

Effects of Creative Writing Activities on Student Achievement in Mathematics

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Abstract

This study investigated the effects of using creative writing activities in mathematics to measure students' mathematics achievement. Using a quasi-experimental design, the data were collected from 60 respondents from three intact classes of college freshman students from a university in Iloilo City from June 23, 2014 to October 2, 2014. Results of the study showed no significant differences noted on students' mathematics achievement after exposure to the three methods of instruction when pre-test scores in the mathematics achievement test were used as covariate. However, the paired-samples t-tests showed that there was a significant difference in students' mathematics achievement test scores before and after exposure to Treatment 1, Treatment 2, and Conventional set up. It was concluded that regardless of the method of instruction, students can demonstrate significant gain in the mathematics achievement test. It was recommended that the teacher integrate more mathematics content in creative writing activities.

Keywords: achievement, creative writing, mathematics

The unfortunate performance of the Philippines in the TIMSS (Trends in International Mathematics and Science Study, 2003 and 2008) provided impetus to all educational stakeholders to think seriously about effecting reforms in the curriculum. The urgency of working on this national concern is even supported with facts and data that point to Filipino students' poor performance in the annual achievement tests administered by the Department of Education.

With the K to 12 program as one of the educational reform agenda of the present government, it is high time to revisit classroom practices and to prepare mathematics teachers to face the challenge of making students achieve high performance in one of the core subjects in the curriculum.

Invariably, mathematics teachers desire to have their students learn the knowledge and skills they impart. They expect students to respond positively to the input they give to the students and to be able to apply these successfully to the various situations they encounter in their daily lives. But sometimes students fall short in demonstrating the outcomes expected of them as evidenced by underperformance in the examinations. Students' mathematics achievement gives teachers the window to see the impact of teaching practices. Thus, teachers need to reflect on the teaching-learning experiences that take place in the mathematics classroom. Teachers have to constantly take time to examine their instructional practices whether or not they deliver the desired results so that students can benefit from every learning situation within the confines of available resources and consequently show better achievement in mathematics.

One of the ways teachers could help improve their students' achievement in mathematics is to supplement the traditional learning situation in mathematics with writing activities. Manning and Manning (1996) asserted that "writing is a powerful tool for thinking and learning in mathematics and science; it will bring about improvement in students' writing abilities." Burns (1988) also noted the benefits of engaging students in writing activities in mathematics classes. She stated that writing encourages students to reflect on and explore their reasoning and "extend their thinking and understanding". When students write, their papers provide a window into their understandings, their misconceptions, and their feelings about the content they are learning (Burns, 2004).

In addition, Kenyon (1989) discussed the benefits of writing as a way to improve learning and understanding. Kenyon's work connects writing to problem solving in mathematics: "Problem solving involves application of learned knowledge and skills in order to move through a process of resolving a situation." When students are asked to write thoughts and procedures,

Kenyon noted, this adds another dimension to the learning process—that of being able to see a possible solution for a problem. Abel and Abel (1988) believed that writing should be integrated into every mathematics class. They argued that writing in the process of learning subject matter helps students see new relationships, invent new ideas, and communicate better.

Thus, the researchers pursued this investigation to find out the effects of the use of creative writing activities on the teaching of mathematics to improve the achievement of college freshman students. Specifically, this investigation sought answers to the following questions:

- 1.) Are there differences in mathematics achievement among students who are exposed to Treatment 1, Treatment 2, and Conventional set up?
- 2.) Is there a significant improvement in mathematics achievement of students before and after exposure to:
 - a) Treatment 1? b) Treatment 2? c) Conventional set up?

Materials and Methods

Research Design

The three-group pretest-posttest quasi-experimental design was employed in this study.

$$\begin{array}{cccc}
 G_1 & O_1 & X_1 & O_1' \\
 G_2 & O_1 & X_2 & O_1' \\
 G_3 & O_1 & X_3 & O_1'
 \end{array}$$

where:

G_1 : traditional instruction with Individual Creative Writing Activities

G_2 : traditional instruction with Group Creative Writing Activities

G_3 : traditional instruction without Creative Writing Activities or Conventional group

X_1 : exposure to traditional instruction with Individual Creative Writing Activities

X_2 : exposure to traditional instruction with Group Creative Writing Activities

X_3 : exposure to traditional instruction without Creative Writing Activities or Conventional group

O_1 : Pretest of the Mathematics Achievement Test for the three classes

O_1' : Posttest of the Mathematics Achievement Test for the three classes

The Sample

The participants of this study involved sixty students from three intact classes of freshman students in the College of Nursing enrolled in MATH 102 - College Algebra offered in a university in Iloilo City for the First Semester AY 2014-2015.

The participants were from the same college, and year level, 16-17 age bracket, and with a score of 100 or better in the College Admission Test. The required minimum score of 100 (out of 250) in the CAT is set by the College of Nursing. Nine (9) of the participants were male and fifty-one (51) were female.

To establish the degree of equivalence among the groups, the researcher administered the Mathematics Achievement Test (MAT) (pre-test) before the treatment period. The participants of the study may have different levels of mathematics ability at the start of the study and this can influence their scores in the MAT (post-test).

After the implementation of the treatments, twenty students (20) from each treatment group were randomly selected as participants. The treatments were administered to the entire class but only the data collected from the twenty participants who were randomly selected from each of the treatment groups and the control group were utilized for statistical analysis and interpretation. The class and the participants themselves were not informed that the teacher is conducting research to maintain the natural setting of the classroom.

To justify the utilization of the data of the twenty randomly selected participants, preliminary tests were conducted to check whether the data could meet the assumption for the statistical test. In particular, paired-samples t-test assumes normality and if the distributions of the pre-test and post-test data on the Writing Attitude Scale and Mathematics Achievement Test are normal the use of the data of the twenty respondents is justified.

The results of the normality test showed that the pre-test and post-test data on the Mathematics Achievement Test (MAT) were normally distributed. Thus the use of the data of the twenty respondents on the mathematics achievement instrument is justified.

The Instruments

Mathematics achievement test (MAT). This is a 50-item Multiple Choice-Type test that included questions covering the course content of the syllabus in MATH 102 - College Algebra from June 23, 2014 to October 2, 2014. The questions were taken from the 80-item original achievement test. A table of specification was prepared based on the Trends in International Mathematics and Science Study (TIMSS) 2011 Mathematics Framework. The pre-test was validated by three (3) faculty members of the Department of Mathematics of the university. For reliability before the start of the treatment period, the test was administered to other first year college students who were from a different college in the university also taking MATH 102-College Algebra for the first semester AY 2014-2015. *Cronbach alpha* obtained an initial value of 0.756. The test was then reduced to include only 50 items from the original 80-item multiple-choice questions. After deleting 30 items an alpha of 0.842 was obtained. Of the 50 questions, 18 items belong to the Knowing Cognitive Domain, 15 items belong to the Applying Cognitive Domain, and 17 items belong to Reasoning Cognitive Domain.

Career research report. This is a five-part instrument used by the students to accomplish the research activity about careers that require the use of mathematics. This instrument which can be accessed online was developed by Hurley (no date).

Creative Writing Activities

The types of creative writing activities done by the students included *Vocabulary Paragraphs*, *Numbers Stories*, *Poems*, *Advice Columns*, and *Research Activity*, which was limited only to *Careers That Require the Use of Mathematics*. The choice for these creative writing activities was based on the articles of Janzen (2000) and Education World (2012).

Criteria scale. To score each creative writing activity including the students' research activity the researcher developed a set of criteria. Each creative writing output was rated by the teacher in each criterion from 1-4 with 1 as the lowest and 4 as the highest. The criteria were presented to the chairperson of the English Department of the University for suggestions and comments. The scoring was patterned from the writing rubrics used by the faculty members of the English Department in their respective classes. Students' written outputs were given comments and returned to them.

Data Collection Procedure

Prior to the treatment period, the Mathematics Achievement Test (MAT) was administered to the three classes to collect the pre-test data. The MAT was administered during a one and a half-hour class period. The discussion on the first topic of the course which was about *Sets* followed the next meeting. After all the subtopics on *Sets* had been discussed the first creative writing activity, the *Vocabulary Paragraph* was given. Since it was the first creative writing activity, the teacher gave some sample vocabulary paragraphs and discussed these with the students. The teacher addressed some questions that were raised by the students after which he gave the first set of mathematics vocabulary taken from the subtopics on *Sets*. The time allotted for the activity was 20 minutes but was later extended to 30 minutes because students experienced creative writing activities in mathematics for the first time.

This approach was followed all throughout the duration of the treatment period for the rest of the creative writing activities except for the career research report which was done outside the class hours.

A colleague of the researcher was requested to randomly observe the classes to assure quality of implementation of the creative writing activities. Said colleague was requested to be present during the period when the students would write a creative writing activity. The students in the two treatment groups were observed on three occasions for each.

At the end of the treatment period, the Mathematics Achievement Test (MAT) was administered by the teacher to the three groups to collect the post-test data.

Data Analysis Procedure

All data gathered were reported in the aggregate form to protect anonymity. Means and standard deviations were employed as descriptive statistics. Analysis of Covariance (ANCOVA) and paired-samples t-test set at .05 alpha levels were used as inferential statistics. All statistical computations were processed through the use of IBM SPSS Statistics 20.0.

Statistics from the Mathematics Achievement Test (MAT) pre-test and post-test scores were examined using Analysis of Covariance (ANCOVA) to determine significant differences in achievement in mathematics of students

exposed to Treatment 1, Treatment 2, and Conventional set up. The pre-test scores from the instrument (Mathematics Achievement Test) were treated as the covariate since the researchers assumed that the three groups were not comparable at the start of the treatment period. Preliminary checks were likewise conducted to ensure there was no violation of the assumptions of normality, linearity, homogeneity of variances, homogeneity of regression slopes, and reliable measurement of the covariate.

Paired-samples t-test was conducted to determine whether there was a significant improvement in mathematics achievement of students exposed to treatment 1, treatment 2, and the pure traditional teaching format (Conventional set up) before and after the implementation of the intervention.

Results and Discussion

Effects of Creative Writing on Mathematics Achievement

The Mathematics Achievement Test (MAT) was administered to the three classes before and after the implementation of the intervention to collect the pre-test and post-test data, respectively. The pre-test data show that in Treatment 1, the Mathematics Achievement Test (MAT) scores of the students range from 12-42 which means that the lowest score is 12 and the highest is 42. The score of 42 was the highest among the scores of the 60 participants in the Mathematics Achievement Test pre-test. On the other hand, the post-test data revealed that the MAT scores of students range from 14-46 which means that the lowest score is 14 and the highest is 46. The lowest and the highest among the scores of the 60 participants in the Mathematics Achievement Test post-test were 14 and 46, respectively.

In Treatment 2, the scores of students in the MAT (pre-test) range from 12-35 which indicates that the lowest score is 12 and the highest is 35, while in the MAT (post-test) the scores of students range from 16-34 which indicates that the lowest score is 16 and the highest is 34.

In the Conventional group, the scores of students in the MAT (pre-test) range from 7 as the lowest and 39 as the highest. This range also shows that the score of 7 is the lowest among the scores of the 60 participants. On the other hand, the scores of students in the MAT post-test range from 18 as the lowest and 44 as the highest.

A one-way between-groups analysis of covariance was conducted to ascertain the effects of the interventions on the participants' mathematics achievement. Participants' scores in the pre-intervention administration of the Mathematics Achievement Test (MAT) were used as the covariate in this analysis. After adjusting for pre-intervention scores, it was noted that there were no significant differences on post-intervention scores on the Mathematics Achievement Post-test [$F(2,56) = .07, p = .94, \text{partial eta squared} = .002$] among students who were exposed to Treatment 1, Treatment 2, and the Conventional set up. Moreover, there was a strong relationship between the pre-intervention and post-intervention scores in Mathematics Achievement Test as indicated by a partial eta squared value of .44. This also means that the covariate, MAT pre-test scores, were significantly related to MAT post-test scores [$F(1, 56) = 43.79, p = .000$]. This goes to show that an increase in the level of mathematics achievement before the intervention would likely have a corresponding increase in the level of mathematics achievement after the intervention.

The present investigation revealed that there are no significant differences in mathematics achievement of students who were exposed to Treatment 1, Treatment 2, and Control set up. This result corroborates the investigation carried out by Phillips (1993) which did not yield significant differences when writing activities were included in the junior high school trigonometry classes (Jurdak & Zein, 1998). Jurdak and Zein (1998) reported that journal writing did not have a positive impact on school mathematics achievement among intermediate students. On the other hand, Evans (1994) and Millican (1994) reported a positive effect of writing on general mathematics achievement in the elementary level. Shepard (1993) and Human (1993) established that writing had a positive effect on the achievement of junior high school level. Stewart (1993) observed improvement in achievement among senior high school students as a result of including writing component in classes (Jurdak & Zein, 1998).

Difference in Mathematics Achievement of Students

Paired-samples t-tests were conducted to find out if differences on students' scores in the Mathematics Achievement Test exist before and after the intervention. On Treatment 1, there was a statistically significant increase in Mathematics Achievement Test scores before ($M = 21.9, SD = 6.73$) and after [$M = 28.8, SD = 8.51, t(-4.99), p = .001$] the exposure to creative individual writing activities. The eta squared statistic (.57) indicated a large effect size. The result indicates that the treatment has a significant effect on students' mathematics achievement.

On Treatment 2, there was a statistically significant increase in Mathematics Achievement Test scores before ($M = 22.80$, $SD = 5.91$) and after [$M = 30.00$, $SD = 4.09$, $t(-6.02)$, $p = .021$] the exposure to the traditional method of instruction with creative group writing activities. The eta squared statistic (.66) indicated a large effect size. The result suggests that the treatment has a significant impact on students' mathematics achievement.

On the Conventional set up there was a statistically significant increase in Mathematics Achievement Test scores before ($M = 21.10$, $SD = 6.32$) and after [$M = 28.50$, $SD = 6.00$, $t(-7.84)$, $p = .000$] the duration of the study. The eta squared statistic (.76) indicated a large effect size. The result means that the traditional method of teaching has a significant effect on students' mathematics achievement. Findings from the three paired-samples t-tests are summarized in Table 1.

The result of the present study corroborates the investigation carried out by Evans (1994) and Millican (1994) who reported a positive effect of writing on general mathematics achievement in the elementary level. Shepard (1993) and Human (1993) reported a positive effect of writing on the achievement among junior high school students. Stewart (1993) reported improvement in achievement among senior high school students as a result of including writing component in classes (Jurdak & Zein, 1998), but contradicts that of Phillips (1993) who did not find significant differences when writing activities were included in the junior high school trigonometry classes. It was also reported that journal writing did not have positive impact on school mathematics achievement among intermediate students.

Table 1

Descriptive Statistics and Paired-samples t-test Results for the three Methods of Instruction (Mathematics Achievement)

Method of Instruction	Pre-test		Post-test		n	95% Confidence Interval of the Difference Lower/Upper	t	df	p
	M	SD	M	SD					
Treatment 1	21.90	6.73	28.80	8.51	20	-9.80, -4.00	-4.99*	19	.000
Treatment 2	22.80	5.91	30.00	4.09	20	-9.70, -4.70	-6.02*	19	.000
Conventional Group	21.10	6.32	28.50	6.00	20	-9.38, -5.32	-7.84*	19	.000

Note: Treatment 1- traditional method of instruction with creative individual writing, Treatment 2- traditional method of instruction with creative group writing, Conventional Group- traditional method of instruction without creative writing
* $p < .001$.

Conclusions

In view of the above results, the researchers conclude that regardless of the method of instruction, students can demonstrate a significant gain in the mathematics achievement test. Likewise, incorporating creative writing activities in mathematics class is equally an effective method in teaching mathematics and the pure conventional method of instruction still has a strong influence on students' mathematics achievement.

Recommendations

In view of the aforesaid conclusions the researchers recommend that the teacher should integrate more mathematics content in the creative writing activities. The teacher should not limit the use of the given words in students' creative writing works to allow them to freely explore and express their ideas and imagination. For each mathematics topic or lesson the vocabulary paragraph should be done first. This is to allow the teacher to gauge students' understanding of the mathematics concepts introduced to them. Subsequently, the teacher can allow the individual student to do any type of creative writing activity included in this study. In this manner, the student is given the opportunity to make the decision to choose from among the creative writing activities with which he/she is comfortable in expressing freely his/her ideas and sentiments and as a way of demonstrating the learning of mathematics content.

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