

The Effects of Writing - to - Learn Strategy on the Mathematics Achievement of Preparatory Stage Pupils in Egypt

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Introduction:

The traditional view has been that students learn to write in English classes and to compute in mathematics classes. Recent trends in curriculum and instruction have stressed developmental and cognitive issues. One such trend is called “writing - to - learn” or “writing - across - the curriculum”. The use of the writing - to - learn strategy in mathematics classes is one way teachers can implement “ Mathematics as Communication “ the second standard in NCTM’s (1989:78) Curriculum and Evaluation Standards for School Mathematics. The use of writing in mathematics is receiving increased attention as an instructional tool for teachers and as learning aid for students.

Theoretical Background:

“ writing - to - learn” strategy or “writing across the curriculum” has been emphasized in the literature since the early 1980’s (Johnson and Holcombeg , 1993) this strategy is based on the view that the process of writing about a subject leads to increased understanding and develop the capacity to use the language of these fields fluently. To throw light on this strategy, the following points should be known:

I. The Different Kinds of Writing Activities :

There are many kinds of writing activities which can be used in the “ writing - to - learn “ strategy such as :

K- W-L activity:

K-W-L is an abbreviation of what students : **K**now - **W**ant to know - **L**earned. To use this activity , place three columns labeled K,W, L on a sheet of paper. At the start of a unit distribute the paper and ask students to complete the first two columns. Through their responses, the teacher can determine the prior knowledge of the class and their interests. At the end of the unit, the students are asked to complete column three to see the growth they have made (Andrews,1997 : 141).

Write and Follow Directions:

One student builds a structure and records a set of directions (by using a large number of mathematical terms) for another student to follow and to produce the same structure (Burchfield and others, 1993).

Pair Share :

This is a very simple activity to use when the teacher senses that the student does not understand the lesson. He stops and asks them to explain what is giving them trouble. After the students “ Free - write “ for a couple of minutes, they share their writing with their classmates. This can help to remove their confusion (Burchfield and others, 1993).

Journal Writing:

This is a diary like a series of writing assignments. Each assignment is short and written in prose rather than in the traditional mathematical style. The students can write in their journals: daily goals, rational for learning any concepts, and the strategies used to solve

problems (Bagley, 1992 : 660). It can give both the teachers and the students great insight into a student's progress (Potter, 1996 : 184).

Creative Writing:

Students are encouraged to write poems or stories or plays about mathematical concepts. They can be asked to write a letter to:

- Mathematicians of yore (McIntosh , 1991 : 423).
- A friend advising him how to correct his mistakes , solve his problems or explain mathematical lesson to him.

II.The Timing of Writing Activities:

There are many opinions about the best time to apply these writing activities such as:

- Elliott (1996 : 92) suggested that writing activities can be an effective tool at different times in the classroom. During the first few minutes, a student can respond to a review question. Students also can summarize the day's lesson in the last few minutes of a class.
- Ryan and Rillero (1996 : 78) recommended that the “ writing - to - learn “ math program, should take only a few minutes each class period. It does not take long to answer the question usually a few minutes after the start of the period.
- Stewart and Chance (1995 : 92) stated that the writing activities should occur three times a week during the last five minutes of class.
- Burchfield and Others (1993) suggested that the writing activities can be used:
 - ☐ Before a lesson to help the student to activate the prior knowledge he has on the subject.
 - ☐ During a lesson, when a class has been learning a new idea, through writing a short paragraph describing what they understand .
 - ☐ After a lesson, students are asked to reflect back on the lesson.

III . The Importance of Writing in the Mathematics Classroom :

Writing in mathematics classroom is important for both the teacher and the student for these reasons:

- It is a way of stimulating dialogue between students and teachers (Miller, 1991 : 516 - 521).
- It helps pupils to:
 - * Explore, clarify, confirm and extend their thinking and understanding of mathematics (Dustershoff, 1995 : 48 - 49) .
 - * Also assists their understanding of the “ why, what, and how to..... “ of mathematics. (Palmer, 1997 : 506) .
- It helps the teacher to :
 - * Monitor students Progress, make instructional decisions and evaluate students' achievement (Mayer and Hillman, 1996 : 428)
 - * Determine the abilities of the students in: explaining concepts, using mathematical language effectively, organizing information, using communication skills and using mathematics to make sense of a complex situation. (Burchfield and others, 1993) .

Through the previous theoretical background, the researcher could:

- ☐ Design some writing activities which are a collection of different kind of activities such as: creative writing, writing and following direction.
- ☐ Determine the application time of these activities. The last five minutes in each class is used for these writing activities.

Previous Studies:

Through the survey of the recent studies, the following conclusions can be made:

- These studies were aimed to measure the effectiveness of writing activities on one or more of the following:
 - Mathematical achievement (Sallee, 1997 ; Davis 1996 ; Albert 1996 ; Mower 1996 ; Pugalee 1996 ; Smith 1996).
 - Teacher's decisions (Lollis, 1997).
 - Attitude towards mathematics (Rodgers, 1997 ; Heath 1997 ; Abbey 1997 ; Baker 1995 ; Kasperek 1994).
 - Mathematical communication (Senne 1996).
- Writing - to - learn strategy was applied in different stages such as:
 - Elementary stage (Thurlow, 1996).
 - Middle stage (Dipillo, 1994).
 - High school (Doctorow, 1996 ; Kasperek 1994).
 - College (Giovinazzo, 1997 ; Heath 1997 ; Mower 1996 ; Baker 1995).
- There are contrasts between the results of these studies such as:
 - Some studies proved that this strategy has an effect on mathematical achievement and attitude (Dipillo, 1994).
 - Others proved that this strategy has no effect on mathematical achievement nor attitude (Rodgers, 1997).
 - Others proved that this strategy has an effect on mathematical achievement and no effect on attitude (Millican, 1994).

Maybe the reasons are related to the differences in the samples or in the type of writing activities which are used. It is obvious that there is no previous studies that aim to measure the effectiveness of this strategy on the mathematical achievement of Egyptian pupils. Because of the lack of studies, there is a need to do this research.

The Problem:

The curriculum and evaluation standards for school mathematics (NCTM), emphasize the need to address communication skills. These skills, including listening, speaking, reading, and writing, enhance mathematical understanding and problem solving ability. In Egypt, the only writing activity of the pupils is solving some problems according to standardized steps. The pupils do not get an opportunity to express their mathematical suggestions or feelings in writing. But according to this strategy, there are many kinds of writing activities which can be easily used in the mathematics classroom. This study tries to answer this major question: What is the effectiveness of “ writing - to - learn” strategy on mathematics achievement of preparatory stage pupils in Egypt?

To answer this question, the following questions should be answered:

1. What are the different kinds of writing activities which can be easily used in math class by using the “ writing to learn “ strategy ?
2. What are the differences between the experimental and control groups in mathematical achievement ?
3. What is the best way to apply this strategy (as a group or as an individual work)?
4. What are the differences between male and female pupils in mathematical achievement?

The Hypotheses:

This study tried to satisfy the following hypotheses:

1. There are statistical, significant differences between the mean scores of experimental groups and control groups in favor of the experimental groups.
2. There are statistical, significant differences between the groups, which work collectively and the groups, which work individually in favor of the former.
3. There are statistical, significant differences between male and female pupils in favor of the male pupils.

The Procedures:

- 1) A theoretical study of “ writing - to - learn” strategy.
- 2) A survey of the previous studies conducted.
- 3) A choice of unit from the first - grade algebra textbook in the preparatory stage.
- 4) Designing some writing activities.
- 5) Designing and developing a mathematical achievement test by following these steps:
 - * Making a content analysis of unit “ sets “ (the first unit in algebra textbook) to determine : the concepts, relations, and applications.
 - * Building test items. The test consists of fifty items (multiple-choice questions).
 - * Refereeing the test by some professors in mathematics education to verify the validity of this test.
 - * Modifying the test according to their opinions.
 - * Applying the test to a sample of pupils to determine:
 - The time of the test (fifty minutes).
 - The value of reliability coefficient of the test (0.91).
- 6) Choosing a sample from the first - grade pupils in the preparatory stage divided into six groups. Experimental groups(1) (45 male- 47 female)- experimental groups (2) (44 male - 40 female)- control groups (51 male - 41 female).
- 7) Measuring the effectiveness of this strategy according to the following steps:
 - Application of the mathematical achievement test on six groups as a pre - test.
 - Application of the writing activities as shown below:
 - Experimental groups (1): writing activities as individual work.
 - Experimental groups (2): writing activities as group work.
 - Control groups: Do not use these writing activities.
 - The method of applying these activities can be shown as follows:
 - (Uno) The teacher explains the lesson.
 - (Due) In the last five minutes, the pupils get one activity and answer within these five minutes.
 - (Tre) The teacher reads these written answers, then writes his comments on each page and records all the answers in his notes.
 - (Quattro) At the beginning of the next class (5 minutes), the teacher returns the corrected answers to the pupils.
 - (Cinque) The teacher encourages the pupils with good answers and makes a presentation in the front of the class.
 - (Sei) In the case of wrong answers, the teacher mentions them without stating the names of the pupils.
 - Application of the same mathematical achievement test on six groups as a post - test.
- 8) The field test of this strategy with 20 sessions during September and October 1998.
- 9) The results were analyzed quantitatively and qualitatively.

The Results:

The results can be analyzed and divided into two parts:

(A) Quantitative Analysis of Results:

- 1) To satisfy the first hypothesis, the analysis of variance was made. The statistical analysis shows that: there are significant differences between six groups, at 0.05 level. Therefore this strategy is effect on the mathematical achievement for the sample of this research.
- 2) To satisfy the second hypothesis, a T - test was made between the means of two experimental groups. The analysis shows that: there is no significant differences between two experimental groups. Therefore this strategy had an effect on the mathematical achievement when applied as a groups or as an individual work.
- 3) To satisfy the third hypothesis, a T - test was made between the means of male and female scores in the math test. The analysis shows that: there are no significant differences between the mathematical achievement of male and female. Therefore the effectiveness of this strategy does not depend on sex.

(B) Qualitative Analysis of Results:

To throw more light on the results of this research, the analysis of pupils' answers for some activities were made as following:

Activity (1) : Many pupils were confused between \subset \in Write your suggesting to help your friends to distinguish between them.

Answers : some pupils:

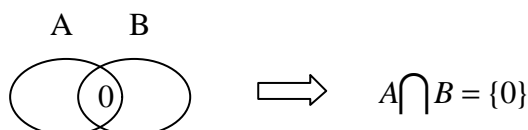
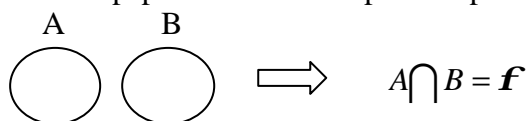
- State the definition of each symbol.
- Form examples to explain the usage of each symbol.
- Establish a connection between these two symbols and other symbols that are familiar to all pupils such as:
 - \subset like the shape of (c) letter, \in like the shape of (E) letter.
 - \subset is similar to an arrow, \in has similarity to an arrow with dash.
 - \subset has similarity to half of circle, \in has similarity to half of circle with dash.
- State this rule:
If one finds a number or letter without { } put \in
If one finds a number or letter between { } put \subset

Activity (2): Write a letter to your friend to explain to him: why: \emptyset { \emptyset }?

Answers : Some pupils stated that:

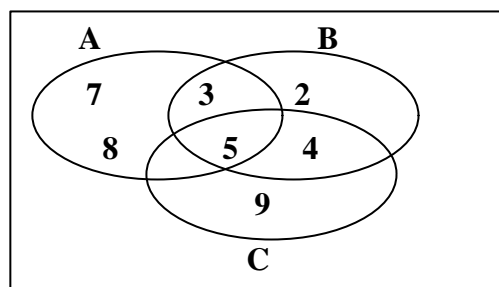
- \emptyset is an empty set but { 0 } is a non empty set.
- { 0 } has one element, \emptyset hasn't any elements.
- If we delete zero, they will be two equal sets.

- A few pupils used Venn shapes to explain that as following:



It is obvious from these two shapes that $\emptyset \neq \{ \}$.

Activity(3): Describe the following shape to your friend by telephone to help him to draw it. Put your description in written words.



Answers : Some pupils:

- State only the elements of each set.
- State the elements of each set and intersection between each two sets.
- State the intersection between three sets then the intersection of two sets then the differences between each two sets.
- Describe the shape in more detail.

From the previous analysis, the following conclusion was found:

when the pupils are given a chance to express their mathematical knowledge, they are able to create and explore new rules, relations and establish connections.

Recommendations:

According to the results of this research, the following recommendations can be made:-

- The teachers should receive some training about how to design writing activities before applying this strategy.
- The pupils should be encouraged to write if they lack motivation by presenting their best writing to the class using praise words like: good, well done or excellent.
- The teacher should use this strategy gradually, until he and his pupils are familiar with it.

Suggestions for Further Research:-

- Measuring effectiveness of using this strategy on the mathematical achievement of primary or secondary stage pupils.
- Measuring this effectiveness when pupils study geometry.
- Conducting a study to determine the level of the pupil (below average - average - advanced) who can find the best benefits from using this strategy.
- Conducting a study on a large scale to determine the difficulties which challenge this strategy in the large Egyptian classrooms seating between 50 - 60 pupils.

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