NJCBSPT - New Jersey College Basic Skills Placement Test.

Achievement - measurement of success of what an individual learned through the use of a mathematics department skills test score and a mathematics department final examination.

The population used for the experiment was comprised of students from Cumberland County College. The sample used were two sections of "Introduction to College Math". The two sections were taught by the researcher. One section (control group) was taught the course the same way the researcher has taught the course for the past seven years. The other section (experimental group) was taught the same way as the control group, but this section was required to keep a mathematics journal. The composition of the students in both classes was a mixture of men and women. Their age levels ranged from students who had just graduated from high school in June 1994 to returning adults in their fifties. A variety of ethnic groups were represented in both classes. There were nine students in the control group and eighteen students in the experimental group. Types of data collected for pretest scores were grades from a mathematics department skills test administered the first day of the semester. Scores from the mathematics department final examination were used as posttest scores. The time schedule in conducting this experiment was a full semester (fourteen weeks).

Statistical analyses used at the end of the semester to test the hypotheses were t-tests.

NOTES

- Miller, L. and D.A. England. "Writing to Learn Algebra". School Science and Mathematics. 89 (4) (1989): 299-312.
- Goffman, L. and J. Dunston. "Writing Across the Curriculum in a Data Processing Class: An Ethnographic Investigation". Research and Teaching in Developmental Education. Vol II (1994): 31-35.
- Capps, L. "Communicating in Mathematics". Current Issues in Mathematics. (1994): 10-11.
- Tierney, R.J., et al. "The Effects of Reading and Writing Upon Thinking Critically". Reading Research Quarterly. 24(2) (1989): 134-73.
- Grossman, F., C. Miller, B. Smith. "And You Say 'Write' in Mathematics Class?". Journal of Developmental Education. (1989): 2-6.
- Grossman, F., C. Miller, B. Smith. 5.
- Countryman, J. Writing to Learn Mathematics: Strategies that Work. Heinemann. Portsmouth. N.H. (1992): 42-92.

CHAPTER 2

Review of Literature and Research

Introduction

Higher education in general and community colleges specifically are experiencing an increase in enrollment of students who are not prepared for college-level courses. Much has been focused on learning strategies for elementary and secondary levels of education. The evaluation of the effectiveness of these strategies is just beginning to emerge. Little has been focused on learning strategies for college-level students. Frequently, these students sit in a lecture hall with the professor in the front lecturing for an hour with little interaction between student and professor. The student takes notes and is tested on the material that was taught. New or different learning styles are not often found at colleges.

What follows is a review of the literature of the effectiveness of journal writing as a means of retention and achievement in a mathematics classroom.

Review of the Literature

An article, by Mumme and Shepard, suggest that by asking students to write, we are telling them we value

their opinion and the doors of communication are opened. This communication promotes a comfortable environment for learning (19). Writing is a means through which students should be able to communicate their understanding of mathematics and its application. Writing about how the student approaches a problem makes a student think clearer and sharper. A great deal can be learned from a student when they are asked to write. The teacher gets a clearer picture much sooner of how the students are thinking mathematically (Miller 52).

An article entitled "Using Writing to Learn Mathematics" tells us that writing serves two purposes. The first purpose is that it allows students to proceed at their own rate and to converge on an understanding of mathematical concepts using their own experiences. The second purpose is that the writing provides teachers with a unique diagnostic tool in evaluating their students (Nahrang and Peterson 862).

Barbara Allen, in 1994, tells us that many times students enter a mathematics class with poor self-image, unsuccessful study habits, and anxiety of varying degrees because of past experiences with mathematics. By asking a student to write about mathematics or a mathematical topic we are increasing communication between the student and teacher. Some other benefits include individualized

and prescriptive instruction, implementation of alternative learning styles, and development of productive study habits. The task of writing demands that a student examine their thoughts, organize information that is stored and express their ideas in a clear manner. Students benefit both affectively and cognitively from writing. By writing about their attitudes toward mathematics this helps the student cope with their emotions. When asked to explain mathematical notation in their own language, the student comes to appreciate the power of mathematical symbols to communicate thoughts (A103-A107).

The Standards for Curriculum and Pedagogical Reform in Two-Year College and Lower Division Mathematics, published in 1993, emphasized that writing about mathematical concepts using appropriate terminology provides students with the needed practice of communicating orally and in writing. The position the "Standards" took was that writing provided the opportunity for the students to analyze their own thinking in writing (29).

In "Writing to Learn Mathematics: Strategies that Work," Countryman listed some purposes for using journal writing in a mathematics class. Some of these purposes were to increase confidence, increase participation,

decentralize authority, encourage independence, and enhance communication between teacher and student (45). Countryman theorized that writing to learn is different than writing to show that you have learned. As you write, ideas come to you and you can wonder, speculate, and experiment with the ideas (56). Too often mathematics is viewed as a subject of figures, calculations, and answers with no room for discussion. By keeping a journal students can investigate, explore, and discover mathematics (90).

In an article in Mathematics Teaching, Hoffman and Powell indicate that mathematical writing provides a vehicle for a meaningful statement which goes beyond closed-end questions (55). Through writing students learn about themselves as mathematical learners. Through writing, a personal communication is established between the instructor and the student (57).

In 1985 Elizabeth Bell and Ronald Bell said that the value of writing in a mathematics class was that it processed original numerical information into verbal form, which added another facet to a multiple approach to learning (212). By responding to the writing, an instructor provides immediate and individual feedback to the student (215).

Review of the Research

In the Journal of Developmental Education, an article entitled "And You Say 'Write' in Mathematics Class?", authored by Grossman, Smith, and Miller, described a study that was conducted at Georgia State University with seventy developmental mathematics students. Students were given writing questions for homework and in-class quizzes. Students were given examinations which included a single writing question and one or two mathematics problems related to the writing. The assessing was done on the students' ability to comprehend and apply mathematical concepts (5). The authors also stated that writing may correct some misconceptions of mathematics such as viewing mathematics as a guessing game or a subject of sheer mystery (6).

A study done at Robert Morris College in Pittsburgh, Pennsylvania involved one hundred four remedial Algebra students. There were fifty-two students in the control group and fifty-two students in the experimental group. The same methods and techniques that the instructor had been using for more than twenty-five years was used in the control group while the experimental group were taught a course design that incorporated writing-to-learn. When it came time for testing, the experimental group had been broken down into two groups. Group A had

written all the steps in solving a problem perfectly. All these students scored 80 to 100 percent. In group B, these students were not able to write down step-by-step procedures. All these students received a test score below 80 percent. The control group completed the course with a mean average of 74.5 percent, while the experimental group averaged 77.7 percent. At the end of the semester everyone in the experimental group, even the eight students who did not pass the course, were positive about this writing experience. The students felt that writing-to-learn raised their level of confidence and gave them a more positive attitude toward mathematics (Lesnak).

A study was done at a small four year liberal arts college in the U.S.A.. The course entitled "Algebra for Professional Programs" was taken during the first or second year of college, predominately by business students. On the first day of the course, the students were given a written hand-out and a brief explanation of why they were being asked to keep a journal for the class. The students were required to write three entries per week, with the journals collected every other Friday and returned on the following Monday, along with comments by the teacher. Credit towards the course grade was assigned for maintaining the frequency and volume of

writing, but not on the basis of mechanics or content. This study indicated that major problems with learning in mathematics stemmed from the preoccupation with product and answers, anxiety, external manipulation of symbols, and passive and disengaged learning. The conclusion was that journal writing may provide a valuable addition to current modes of mathematics instruction. It is important to remark that not only "what" the students choose to write about, but also "how" they did so, may affect the extent of the potential benefits of journal writing. The more the students use their journal to write expressively, the more they exploit the potential of writing as a tool for learning and growth (Borasi and Rose 350-355).

According to Miller, in 1992, a study was conducted at a large high school in southern Louisiana. Three teachers volunteered to participate in an experiment in two Algebra I classes and one Algebra II class in having their students keep a mathematics journal. Also involved in this experiment were two university professors, one mathematics educator and one writing specialist. This experiment not only benefitted the students but also the teachers. By reading what their students wrote, the teachers were able to reteach a concept that was not understood by their students immediately and they could

delay an examination because of the lack of understanding on the students' part as reflected in their writing. The teachers were able to schedule a review based on the students' writing and have private discussions with individual students about problems they were having in class (335). One of the comments from one of the teachers doing the experiment was "This writing project has allowed me to evaluate my teaching. It has given me insight into my own teaching practices" (336).

Richard Maher, in 1990, wrote an article entitled "Writing, Teaching and Learning in Mathematics: One Set of Experiences". He raised questions concerning the relationship between writing, teaching and learning in the mathematical sciences. One course he taught at Loyola University of Chicago was an operations research course which required the use of writing to learn mathematics. It was the author's experience that, in appropriate settings, writing is supportive of the mathematics learning process. The realization that the student will have to present something mathematical in writing motivates the students to better organize their thoughts from the beginning. This improved organization in turn seems to lead these students to a better understanding of the material they are studying. If students develop writing skills at some point during

their college education, then Maher said it is not unreasonable to expect them to utilize these skills in later courses, no matter what the discipline (40).

The debate about the effects to be expected from writing goes back to the beginning of written language, as we know it, when Plato argued against the corruption of mind that would follow inevitably from relying on books, instead of the discipline of mind, for our knowledge and wisdom. Aristotle, on the other hand, offered us an extensive and still useful inventory of procedures for thinking about and developing an argument. The research that does exist in this area suggests a broad agenda for future work in three areas: cultural effects of literacy, the effects of particular writing experiences on individual learning, and the role of writing in the development of reasoning skills in school contexts (Applebee 590).

NOTES

- Allen, Barbara. Writing in a Mathematics Class. Johnston, Willis, Lazaris. PWS Publishing. (1994): A103-A107.
- Applebee, Arthur. "Writing and Reasoning". Review of Educational Research. 54(4) (1984): 577-96.
- Bell, E. and R. Bell. "Writing and Mathematical Problem Solving: Arguments in Favor of Synthesis." School Science and Mathematics. (1985): 210-21.
- Borasi, R. and B.J. Rose. "Journal Writing and Mathematics Instruction." Educational Studies in Mathematics. 20 (1989): 347-65.
- Countryman, Joan. Writing to Learn Mathematics: Strategies that Work. Heinemann. Portsmouth, N.H. (1992): 42-92.
- Grossman, F., B. Smith, C. Miller. "And You Say 'Write' in Mathematics Class?". Journal of Developmental Education. (1989): 2-6.
- Hoffman, M. and A. Powell. "Mathematical and Commentary Writing: Vehicles for Student Reflection and Empowerment." Mathematics Teaching. (1986): 55-57.
- Lesnak, Richard. Using Linguistics in the Teaching of Developmental and Remedial Algebra. (1993): ERIC, ED 356383.
- Maher, Richard. "Writing, Teaching and Learning in Mathematics: One Set of Experiences." Using Writing to Teach Mathematics. n.p. (1990): 39-41.
- Miller, Loretta. "Writing to Learn Mathematics." Mathematics Teacher. (1991): 516-21.
- Miller, Diane. "Teacher Benefits from Using Impromptu Writing Prompts in Algebra Classes." Journal for Research in Mathematics Education. 23 (1992): 329-40.

Mumme, J. and N. Shepard. "Implementing the Standards: Communication in Mathematics." The Arithmetic Teacher. 38 (1990): 18-22.

Nahrang, C.L. and B.T. Peterson. "Using Writing to Learn Mathematics." Mathematics Teacher. 79 (1986): 461-65.

Standards for Curriculum and Pedagogical Reform in Two-Year College and Lower Division Mathematics. American Mathematical Association of Two-Year Colleges. (1993): 13-38.

Chapter 3

Procedures

Introduction

The purpose of this experiment was to determine the effect of journal writing in an "Introduction to College Math" class on the level of academic achievement. The experiment was conducted at Cumberland County College in Vineland, New Jersey. Cumberland County College is an open-door, comprehensive two-year public institution. Student enrollment is approximately three-thousand students. Minority enrolled is 27.6 percent of the total college enrollment. Students from Africa, Mexico, Jamaica, South America, Japan, Korea, India, and Kuwait attend the college.

Daytime classes are arranged on a Monday-Wednesday-Friday schedule for fifty-five minutes and a Tuesday-Thursday schedule for one hour and twenty-five minutes. A semester lasts fourteen weeks.

This study occurred during the Fall semester of 1994. Two classes of "Introduction to College Math" were used in this experiment. One section, the control group, was taught the same way as the researcher has taught the course for the past seven years. The control group was comprised of nine students. The other section, the

experimental group, was taught the same way as the control group, but this section was required to keep a mathematics journal. The experimental group was comprised of eighteen students. The composition of the students was a mixture of men and women. Their age levels ranged from students who had just graduated from high school in June 1994 to returning adults in their fifties. A variety of ethnic groups were represented in both classes.

Preparation for the Study

On the first day of the semester students enrolled in "Introduction to College Math" are given a mathematics department skills test. This test is comprised of ten computational problems and ten elementary Algebra problems. The students are told to do just the problems they know how to do and to avoid guessing. The scores the students achieved on this test were used to determine if a significant difference in their mean scores existed. An independent t-test was done for both classes using the above scores. The mean score for the control group was 56.88 percent with nine students being tested. The mean score for the experimental group was 50.0 percent with eighteen students being tested. This test involves the computation of the ratio between experimental variance (observed difference between two sample means) and error

variance (the sampling error factor). The control group met Monday-Wednesday-Friday from 9:00 - 9:55 a.m. and the experimental group met Monday-Wednesday-Friday from 10:00 - 10:55 a.m.

Explanation of the Study

During the entire semester, the experimental group was allowed time during class, one or two times a week, to complete journal entries on specific assigned topics. They were also given journal assignments to do at home. This journal time covered five minutes of class time, usually done at the beginning of the class. On two chapter tests, the experimental group, was given a written assignment as part of the test. Each of the six chapter tests, a requirement of this course, had specific journal assignments to be answered. These journal assignments were collected on the day the student took each chapter test. The students were not given a grade for the journal assignments but instead a plus-plus, a plus or a minus was recorded in the researchers grade book. A plus-plus signified that the student had a good grip of the chapter and was able to answer all the questions. A plus meant that the student had a working knowledge of the chapter but was unclear on a couple concepts. A minus meant that the student did not have a good knowledge of the chapter and was not able to answer

many of the questions. Frequently, the researcher made comments and answered questions on the students' journal assignments. The control group was not involved in the journal writing but the first five minutes of class time was devoted to different topics such as the uses of mathematics, new ideas in mathematics, and professions using mathematics. Therefore, the same amount of time was spent in each class for the daily presentation of the lesson.

The topics for the journal writing included mathematics questions, definition questions, exploratory questions, research questions, and problem-solving questions. A list of the particular questions is found in Appendix A. None of the students in the experimental group questioned the reason behind the journal writing.

Conclusion of the Study

At the end of the semester a mathematics department final examination was administered to both groups under the same conditions. Each group was given the final examination in a mathematics laboratory and were allowed one hour to complete the examination. The mean score of the experimental group was 78.33 percent with $n = 18$. The mean score of the control group was 72.8 percent with $n = 9$ which was a difference of 5.53 points. An independent t-test was once again used to compare the

control group and the experimental group to determine if a significant difference existed between their mean scores.

NOTES

Best, John W. and James V. Kahn. Research in Education. Allyn and Bacon. Boston, Mass. (1993): 323-345.

Bluman, Allan. Elementary Statistics, A Step by Step Approach. Wm C. Brown. Dubuque, Iowa. (1995): 323-337.

CHAPTER 4

Analysis of Data

Introduction

The purpose of this study was to determine if there was a significant difference in achievement between college-level students in a developmental Algebra class who wrote in a journal weekly and those students who did not write in a journal. The experimental section consisted of eighteen students and the control section consisted of nine students. Both sections were taught by the researcher.

Pre-Comparison of Academic Achievement

The first procedure performed was to ensure that the control group and the experimental group were equivalent in achievement. The scores on a mathematics department skills test, administered the first day of the Fall semester, was used to conduct a t-test. This skills test consists of ten computational problems and ten elementary Algebra problems. The mean score for the control group was 56.88 with $n = 9$. The mean score for the experimental group was 50.0 with $n = 18$ (refer to Table 1). The standard deviation was 9.98 for the control group and 15.1 for the experimental group. The standard error of the mean was 3.5 for the control group and 3.7

for the experimental group. Given twenty-five degrees of freedom, the t-value at the 0.05 level of significance for a two-tailed test was found to be 2.060. Since the t-value of the experiment does not fall in the rejection region ($1.35 < 2.060$), the null hypothesis is not rejected.

The null hypothesis stated was that there is no significant difference in achievement between college-level students in a developmental Algebra class who wrote in a journal weekly and those students who did not write in a journal weekly.

TABLE 1
A Comparison of Pretest Scores
Between the Control Group (c₁) and the
Experimental Group (c₂)

	N	Mean	S.D.*	S.E.*
<u>Pretest Scores</u>				
c ₁	9	56.88	9.98	3.5
c ₂	18	50.0	15.1	3.7
		t = 1.35**	df = 25*	

S.D.* Standard Deviation S.E.* Standard Error of
the Mean df* Degrees of Freedom
Not Significant at the .05 level **

Journal Writing

During the entire Fall semester, the experimental group was allowed time during class, one or two times a week, to complete journal entries on specific assigned topics. This journal time covered five minutes of class time, and was usually done at the beginning of the class. The students were also given journal assignments to do at home. The experimental group was given a written assignment on two chapter tests as part of the test. Each of the six chapters required for the course included specific journal assignments. These journal assignments were collected on the day the student took each chapter test. Frequently, the researcher made comments and answered questions on the students' journal assignments. The control group was not involved in the journal writing, but the first five minutes of class was devoted to different topics such as the uses of mathematics, new ideas in mathematics, and professions using mathematics. Therefore, the same amount of time was spent in both classes for the daily presentation of the lesson.

Comparison of Six Chapter Tests

Both the experimental section and the control section were given six chapter tests administered the

same day. T-test scores were computed on each chapter test (refer to Table 2). The mean score on Chapter One test for the control group was 85.0 and for the experimental group was 84.4 with the t-value of 0.11. With twenty-five degrees of freedom, the t-value at the 0.05 level of significance for a one-tailed test was found to be 1.708. Since the t-value of this study does not fall in the rejection region ($0.11 < 1.708$), the null hypothesis is not rejected. On Chapter Two test the mean score for the control group was 72.3 and 73.2 for the experimental group with the t-value of 0.10. Given twenty-five degrees of freedom, the t-value at the 0.05 level of significance for a one-tailed test was found to be 1.708. Since the t-value of this study does not fall in the rejection region ($0.10 < 1.708$), the null hypothesis is not rejected. Chapter Three mean test scores was 73.9 for the control group and 71.8 for the experimental group with the t-value of 0.26. Given twenty-five degrees of freedom, the t-value at the 0.05 level of significance for a one-tailed test was 1.708. Since the t-value of this study does not fall in the rejection region ($0.26 < 1.708$), the null hypothesis is not rejected. The mean scores on Chapter Four test was 78.2 for the control group and 82.4 for the experimental group with a t-value of .61. Given twenty-five degrees

of freedom, the t-value at the 0.05 level of significance for a one-tailed test is 1.708. Since the t-value of this study does not fall in the rejection region ($0.61 < 1.708$), the null hypothesis is not rejected. Chapter Five mean test scores was 75.5 for the control group and 81.6 for the experimental group, with the t-value of 0.68. Given twenty-five degrees of freedom, the t-value at the 0.05 level of significance for a one-tailed test was found to be 1.708. Since the t-value of this study does not fall in the rejection region ($0.68 < 1.708$), the null hypothesis is not rejected. The mean test scores for Chapter Six was 57.7 for the control group and 64.1 for the experimental group, with the t-value of 0.53. Given twenty-five degrees of freedom, the t-value at the 0.05 level of significance for a one-tailed test is 1.708. Since the t-value of this study does not fall in the rejection region ($0.53 < 1.708$), the null hypothesis is not rejected. In all cases the t-value does not fall into the rejection region, so the null hypothesis was not rejected.

TABLE 2
A Comparison of Six
Chapter Tests between the
Control Group (c₁) and the
Experimental Group (c₂)

	N	Mean	S.D.*	S.E.*
<u>Chapter 1</u>				
c ₁	9	85.0	12.6	4.2
c ₂	18	84.4	11.2	2.6
		t = 0.11**	df = 25*	

<u>Chapter 2</u>				
c ₁	9	72.3	22.2	7.4
c ₂	18	73.2	20.4	4.8
		t = 0.10	df = 25	

<u>Chapter 3</u>				
c ₁	9	73.9	18.0	6.0
c ₂	18	71.8	24.1	5.7
		t = 0.26	df = 25	

<u>Chapter 4</u>				
c ₁	9	78.2	18.3	6.1
c ₂	18	82.4	14.0	3.3
		t = 0.61	df = 25	

<u>Chapter 5</u>				
c ₁	9	75.5	20.7	7.3
c ₂	18	81.6	21.9	5.2
		t = 0.68	df = 25	

<u>Chapter 6</u>				
c ₁	9	57.7	31.0	10
c ₂	18	64.1	25.4	6
		t = 0.53	df = 25	

S.D.* Standard Deviation S.E.* Standard Error of the Mean df* Degrees of Freedom Not Significant at the .05 level**				

Post-Comparison of Academic Achievement

At the end of the Fall semester a mathematics department final examination was administered to both the experimental group and the control group. Both groups were given the examination in a mathematics laboratory. They were allowed one hour to complete the examination. The examination consisted of thirty-five elementary Algebra questions. The questions were on materials covered throughout the semester. A t-test was again used to compare the examination results (refer to Table 3). The mean score of the control group was 72.8 with $n = 9$. The mean score of the experimental group was 78.3 with $n = 18$. The standard deviation of the control group was 15.8 and the experimental group was 12.5, the t-value was calculated to be 0.92. Given twenty-five degrees of freedom, the t-value at the 0.05 level of significance for a one-tailed test is 1.708. Since the t-value of this study does not fall in the rejection region ($0.92 < 1.708$), the null hypothesis is not rejected.

The day before the Fall semester ended, a five question survey was presented to the experimental group (see Appendix B). At that time, the researcher told the group that they had been part of an experiment. All of the eighteen responses to the survey were positive. When asked how journal writing could be changed to be more

effective most felt that it didn't need any changes. Two students suggested that students write down problem areas at the end of each chapter so the instructor would know how the student is doing.

TABLE 3
A Comparison of Posttest Scores
between the Control Group (c₁)
and the Experimental Group (c₂)

	N	Mean	S.D.*	S.E.*
<u>Posttest</u>				
c ₁	9	72.8	15.8	5.3
c ₂	18	78.3	12.5	3.0
		t = 0.92**	df = 25*	

S.D.* Standard Deviation S.E.* Standard Error of the
Mean df* Degrees of Freedom Not significant at
the .05 level**

CHAPTER 5

Summary, Conclusions and Recommendations

Introduction

The purpose of this study was to measure academic achievement in a developmental mathematics class through the use of journal writing. This study was done at Cumberland County College in Vineland, New Jersey during the Fall semester of 1994. Two classes of "Introduction to College Math" were used for the experiment and both classes were taught by the researcher. The experimental group, comprised of eighteen students, kept a mathematics journal. These students were required to answer various types of mathematics questions in paragraph form. The control group, comprised of nine students, was not required to keep a mathematics journal. The hypothesis to be tested was to determine if there is a significant difference in achievement between college-level students who wrote in a journal weekly and those students who did not write in a journal.

Summary of the Findings

The academic achievement variable that was used for pretest scores was a mathematics skills test administered

the first day of the semester. The mean score for the control group was 56.88 with $n = 9$. The mean score for the experimental group was 50.0 with $n = 18$. There was no statistically significant difference between these two means. Six chapter tests results were also compared. There was no statistically significant difference between mean scores of the two groups. Posttest scores from a mathematics department final examination were also used for comparison. The mean score for the control group was 72.8 with $n = 9$. The mean score for the experimental group was 78.3 with $n = 18$. Again, there was no statistically significant difference between these two means.

Conclusions

Since the six chapter tests and the posttest scores did not indicate a significant difference in mean scores, a conclusion can be that drawn that journal writing in a developmental mathematics class on a college-level does not improve achievement.

Recommendations

A five question survey about journal writing was answered by the experimental group. All of the responses were positive. The students even suggested that the researcher continue this experiment in the Spring semester.

Through the journal writing, the researcher was able to see the students' strengths and weaknesses and focus on these to build the students' confidence in mathematics.

Although not tested statistically on attitude, there was a tendency for the experimental group to have a more positive attitude towards this mathematics class. There was much more participation and questions in the experimental group versus the control group. This class does not transfer to a four-year college and does not count in the students' GPA, so frequently attitude and retention is very low.

Although not part of the experiment, the researcher has tracked the students involved in both the control group and the experimental group in their college-level mathematics class to see the success rate, achievement level, and retention rate.

At the midterm of the Spring semester twelve of these students were tracked, six from the control group and six from the experimental group. With success rate being measured as an A, B, or C five students from the control group were successful and five students from the experimental group were successful.

The researcher continued to use journal writing in the Spring semester in two classes of "Introduction to

College Math". Many comments have been received from the students, such as " the instructor is student friendly" and " cares about the success of her students". It will be interesting to compare test results and retention rate using a larger sample size.

Appendix A

Journal Questions

September 1994

1. Write a math autobiography. Tell me about your triumphs and disasters. Go back as far as you can remember. What do you like about learning math? What do you not like?
2. Give an example of a real-life situation that can be described with integers but not with whole numbers.
3. Why are the rules for order of operation needed?
4. Explain why $6 - 11$ is the same as $6 + (-11)$.
5. Explain why $6/0$ is undefined.
6. Shirley has taken on the job of organizing this year's 3-day state convention of surgeons. The location is a remote island. The convention will be attended by 600 surgeons. There is one problem; the island has a single airstrip allowing only one plane holding 26 passengers to land each half-hour. Investigating other methods of transportation, Shirley finds 3 local fisherman who could transport 15 people at one time. The one-way passage could take as long as $3/4$ of an hour from the main island where conventioners would wait their turns for a boat or plane. Should Shirley look for another convention site? On what basis should Shirley make her decision? Any

other information you can give her?

October 1994

7. In your own words, explain how to combine like terms.
8. Make up an equation that has no solution and explain why.
9. Explain the difference between simplifying an equation and solving an equation.
10. Give an example of how you solved a mathematical application in the last week.
11. Explain the difference between an equation and an inequality.
12. List 5 ways we use Algebra.
13. Explain why order is important in ordered pairs.
14. Discuss whether a vertical line ever has a y-intercept. Discuss whether a horizontal line ever has an x-intercept.
15. In charge of arranging food for her company picnic, Karen hires a caterer. The rates the caterer charges are \$250 for 40 people and \$1800 for 360 people. Karen expects 120 people. The caterer tells Karen that since he charges \$250 for 40 people, he intends to charge her \$750. How do you suppose he arrived at that cost? If you plot points on a cartesian coordinate system so that each x-coordinate is the number of people the caterer serves and the y-coordinate is the caterer's charge for

the number of people, is it reasonable to assume that the points lie on a straight line?

16. According to legend, Renee Descartes watched a fly move about the ceiling while lying in bed and tried to think of a way to describe the location of the fly as it moved from place to place. Describe the system he designed?

17. Was math invented or discovered?

18. Now that it is the midterm write a self evaluation of where you are "at".

November 1994

19. Explain the difference between $(-5)^2$ and -5^2 .

20. Simplify each expression and explain the difference between the two problems.

a. $(3x)^2 (4x)^2$ b. $3x^2 + 4x^2$

21. Explain how to square a binomial.

22. Chain letters have been around for years, yet many people do not realize that some chain letters violate U.S. postal regulations. The originator of a chain letter makes a list of, say, 4 people's names, including his own name at the bottom of the list. The letter tells each person to send something to the person at the top of the list and to put his own name at the bottom. In just a few weeks, the letter promises something. Chain letters asking for money are against the law. What

justification can you give for the law against money chain letters? If the letter asked for \$2.00 and the originator and each person who gets the letter sends it to 10 people, how much money does the originator hope to get if his name was on the bottom of his original list of 4 names? What if each person sent the letter to 15 people?

23. Explain the difference between the "foil" method and the "column" method in multiplication of polynomials.

24. Explain "long division" with polynomials.

25. Describe what it means to factor a polynomial.

26. Describe a perfect square trinomial, and then give one example.

27. Peter is going to put a swimming pool in his back yard. He's talked to suppliers, and has settled on a pool 10' by 15'. The pool will be surrounded by a cement patio, equally wide on all sides. Constructing the patio costs \$800 for every square foot of patio and Peter can only afford \$2400 for the patio. How wide can Peter's patio be? What if Peter choose a smaller pool costing \$300 less and used the savings for a bigger patio. How wide can Peter's patio be now?

28. List and explain any new vocabulary words you learned in this chapter.

29. Explain what a GCF is and give an example.

30. Explain what it means to factor by grouping.

December 1994

31. Explain how to write a rational expression in lowest terms.

32. List the steps necessary to divide 2 rational expressions.

33. Write some instructions to help a friend who is having difficulty finding the LCD of two rational expressions.

34. Explain the difference as well as the likeness of rational expressions and numeric fractions.

35. Explain how you would do this problem

$$12x^3 + 20x^2y / 8x^2y$$

Appendix B

Survey

1. Do you think writing in this math class has helped you clarify some of the concepts that were difficult for you?
2. Do you think writing should be used as a means for learning math? Why?
3. How do you feel about journal writing for this course?
4. What do you think are the benefits, if any, of journal writing for a math class?
5. How could journal writing be changed to be more effective in this class?

BIBLIOGRAPHY

- Allen, Barbara. "Writing in a Mathematics Classroom." Essential Arithmetic 7th ed. PWS Publishing. 1994. A103- A107.
- Applebee, A. "Writing and Reasoning." Review of Educational Research 54(4) (1984): 577-596.
- Bell, Elizabeth, and Ronald Bell. "Writing and Mathematical Problem Solving: Arguments in Favor of Synthesis." School Science and Mathematics. (March 1985): 210-221.
- Best, John W. and James V. Kahn. Research in Education. Boston, Mass. (1993).
- Blumen, Allen. Elementary Statistics, A Step by Step Approach. Wm. C. Brown. Dubuque, Iowa. (1995): 323-337.
- Bode, Barbara. "Dialogue Journal Writing." Reading Teacher. 42 (April 1989): 568-571.
- Borasi, R. and B.J. Rose. "Journal Writing and Mathematics Instruction." Educational Studies in Mathematics. 20 (1989): 347-365.
- Brandau, L. "Rewriting our Stories of Mathematics." Using Writing to Teach Mathematics. Mathematical Association of America. (1990): 73-77.
- Capps, Lee. Current Issues. "Communicating in Mathematics." Houghton, Mifflin. 10-11.
- Connolly and Vilardi. Writing to Learn Mathematics and Science. 1989.
- Countryman, Joan. Writing to Learn Mathematics, Strategies That Work. Heinemann. Portsmouth, N.H. 1992.
- Easley, A. "Learning Through Writing." Journal of Developmental Education. 13(1) (1989): 10-12.
- Eisenhart, M.A. "The Ethnographic Research Tradition and Mathematics Education Research." Journal for Research in Mathematics Education. 19 (1988): 99-

114.

- Evans, Christine Sobray. "Writing to Learn Mathematics." Language Arts. 61 (December 1984): 828-835.
- Feingold, Marilyn. Occupational Education and the Effect of Basic Skill Remediation in Student Retention in a Community College. Ph.D. diss., Rutgers University, 1994.
- Gambrell, Linda. "Dialogue Journal Reading-Writing Interaction" Reading Teacher. 38 (February 1985): 512-515.
- Geeslin, William. "Using Writing About Mathematics as a Teaching Technique." Mathematics Teacher. 70 (February 1977): 112-115.
- Goffman, L. and J. Dunston. "Writing Across the Curriculum in a Data Processing Class: An Ethnographic Investigation." Research and Teaching in Developmental Education. Vol II (1994): 31-35.
- Grossman, Frances Jo, Brenda Smith, Cynthia Miller. "And you Say 'Write" in Mathematics Class?" Journal of Developmental Education. (1989): 2- 6.
- Hayes, C., M. Simpson, N. Stahl. "Effects of Extended Writing on Students Understanding of Content Area Concepts." Research and Teaching in Developmental Education. 10(2) (Spring 1994): 25-35.
- Hoffman, M. and A. Powell. "Mathematical and Commentary Writing: Vehicles for Student Reflection and Empowerment." Mathematics Teaching. (March 1986): 55-57.
- Gladstone, Carol. Thinking, Reading and Writing Across the Curriculum. ERIC, 1987, ED 291 089.
- Goldberg, D. "Integrating Writing into Mathematics Curriculum." Two Year College Mathematics Journal. 14(5) (1983): 421-424.
- Gopen, G. and David Smith. "What's an Assignment Like You Doing in a Course Like This?: Writing to

- Learn Mathematics." College Mathematics Journal. 21 (1990): 2-19.
- Johnson, Marvin L. "Writing in Mathematics Classes: A Valuable Tool for Learning." Mathematics Teacher. 76 (February): 117-119.
- Kennedy, Bill. "Writing Letters to Learn Math." Learning. 13(6) (February 1985): 59-61.
- Kennedy, M.L. "Reading and Writing: Interrelated Skills of Literacy on the College Level." Reading World. 20 (1980): 131-141.
- Langer, J.A. and A.N. Applebee. "How Writing Shapes Thinking: A Study of Teaching and Learning." National Council of Teachers of English. ERIC, 1987, ED 286 205.
- Lawrence, Sandra. Journal Writing as a Tool for Learning in College Classrooms. DAI 49 (1989): 2568A.
- LeGere, Adele. "Collaboration and Writing in the Mathematics Classroom." 84 (March 1991): 166-171.
- Lesnak, Richard. Using Linguistics in the Teaching of Developmental and Remedial Algebra. ERIC, 1993, ED 366 383.
- Maher, R. "Writing, Teaching and Learning in Mathematics: One Set of Experiences." Using Writing to Teach Mathematics. (1990): 39-41.
- Mauer, S. "Writing in Mathematics at Swarthmore: PDCs." Using Writing to Teach Mathematics. (1990): 22-25.
- McIntosh, Margaret E. "No Time for Writing in Your Class?" Mathematics Teacher. 84 (September 1991): 423-433.
- Mett, Coreen L. "Writing as a Learning Device in Calculus." Mathematics Teacher. 80 (October 1987): 534-537.
- Miller, L. D. and D. A. England. "Writing to Learn Algebra." School Science and Mathematics. 89(4) (1989): 299-312.

- Mumme, J. and N. Shepard. "Implementing the Standards: Communication in Mathematics." The Arithmetic Teacher. 38 (September 1990): 18-22.
- Murray, Barbara and Jennifer Walsh. "Collaborative Writing: English and Mathematics." Innovative Abstracts. Vol XIV 1992.
- Nahrgang, C.L. and B.T. Peterson. "Using Writing to Learn Mathematics." Mathematics Teacher. 79 (1986): 461-465.
- Pearce, D.L. and D.M. Davison. "Teacher Use of Writing in the Junior High Mathematics Classroom." School Science and Mathematics. 88(1) (1988): 6-15.
- Price, J.J. "Learning Mathematics Through Writing: Some Guidelines." College Mathematics Journal. 20 (1989): 393-402.
- Russell, D.R. "Writing Across the Curriculum and Communications Movement: Some Lessons from the Past." Composition and Communications. 38(2) (1987): 184-195.
- Schoenfeld, Alan H. "Learning to Think Mathematically: Problem Solving, Metacognition and Sense Making in Mathematics." Handbook of Research on Mathematics Teaching and Learning. (1992): 334-370.
- Shatzberg-Smith, Kathleen. "Dialogue Journal Writing and the Study Habits and Attitudes of Underprepared College Students." DAI 49(1989): 1723A.
- Standards for Curriculum and Pedagogical Reform in Two-Year College and Lower Division Mathematics. American Mathematical Association of Two-Year Colleges. Circulating draft October 1993.
- Tierney, R.J., A. Soter, J.F. O'Flahavan, W. McGinley. "The Effects of Reading and Writing upon Thinking Critically." Reading Research Quarterly. 24(2) (1989): 134-173.
- Vukovich, D. "Ideas in Practice: Integrating Math and Writing Through the Math Journal." Journal of Developmental Education. 9 (1985): 19-20.

Watson, Margaret. "Writing Has a Place in a Mathematics Class." Mathematics Teacher. 73 (October 1980): 518- 520.

White, Arthur. " A Writing-Intensive Mathematics Course at Western Michigan University." Using Writing to Teach Mathematics. (1990). 34-38.

Yinger, R.J. and C. Clark. Reflective Journal Writing: Theory and Practice. ERIC, 1981, ED 208 411.