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ABSTRACT

Miami-Dade community colleges and middle schools participated in a three-year project designed to improve female students' mathematics skills and prepare them for technical jobs. Faculty encouraged the application of transactional writing in college and middle school algebra, to determine whether combining communication skills with mathematical skills would have a positive effect on achievement and attitude. Math and English faculty examined student transactional writing exercises for inconsistencies and state-mandated quality writing, and handed back comments. Students then turned in revisions. Project results were evaluated by raw scores on algebra placement tests for college, and the scaled math scores on the Stanford Achievement Test for middle school; attitude was measured by the Revised Mathematics Attitude Scale. Outcomes for college algebra included higher grades for the writing group, with females receiving higher pass rates than males, and a positive change in attitude towards mathematics for everyone except female non-writers. Outcomes for middle school algebra indicated that writers outperformed non-writers, with female writers showing the greatest improvement. Female writers and male non-writers showed positive changes in attitude towards mathematics. (Contains 27 references.) (YKH)

# Transactional Writing: Empowering Women and Girls to Win at Mathematics

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# TRANSACTIONAL WRITING: EMPOWERING WOMEN AND GIRLS TO WIN AT MATHEMATICS

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## Project Goals and Objectives

In the past century, women have outperformed men on most measures of rudimentary and middle-level literacy. At the higher educational levels, Wilder and Powell report that girls outscore boys on the English portion of the Scholastic Achievement Test, and on the Graduate Record Examination women only outscore men in the area of English (cited in Kaestle, Damon-Moore, Stedman, Tinsley, & Trollinger, 1991). These observations speak to the point that men, particularly at higher levels, excel over women in mathematics performance. Yet according to Burton (1987), good writers showed higher mathematics achievement than poor writers. Given the urgent need to recruit women into technical fields, continued superior performance in the area of literacy is desired and at the highest levels, further equalization in the attainment of mathematics skills is expected.

The objectives of this three-year project are to determine the effect of transactional writing on females' achievement in, and attitude towards, their respective mathematics classes. Transactional writing exercises are being applied in three different groups of student participants in the basic and intermediate college algebra sequence, as well as in groups of participants in a one-, two- or three-year mathematics sequence in each of three middle schools.

## Program Design

The faculty comprising the college team (three members of the mathematics faculty - the principal investigator and two co-principal investigators, and two members of the English faculty) were selected from interested and qualified mathematics and English faculty accepting invitations to participate extended by the principal investigator. Each investigator coordinates project efforts with the mathematics teachers at one of

the middle schools. The two members of the English faculty are knowledgeable of the essay component of the College-Level Academic Skills Test model (CLAST; Florida Department of Education, 1995); both English investigators critique the written exercises according to the CLAST essay rubric and coordinate project efforts with the English teachers at the middle schools. The principal investigator is responsible for coordinating the design, implementing the training component for all teams, articulating with the appropriate administrative personnel and the college/middle school teams before, during, and after implementation, and consulting with the project's statistician. The project's statistician, from Institutional Research, M-DCC conducts all statistical tests on the data supplied.

The middle schools have student enrollments which represent each of Mimai-Dade County's major ethnic groups, i.e., African-American, Hispanic, and White Non-Hispanic, and have female student populations of approximately 50%. Given the autonomy of the schools within the Miami-Dade County Public Schools (M-DCPS) established by school-based management, at each site, two members of the mathematics faculty have been selected based upon their assignment to the required classes, their interest in participating (especially their desire to go "on-line") and the recommendation of school-based administrative personnel. A member of the English faculty knowledgeable of the Florida Writing Assessment Program model (Florida Department of Education, 1990) has been selected. These three faculty members constitute a school project team at each middle school site.

This design provides for articulation through which the middle school and college teams will provide resources and support for one another before, during and after the life of the project. The students of the selected mathematics faculty are the student participants and have been placed in these classes based upon existing academic criteria. Hence, student participants will be similar in their level of mathematics performance. All team members trained for project implementation during the Summer of 1996.

A three-year project will permit the application of transactional writing in three different groups of student participants in the basic and intermediate college algebra sequence, as well as in groups of participants in a one-, two- or three-year middle school mathematics sequence, to determine whether the combining of communication skills with mathematical skills will have a positive effect on female students' achievement/attitude. Conducting the program over three years will permit validation of these premises, will enable the principal investigator to use formative evaluations as a guide for redesign and restructuring of the program, as needed, and will increase the validity and reliability of the project's results. Furthermore, a three-year project will permit sufficient training of the project teams such that after implementation their experience levels will be made closer to that of the principal investigator. The investigators are using "a two-group design, which allows for more control over extraneous variables" (Aiken, 1970, p. 578). A non randomized control group, pretest- pretest-posttest quasi-experimental design is being used. Hence, subjects are not randomly assigned to treatments, but four of eight college classes and nine of eighteen middle school classes from each school, selected at random, comprise the experimental group. The remaining classes each comprise the control group. The experimental and control groups are further separated, by level, according to gender; female components of each group being the focus of the project.

## Program Content

During the Summer term of 1996, the principal investigator coordinated the design and implementation an 8-hour training component for all teams. Training included a description of the project highlighting goals/objectives, project design, content and procedures, and unique/innovative aspects. The team members were introduced to the instruments of evaluation, received instruction as to their administration, and were advised of the format of data collection and transfer agreed upon by the principal investigator and project statistician. An integral part of the training was the development of level specific writing exercises for first-year implementation, particularly on the middle school level, and a schedule for their dissemination,collection, etc. The principal investigator not only utilized writing exercises already developed, but also used current constructivist classroom strategies, the knowledge and experiences of the

mathematics and English team members, and the contents of their respective curricula, to develop writing exercises, as needed. Team members also received training in the writing, critiquing and grading of the transactional writing exercises. Four-hour meetings will be held during the Summer terms for the development of level specific writing exercises for the 2nd- and 3rd- years of implementation and a schedule for their dissemination, collection, etc.

Data is being gathered with respect to demographic variables, gender, ethnicity, and age . Inter- and intra-group comparisons are being made on these variables according to pre- and post- attitude and achievement scores. At the end of each term (Fall and Winter) a 2-hour meeting of all project teams is held. Each meeting held at the end of Winter term will enable the principal investigator to confirm that data collection has been made such that summative evaluations can begin. The 4-hour meeting held at the end of the Winter term of 1998 will confirm all components of data collection such that final summative evaluations can begin.

The independent variable in this study is a treatment consisting of level and content-area specific written exercises. The experimental group receives whole class instruction including transactional writing exercises. Transactional writing exercises (See Appendix 1) exemplify writing as a tool to learn, reflect discoveries made by students in the classroom, and as appropriate, will adhere to specific objectives of the mathematics components of the CLAST and the Stanford Achievement Test (Buros Institute, 1985). These writing exercises are a significant part of the teaching/learning process and are given as a regularly scheduled part of students' homework; their subject matter is pertinent to the instruction received in class, and grades earned on them are considered in the computation of mathematics course grades. Furthermore, evaluation of the exercises by the respective English faculty team member follows the state-mandated writing assessment paradigms of the essay/writing component of the CLAST or the Florida Writing Assessment Program, respectively.

A split-page format (graphic organizer) is used, i.e., students write on the left side of the paper; their writing is in the format required by the respective state writing paradigms. Writing exercises are "collected" by the assigned mathematics investigator and examined for content and accuracy. The mathematics investigator acts as the audience for the writing exercises, i.e., the "someone who needs help". Since this reader sees what was written, and not what was meant, the investigators comment on any errors, omissions, and inconsistencies that were observed; typically, occurrences that the investigator looks for are failure to define terms/provide reasons, and failure to answer the question (Price, 1989). In light of the project's goal of continued superior performance in the area of literacy, students are held accountable for what they put on paper and how they put it there. Rather than teach them that "incompetence in their language is acceptable" (Sherrill, 1994, p.1), this project seeks to "demonstrate the [mathematics] and ... English [departments] are unified in valuing writing." (Sherrill, 1994, p.2). Hence, drafts are also critiqued by a designated English faculty project team member. This collaborative effort towards state-mandated quality writing will support an interdisciplinary writing-across-the-curriculum effort at each level. Each investigator will record for her classes appropriate comments/suggestions on the right side of the paper. The exercises are "returned" to the students. Using the critiques of both the mathematics and English investigators and using the same format, students are required to submit a revision of each exercise. Price (1989) found that a procedure that includes revisions eliminated much unacceptable writing, and helped students to see the need for revision. Gebhard (1983) and Crane (1986) found holistic scoring to be an efficient method to grade papers; students are not threatened by technical mistakes and tend to concentrate on what they are exploring. Hence, the revision is commented upon and rated for content and accuracy on a six-point scale by the respective mathematics investigator and is also rated according to the appropriate state-mandated essay/writing rubric by the respective English investigator. These scores are recorded by the mathematics investigator. It is expected that the dual critiques will "... reinforce the value of writing in [both] areas ..." (Sherrill, 1994, p.1) and will induce an overall better quality of writing in subsequent writing exercises. The other classes (the control group) also receive whole class instruction, as did the experimental group, but without transactional writing exercises. The dependent variables are achievement between the female (male) components of the experimental and control groups (by level and class); and attitude between the female (male) students of the experimental and control groups (by level and class). We

are beginning to experiment with "writing" via email. This will provide an exciting new model to encourage enhanced writing, communication and interaction between student and teacher in an educational setting. The varying technological settings, and levels of expertise of students and teachers continue to present challenges to these efforts.

## Related Research and Projects

Within a cognitive framework, "what a student learns depends to a great degree on how he or she learned it" in terms of active, constructive processes (Commission on Standards for School Mathematics of the National Council of Teachers of Mathematics, 1989, P.5). Zinsser (1988) claims that the best way to immerse oneself in a field and to make it one's own, is to write about it. A method to teach students mathematics based on writing exercises invites students to be more active and to see themselves as mathematicians (Countryman, 1993). According to Nahrgang and Petersen (1986), writing will provide an opportunity to "formulate, organize, internalize and evaluate..." (p.461); "a variety of intellectual skills such as synthesis, interpretation, translation, analysis and evaluation" (p.465) will be used. In a study by Lesnak (1989), remedial algebra students in the control group, i.e., those not exposed to the writing-to-learn activities, completed the course with a mean grade of 74.5%, whereas students in the experimental group, averaged 77.7%. Hence, Lesnak believes that writing is a valuable tool in improving academic skills.

The following observations support the need for implementing such writing programs in mathematics: 1. Teachers fail to give female mathematics students ample opportunities to communicate in ways indicative of true understanding. This impedes the learning of mathematics. 2. Students, particularly females, hold unhealthy beliefs about mathematics, concerning its nature, behavior, and tasks, e.g., isolation and conceptions of self and others. These beliefs influence how female students learn mathematics (Mtetwa & Garofalo, 1989). In order to begin to change some of the teacher/female student negative practices and beliefs that interfere with the female student's deeper understanding of mathematics, the focus of educators must shift from learning products to learning processes (Mtetwa & Garofalo, 1989) such as writing. Female students and their teachers will regard mathematics in a new way.

The principal investigator began actual experimentation with writing-to-learn exercises in Spring, 1989. Since that time data has been collected from classes ranging from the level of Basic College Mathematics through College Algebra. An analysis of this data has consistently confirmed that the average total number of points earned on writing exercises was higher for students earning the better (passing) course grades, i.e., better writers of math are better math students. At the end of doctoral level research conducted during Winter 1990 practical significance was observed on achievement ( $X_{exp} = 21.45$, $X_{cont} = 20.43$) and attitude ( $X_{female} = 20.90$, $X_{male} = 20.82$). Significant differences were found between gender and age groups on attitude, i.e., female[$X = 65.71$] over male [$X = 62.51$] and > 20, $X = 67.00$, < 20, $X = 61.70$). Within the experimental group, the high proficiency writing group scored significantly higher than the low proficiency writing group on achievement, i.e., there was a significant difference in the achievement of good writers of English and math and poor writers of English and math, $X_{good} = 23.26$ and $X_{poor} = 19.25$ (Austin, 1992). Data analysis for a writing project implemented during Fall, 1994 (Introductory Algebra) revealed similar results concerning writing and performance, e.g., differences in average points on test questions pertinent to the writing exercises ranged from .72 to 6.97 in favor of the experimental group. Further analysis implies that writing impacts not only performance by gender (female over male; $Experimental_{female}$ over $Control_{female}$) but also retention ($n_{EXP} = 33$ and $n_{CONT} = 25$).

## Evaluation

Achievement on the college level is measured by using a version of the Elementary Algebra Skills test which is one of the four placement tests in mathematics and English, each designed to provide information about readiness for an entry level course. These tests comprise the Florida Multiple Assessment Programs and Services: Assessment and Placement Services Colleges and Universities Program (Multiple Assessment Programs & Services of the College Board, 1984). This instrument contains thirty-five multiple choice items dealing with topics found in most first-year algebra courses. Students will take a different form of the test twice: pretest and posttest. Achievement will be

determined by raw scores (the number of correct answers). On the middle school level, achievement is measured using the mathematics portion of the Stanford Achievement Test which is four tests representing a sample of the major components of school mathematics curricula in each grade. This annual test contains is basic, multiple choice battery (Buros Institute, 1985). Achievement will be determined by scaled scores.

Attitude is measured by the Revised Mathematics Attitude Scale (Aiken, 1963). This instrument contains 20 items; 10 items connoting negative attitudes and 10 items connoting positive attitudes. A five-point scale weighted with integers from one to five, in the direction of strongly disagree-strongly agree is used. The scores for each item are added to yield an individual's score. Participants will complete the attitude scale twice; pretest and posttest. On the college level, pretests are administered during the first class meeting, preceding the achievement instrument in administration. On the middle school level the Stanford Achievement Test is typically administered in the Spring, hence, pretests of attitude will be administered approximately five (5) months after the pretests of achievement. Posttests on attitude are administered on the second to the last day of classes, preceding the achievement instrument in administration on the college level, and on the middle school level, prior to the administration of the current year's Stanford Test. Traditional examinations are also administered during the treatment period. All instruments will be administered by the investigators or members of the Department of Testing.

## Data Analyses

The Elementary Algebra Skills test is used to record the pre- and post- achievement of the college experimental and control groups by class and gender. Similarly, the Stanford Achievement Test is used to record the annual achievement of the middle school groups . Aiken's Revised Mathematics Attitude Scale is used to record the attitudes of all the participants in the experimental and control groups, by level, class and gender. Pre- and post- mathematics attitude scales are administered. Data collected from the classes that comprise the female (male) components of the experimental group, by level and class, will be collapsed in order to conduct the analyses. The data collected from the classes which comprise the female/male components of the control group will be treated similarly. Using the data gathered from the pre- (prior) tests, t-tests are conducted to determine the equivalency of the collapsed control and experimental groups on both achievement and attitude. If the respective pairs of groups are found to be equivalent in achievement and/or attitude, t-tests are conducted using the data gathered from their post- (current) tests. If the groups are not equivalent in one or both dependent variables, an analysis of covariance (ANCOVA) with the pre- (prior) test as a covariate will be conducted to determine the extent of the effect of transactional writing on achievement and/or attitude. Similar analyses are conducted with data according to race/ethnicity, age, etc. All such tests are conducted by the project's statistical expert. Formative evaluations are conducted at the end of each major term in order to assess the need for any revisions, modifications, and changes in the program. In addition, formative evaluations are used to investigate the consistency of grading by the respective mathematics and English faculties. Summative evaluations will be conducted at the end of each academic year and at the end of the three-year project period.

## First Year Outcomes - College

At the onset of the Fall term, no significant differences in grades, attitude profile, pre-test of math ability and demographics were found in participants grouped by gender/writing status (writing vs. non-writing) or gender/ethnicity. At the end of the term (See Table 1),

a) writing appears to have a significant impact on participants assigned the enrollment status code, "returning student", i.e., a student who has not been enrolled for at least Fall and Winter terms.

b) The mean difference of the writing group (5.522) was higher than that of the non-writing group (4.231).

c) a significant difference in final course grades was found between writing and non-writing college-preparatory groups. The writing group produced a significantly higher number of "S" grades among males and females. Follow-up studies reveled that members of the writing group were more likely to obtain a grade of "S" and consequently, would be allowed to continue their study of math at the college level; whereas, member of the non-writing group were more likely to obtain a grade of "P" and consequently, have to repeat college preparatory work.

d) The writing seemed to help reduce the number of withdrawals, but not significantly.

e) Attitude towards math was examined using a factor analysis to determine if different patterns existed. None did.

Table 1
M-DCC Fall Term
Basic College Algebra
Gender by Writing Status

| | Non-writing | Writing | Total |
|---|---|---|---|
| Male | 49 | 54 | 103 |
| Female | 67 | 60 | 127 |
| Total | 116 | 114 | 230 |

At the end of the Winter term (See Table 2) the following observations were made:

a) After not being enrolled for at least Fall and Winter terms, fewer students return to school in the Winter term than in the Fall. Hence, writing did not appear to have a significant impact on Winter term MAT 1033 students assigned to any of the enrollment status codes.

b) Within the non-writing group there exists an equal likelihood of earning a grade of A, B, C, D, or F, regardless of gender. Whereas, within the writing group, male participants were more likely to earn a grade of C while female participants where more likely to earn grades of A or B. The observed gender-related difference in final course grades earned in the writing group was significant. When compared to the non-writing group, it is interesting to note that regardless of gender, a smaller percentage of participants enrolled in the writing group earned grades of D or F, 25% vs. 37%. No significant difference was found in analyses of final course grades according to gender by writing status by ethnicity. Overall, the writing group produced a higher percentage of passing grades, i.e., grades of A, B, or C (75%); writers are more likely to "pass" MAT 1033. By gender, the percentage of passing grades was highest among females. Inter-group comparisons of posttest means revealed that female writers outperformed female non-writers, 25.242 and 23.115, respectively. Inter-group comparisons of posttest means for students who took both the pre- and posttests again revealed that female writers outperformed female non-writers, 24.24 and 23.115, respectively. It is interesting to note that male non-writers tend to outperform male writers. This would seem to confirm that the writing project is a "female-oriented" intervention.

c) In spite of challenges incurred in maintaining the student population from Fall term to Winter term, forty (40) students were participants both terms; seventeen (17) students (12 females and 5 males) were enrolled in a writing section both terms, and twenty-three (23) students (16 females and 7 males) were enrolled in a non-writing section both terms. Females represented equivalent percentages of these writing and non-writing groups, i.e. 71% and 70%, . Fifty-eight percent of these females writers earned course grades of A, B, or C, whereas only 50% of the female non-writers earned these same grades. A larger percentage of female non-writers earned grades of D, F, or W (50%) that did female writers (42%). The direction of these comparisons was reversed for males.

d) By gender, the percentage of student withdrawals from both the treatment groups was about the same. However, when compared to the non-writing group, fewer students withdrew from the writing group, and the smallest number of student withdrawals was among female writers.

e) The following items, illustrative of the two attitudes, were selected by the statistician.

1. I am always under a terrible strain in a math class.
2. I do not like mathematics, and it scares me to have to take it.
3. Mathematics is very interesting to me, and I enjoy math courses.
4. Mathematics is fascinating and fun.

For items 1 and 2, a decrease in the mean responses (pre- to post-) was hypothesized, whereas for items 3 and 4, an increase in the mean responses (pre- to post-) was hypothesized. A comparison of pre- and posttest mean responses to the these items, by gender and writing status, was used to report significant changes. Analysis of the responses collected from the female non-writers revealed none of the expected changes, whereas, analysis of the responses of the female writers revealed the expected changes on all four items. The analysis of the responses given by the male writers revealed the expected changes on only three of the items (1, 2, and 3). When this same analysis was conducted using data collected from male non-writers, expected changes were observed, again, for all four items. In

other words, changes in attitude in the anticipated directions were observed for all groups, gender by writing status, except for female non-writers. But the most demonstrative changes were observed among females writers and male non-writers. These analyses suggest that among females, changes in attitude towards mathematics, in the anticipated directions, may be attributable to writing. For males, the same kinds of changes in attitude occur regardless of treatment group.

At the end of the Winter term, analyses conducted on responses to the attitude scale included baseline data on two additional sections assigned to the control group. These sections were taught by instructors not assigned to the grant / not using the writing component. The responses of these students was very much like those given by the non-writers in the project.

Table 2
M-DCC Winter Term
Intermediate Algebra
Gender by Writing Status

| | Non-writing | Writing | Total |
|---|---|---|---|
| Male | 23 | 26 | 49 |
| Female | 53 | 31 | 84 |
| Total | 76 | 57 | 133 |

## First Year Outcomes - One Middle School (See Tables 3-5)

- Writing Assignments for Year#1 were oriented towards Mathematics Computation.
- Among female participants: **Writers** showed a greater increase than Nonwriters.
- Among male participants: **Writers** showed a greater increase than Nonwriters.
- Among **writers**: **Females** showed a greater increase than Males.
- Among nonwriters: Females showed a greater increase than Males.
- When mean scores where compared (Spring '96 vs. Spring '97), **female writers** showed the largest gain in scale scores and the smallest drop in percentile rank.

Table 3
M-DCPS : One Middle School (grade 6)

| | Nonwriters | Writers | Total |
|---|---|---|---|
| Males | 32 | 38 | 70 |
| Females | 36 | 25 | 61 |
| Total | 68 | 63 | 131 |

Table 4
Stanford Achievement Results
Median Percentile
Spring '97

| | Mathematics Computation |
|---|---|
| Grade 6 | 61 (Spring '96; School data drawn form 1996 - 1997 Dade County Public Schools, District School Profiles.) |
| Writing - Female | 48 |
| Writing - Male | 35 |
| Nonwriting - Female | 46 |
| Nonwriting - Male | 28 |

Table 5
HYPOTHESIS TESTING

| | | | |
|---|---|---|---|
| Females | Mean = 48.67 | st.dev. = 23.2 | n = 24 |
| Males | 38.57 | 21.2 | n = 37 |
| | t = 1.7548, p<.0845 | | |

For **writers,** Mathematics Computation - percentiles - 1997 scores, **females scored significantly higher than males.**

The following items, illustrative of the two scale attitudes, were selected by the project statistician. The last two items were slected to verify the consistency of the responses to the first four items.

1. I am always under a terrible strain in a math class.
2. I do not like mathematics, and it scares me to have to take it.
3. Mathematics is very interesting to me, and I enjoy math courses.
4. Mathematics is fascinating and fun.
16. It makes me nervous to even think about having to do a math problem.
17. I have never liked math, and it is my most hated subject.

For items 1, 2, 16, and 17, a decrease in the mean responses (pre- to post-) was hypothesized, whereas for items 3 and 4, an increase in the mean responses (pre- to post-) was hypothesized. A comparison of pre- and posttest mean responses to the these items by gender, level and writing status, was used to report significant changes. Regardless of level, more anticipated changes in attitude were found among female writers (15) than among female non-writers (10). More anticipated changes were found among male non-writers (19) than male writers (13). In other words, changes in attitude in the anticipated direction were observed for all groups. But the most demonstrative changes were observed among females writers and male non-writers. These analyses suggest, again, that among females, changes in attitude towards mathematics, in the anticipated direction, may be attributable to writing.

## Locale/Rationalization

Miami-Dade Community College (M-DCC) is a large, urban two-year college located in Miami-Dade County, FL. The College is comprised of six main campuses. The Kendall Campus is located on a 185-acre site in the southwest area of Miami (Miami-Dade County, FL). According to a recent demographic profile, 55-65% of the incoming students are below placement level in one or more basic skills. The sample will be drawn from this population. Among the credit students, 62% reported a native language of English. The ethnic composition of the population is 35% White non-Hispanic, 55% Hispanic, and 7% Black non-Hispanic; 55% of the population is female. Enrollment patterns at MDCC - Kendall affirm the lack of representation of women in occupations requiring mathematical or scientific knowledge. Although a total of 20339 students registered in the Fall term 1993, of the 11187 females comprising the total, 86 females had designated Engineering as a major; one, Physics as a major and 116, Computer Science as a major.

The Miami-Dade County Public Schools is a large, urban school system located in Miami-Dade County, FL. According to recent demographic profiles, approximately 51% of the student population is female. Among females, at the district wide level, mathematics performance on the Stanford Achievement Test is less than or equal to that of males, beginning at grade eight. Furthermore, at this level, students are tested yearly and this three-year project will permit long-term observation of growth/change. Hence, middle schools were selected as off-campus research locales. Specifically, middle schools with which MDCC has an articulation agreement were considered. Under consideration are middle schools each representing a cross-section of the area's diverse ethnicity and having female student populations of approximately 50%.

A challenge facing all of us in mathematics education is "attracting and retaining ... women" (Friedman, 1990). Girls in the project who stay with and succeed at mathematics through middle school will be

unlikely to opt out of the discipline later in the pipeline. The cohort groups of female students/teachers formed at each level will counter the reasons given frequently for abandoning mathematics later, e.g., social concerns (being the only women in the mathematics class) or conceptions of self (inability to see oneself or any female doing real mathematics) (Becker and Jacobs, 1983 and Moody and Linn, 1986 as cited in Friedman, 1990).

Women, especially minority women, continue to be underrepresented in male dominated occupations, thus perpetuating women's and minorities' inability to reach higher income levels. It is by changing behaviors, beliefs, and attitudes within the classroom that women become more confident and successful in mathematics and hence, facilitate their pursuit of male-dominated careers. Hence, these locales can provide greater educational equity for women in non-traditional fields by implementing activities that will encourage the adaptation of instructional delivery styles and classroom behaviors to the needs and concerns of female students.

This project focuses on two critical points which hinder girls staying with and succeeding at mathematics and hence, women successfully pursuing mathematics-based careers and reaching higher income levels - lack of achievement and poor attitude. At crucial transition points in their education, empowerment, among females, will replace disenfranchisement and eventual exit from the mathematics pipeline. Such results will contribute to the evidence that proposes that writing facilitates the teaching and learning of mathematics; females, as responsible learners, will pass enthusiastically from passivity to activity. In this context, transactional writing will be an instrument in the construction of knowledge and the reshaping of beliefs. One female writer commented, "...I do see the purpose of the writing assignments, and it has helped me to stretch my brain, and investigate to find the right answer." Investigators feel that the "'Womenwin project' is a part of the changing [math] classroom" where the emphasis has moved from "calculating" to "understanding". By using transactional writing, we have been able to "see great things happening [to students] both academically and emotionally." This is truly "a really remarkable achievement".

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