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The Effect of Drawing on Learning Math

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Abstract Drawing strategy is one of the most useful tools of problem solving and in case of using it, the issue becomes more tangible and the problem solver obtains a clearer understanding of the issue data. The aim of this study was to evaluate the effect of drawing on the math learning of students. The present study is a descriptive study. The statistical population of this study included all grade seven students and teachers in Bandar Charak city as 80 students and 4 teachers in 2015-16 academic years. Due to the low volume of the study, all grade seven students and teachers were studied to get more accurate and scientific results. Data collection tools in this study consist of two standard questionnaires one of which is related to teachers and the other to students. Research data were analyzed at two descriptive and inferential statistics levels through SPSS software. The results show that mathematics education by drawing has a positive impact on both the learning and on solving math problems. Drawing shapes increases the interest of students to learn mathematical concepts. The teachers' information about figure drawing is high and math teachers benefit figure drawing in their teaching. But, in the view point of seventh grade math teachers, figure drawing strategy has not been paid attention to competently.

Keywords: problem solving strategy, drawing shapes (drawing), problem solving, math learning

Introduction

One of the goals of mathematics education is educating discerning, critical and decision-making individuals who are able to have a correct analysis in dealing with the new situations and have the best reactions to their work. The necessity of showing correct behavior is having a regular mind and familiarity with thinking skills one of the most important of which is the art of problem solving. So far, various definitions of "problem" have been raised by mathematicians and math educators. One of the valid definitions is the necessity of unknowingly solution search to achieve a goal that seems inaccessible at first. In fact, problem solving means finding a solution to the problem. Problem solving is one of the most important learning approaches in mathematics so that in some countries, teaching is based on problem-solving approach. One of the problems of teaching math to students is the lack of correct entries. If mathematic is taught to students with creativity, the interest in this comprehensive lesson is increased. This problem should be restored from baseline levels. Most of students do not have the problem solving ability and skills. One of the reasons for this inability is the lack of a plan for teaching problem-solving skills to students. In other words, teachers have not taught their students how to solve problems. Whenever students face a problem and are incapable of solving it, teachers have only stated the solutions or answers to problems. What is the problem with mathematics learning starts from primary school and will continue in higher periods of education. Disabled people in learning mathematics are people who have serious problem in mathematics and have slow development compared to their peers despite their natural talent and mental and physical health and the appropriate social and economic environment (Schoenfeld, 1992). Most students, in different courses,

usually have major problems in math. One of the main problems is that when students face with a problem, they do not know where to start or how to solve the problem. One of the ways to solve these problems is to solve math problems by drawing shapes. Drawing appropriate shapes for problems is the most natural strategy that comes to mind for problem-solving which helps to better understand the problem and find a way to solve it. Sometimes, the problem is completely solved by drawing figure and there is no need to write math. Dennis, Knight and Jerman (2016) have focused on the historical review of this strategy in their article entitled as: "Drawing shape strategy in mathematical problem solving". In this paper, they have studied the advantages and disadvantages of using this strategy with a historical perspective to the past mathematicians.

In the following, how to use drawing strategy along with several other strategies (which are closely related to drawing strategy, including changing the shape and coloring shapes) are mentioned in solving various problems. In addition, wordless proofs have been discussed as common since ancient times, and in the end, some recommendations on the figure drawing strategy are stated:

A: reducing chaos and visual clutter in shapes that causes distraction.

B: parts that are more important are more evident (full color).

C: the shapes and charts should be able to redefine the problem for us.

In previous books of junior high school in our country and especially first and second grade books, students were gradually getting familiar with various strategies of problem solving during the school year. But, in the seventh grade book, little attention has been paid to the drawing shapes strategy. In new seventh grade math book and previous books, problem-solving teaching style is based on a four-step problem-solving method of Polya. The first step is to understand the problem, the second step is to understand how the components of the problem are attached to each other and what the relationship of the unknown to the problem is in order to find a way to solve the problem and have a plan for it. Third step is to implement the map. Fourth step is to look up and revise and discuss about the problem (Polya, 1945, translated by Aram, 1998). In the new authored book of seventh grade (2013), we see the education of eight strategies at page 12 which is contrary to the Schoenfeld (1992) that states that fewer number but deeper strategies training will make us more successful. But in this book, more strategies have been taught with less depth. So, when students are faced with a problem, they are not able to properly choose a good strategy to solve the problem despite the many strategies that have been introduced to them to solve the problem. Math teachers also do not use varied strategies for problem solving and usually use the cliché strategy of equation to solve all sorts of problems while in many cases, they can simply use the drawing strategy as solution. One of the strategies of particular importance to solve mathematical problems is drawing shapes strategy. With this strategy, all the information and relations of the data and the issue are considered as a whole. The aim of this study is to examine the effect of drawing shapes on the seventh grade math learning in Bandar Charak city. According to the results, the following recommendations are provide in this regard.

The following questions are answered in this study:

1. Does mathematics education by drawing the shape affect the seventh grade math learning positively?
2. Does drawing shapes positively affect the seventh grade math problem-solving by students?
3. Does mathematics education by drawing the shape increase the students' interest to learn mathematical concepts?
4. To what extent seventh grade Math teachers are aware of the drawing strategy in their

teaching?

5. To what extent seventh grade Math teachers benefit the drawing strategy in their teaching?

6. To what extent the drawing strategy is paid attention to in the seventh grade book in the view point of teachers?

2. Drawing the shape in mathematics education:

A strategy that seems most natural in the minds of the students is to draw shapes. Many of the issues are fully solved or their solution is fully manifested by appropriate drawing. In any possible issue, drawing a shape (such as geometric or a graph etc.) can be as an inspiration in solving the problem and show the relationship between the components better. Most teachers reject this strategy in solving the problems, which is why this natural strategy is gradually abandoned. Usually, representing a problem with the aid of a form or graph helps to facilitate, collect and shape information related to the issue and causes attention focus on relationships and dependencies placed in it (Seif, 2014). Descartes states nothing is more concrete than shape for us. Forms can be felt and seen. There are people who need geometric assumptions to make their ideas more tangible. Even some people try to visualize ordinary language phrases in their minds as geometric forms. These people have a paper and pen in hand when they are thinking about an issue, and start to draw different lines. They can only deal with their problem via geometric forms language (Polya, 1964, translated by Aram, 2003).

Some problems are completely solved with drawing strategy and there is no need to another solution. In most problems, drawing helps the better understanding of the issue. Drag a suitable form for problems is the most natural method in problem-solving that comes to mind. This helps to better understand the problem and find its solution (such as geometry). You may not like to draw shapes for some problems but the shape is drawn in your mind and you will solve the problem with the help of these shapes (visualization in the surrounding environment such as volume). Also, sometimes the problem is completely solved with drawing and there is no need to write mathematical operations such as a set of numbers section. Some believe that it is better to draw shapes to solve all the problems. Polya believes that a form plays an important role in finding solutions to the problem and accelerating the comprehension.

Methodology

The study is a descriptive study. The statistical population of this study included all grade seven students and teachers in Bandar Charak city as 80 students and 4 teachers. Due to the low statistical volume in this research, all the statistical population was studied in order to achieve more accurate and scientific results. Data collection tools in this study consisted of two researcher-made questionnaire one of which is related to teachers and the other is related to students. The teacher-related questionnaire consists of 22 questions each of which are related to one of the components of mathematics education with the help of drawing shapes. Students' questionnaire contains 11 questions each of which asks about the usage of drawing strategy in their teacher math teaching. Information is obtained through library method by studying and reading books, scientific papers, dissertations and so on and by field study with the use of questionnaire and survey method.

Results

First, the research results were analyzed using appropriate graphs and frequency tables and finally, research hypotheses were analyzed using one sample T-test and the relationship between the research variables and the related dimensions were analyzed. SPSS software version 20 was used for the data analysis and the significance level was considered as 0.05.

Table 1. Related to one sample T-test to analyze math learning

Variable	Number	Mean	SD	T value	DF	Sig.
Math learning	80	35.42	9.43	33.59	79	0.0001

According to Table 1, results of tests are equal to 33.599 and the degree of freedom shows 79 that is significant at ($p < 0.05$) ($p = 0.0001$), so the null hypothesis will be rejected. This means that the mean scores of the population is higher than the criterion score which is selected for the effectiveness of the drawing shapes strategy as test value=3. The null and the first hypotheses are accepted. As a result, it can be said that teaching math with the help of drawing shapes has a positive effect on the seventh grade math learning.

Table 2. Related to one sample T-test to analyze drawing shapes effect on students' problem solving and math learning

Variable	Number	Mean	SD	T value	DF	Sig.
Math problem solving	80	18.51	6.45	25.64	79	0.0001

According to Table 2, results of tests are equal to 25.643 and the degree of freedom shows 79 that is significant at ($p < 0.05$) ($p = 0.0001$), so the null hypothesis will be rejected. This means that the mean scores of the population is higher than the criterion score which is selected for the effectiveness of the drawing shapes strategy as test value=3. The null and the first hypotheses are accepted. As a result, it can be said that drawing shapes has a positive effect on the seventh grade math problem solving.

Table 3. Related to one sample T-test to analyze drawing shapes effect on students' interest in learning math concepts

Variable	Number	Mean	SD	T value	DF	Sig.
Learning math concepts	80	13.45	3.40	35.33	79	0.0001

According to Table 3, results of tests are equal to 35.333 and the degree of freedom shows 79 that is significant at ($p < 0.05$) ($p = 0.0001$), so the null hypothesis will be rejected. This means that the mean scores of the population is higher than the criterion score which is selected for the effectiveness of the drawing shapes strategy as test value=3. The null and the first hypotheses are accepted. As a result, it can be said that teaching math with the help of drawing shapes has a positive effect on the increase of the students' interest in math concepts learning.

Table 4. Related to one sample T-test to analyze seventh grade math teachers' information about drawing shapes strategy

Variable	Number	Mean	SD	T value	DF	Sig.
Teachers' information	4	3.5000	0.57735	1.732	3	0.0001

According to Table 4, results of tests are equal to 1.732 and the degree of freedom shows 3 that is significant at ($p < 0.05$) ($p = 0.0001$), so the null hypothesis will be rejected. This means that the mean scores of the population is higher than the criterion score which is selected for the effectiveness of the drawing shapes strategy as test value=3. The null and the first hypotheses are accepted. As a result, it can be said that seventh grade math teachers'

information about the drawing shapes strategy is at a high level.

Table 5. Related to one sample T-test to investigate the teachers, benefit of the drawing strategy in their teaching

Variable	Number	Mean	SD	T value	DF	Sig.
Fifth hypothesis	4	3.25000	0.50000	1.000	3	0.0001

According to Table 5, results of tests are equal to 1.000 and the degree of freedom shows 3 that is significant at ($p < 0.05$) ($p = 0.0001$), so the null hypothesis will be rejected. This means that the mean scores of the population is higher than the criterion score which is selected for the effectiveness of the drawing shapes strategy as test value=3. The null and the first hypotheses are accepted. As a result, it can be said that seventh grade math teachers benefit drawing strategy in their teaching.

Table 6. Related to one sample T-test to analyze seventh grade math teachers ideas about the drawing strategy in the book

Variable	Number	Mean	SD	T value	DF	Sig.
Sixth hypothesis	4	1.5000	0.57735	-5.196	3	0.14

According to Table 6.4.4, results of tests are equal to -5.196 and the degree of freedom shows 3 and P value (significance) is equal to 0.14 and greater than the level of significance (0.05) which means that the mean scores of the population is lower than the criterion score which is selected for the effectiveness of the drawing shapes strategy as test value=3. So, the null hypothesis is accepted and the first hypothesis will be rejected. As a result, it can be said that drawing shapes strategy is not been competently paid attention to in the book.

Conclusion

As it was mentioned in the previous sections, drawing shapes can be considered as a useful strategy and sometimes causes to save time. Also, the existence of a form plays an important role in accelerating the process to find a solution and quicker comprehension of the problem and its content. The results of the first question analysis indicate that math education by drawing the shape has a positive effect on the seventh grade math learning. The results of the second question analysis show that drawing shapes has a positive impact on the seventh grade math problem solving of students. The results of the third question analysis show that teaching seventh grade math by drawing shapes causes an increase in the interest of students in learning mathematical concepts. The results of the fourth question analysis show that seventh grade math teacher information about drawing shapes strategy is high. The results of the fifth question analysis show that the seventh grade math teachers benefit drawing shapes in their teaching approach. The results of the sixth question analysis show that drawing shapes strategy is not been competently paid attention to in the book.

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