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EVALUATION OF THE EFFECT OF K-W-D-L PROBLEM-SOLVING MODEL ON SELF-EFFICACY, ANXIETY AND MATH FUNCTION

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ABSTRACT

The aim of the research was to evaluate the effect of K-W-D-L problem-solving model on self-efficacy, anxiety and math function of students. The statistical population of this research was junior high school students in Tehran. ,Three high schools were selected from Tehran's area based on cluster sampling method, according to the existing facilities, and same major classes of each school were randomly selected among the selected schools. The sample size was 145 people. This research has been done on both test and control groups and also evaluated before and after model implementation. To evaluate the math self-efficacy and anxiety, MATHEMATICS SELF-EFFICACY AND ANXIETY QUESTIONNAIRE, was used. To assess the math function of students, the first and second semester grades of the students were considered in the experiment. After data analysis, it was found that the KWDL problem-solving model leads to improve the math function and self-efficacy.

Keywords: *Model, problem-solving, K-W-D-L, math self-efficacy, math anxiety*

INTRODUCTION

Today, problem-solving is one of the most important concerns of the developed countries in the field of education. According to the results of international tests, Japan is one of the leading countries in education of mathematics. In Japan during 1947 to 1951 and due to the growing education, the emphasis of lesson studies is on daily life experiences and in the same period, problem-solving was become as a part of the curriculum of the primary schools. In 1951, problem-solving was proposed as the goal of teaching mathematics in schools. However, it was the only period that problem-solving was indicated as the main objective of the curriculum of this country. Of course, problem-solving was basically related to addition, subtraction, multiplication, division and promotion [1]. After 1958, the aim of teaching mathematics was to reinforce the mathematical thinking. In the course studies of 1958, the aims of mathematics education were considered as follow: (Students should understand the concepts, principles, values, quantities and the geometric shapes. They must have advanced mathematics thinking and also be able to solve their problems using mathematics.) Mathematical problem-solving is a very important factor in the review of math education [2].There are different strategies and approaches to teach (problem-solving) in the classroom and this teaching was not limited to a specific formula. One of those methods was (work in small groups) based on Vygotsky (the theory of social interaction). Vygotsky's ideas are strong justification on the importance of the role of small groups in growth and development of learners. Vygotsky claimed that collaboration helps students to achieve to the approximate range of growth [3]. Small groups creates a natural environment for students that

through it people can interact and discuss with each other and understand the mathematical relationship better. One of the organizing pattern of small groups in the classroom and monitoring their actions is K-W-D-L model which has been developed by the University of Mississippi. This model consists of four stages and each group declares results of their work in four stages after the problem presentation by teacher. These four steps are:

1. What I know?
2. What I want to find out?
3. What I did?
4. What I learned?

Bandura (1997) noted that students with high self-efficacy have more desire and motivation for learning and show more insist to solve the challenge in challengeable situation [4]. Bandura introduces four main sources for self-efficacy:

1. Mastery experiences
2. Vicarious experiences
3. Social persuasion
4. Physiological states

Many students' beliefs about their capabilities are returned to their old experiences. For example, students who were successful in their previous mathematical tests for several times, most believe that they can be successful at the next tests also. The second source involves the students with this problem to evaluate their similar social models and how those models are deal with the similar tasks. Although this case is not effective like the past experiences, but however the students feel more self-confidence if find that the similar students with their situation are successful in mathematics. Social stimulations were returned to encourage whether positive or negative from the friends, teachers and parents. Physiological states of the students returned to the student body such as fatigue, pain and nausea [4].Anxiety is in all people in a moderate rate as a part of every human's life and it is considered as an adopted answer in this range. So, it can be said that: with no anxiety, all of us were asleep on back of our desks. Lack of problems may face us with many problems and dangers. Low level of anxiety is essential for the survival of human and can be considered as normal [5]. In some cases, anxiety creates productivity and creativity in the person, provides the ability to visualize the situation and dominate them or causes to raise his or her to seriously face with an important responsibility such as preparing for an exam or accepting a social responsibility. But as its disease form, it is considered as defeat, lack of compromise and a wide frustration which deprives the person from a much of its facilities [6]. Math anxiety was introduced as a new term to describe the difficulty attitude of students regarding mathematics by Dreger & Aiken in 1957 for the first time. Perry has defined the math anxiety as lack of the individual's ability to cope with the situations which are concerned with numbers and in general terms with mathematics. Generally anxiety and particularly math anxiety can increase the rate of distractions and attack of irrelevant thoughts to the mind and cause distortion of individuals' perceptions of phenomena and math issues by creation of disruption in mental structures and processing of information [7]. The students who suffer from math anxiety, do not have anxiety in other subjects necessarily. Math anxiety have many negative effects. Students who have a high math anxiety usually have a negative attitude and feeling for mathematics. When the students reach to academic mathematics, their attitudes about mathematics become stable and the students with math anxiety do not like to participate in math classes or the jobs which are involved with mathematics. Maybe the highest effect of math anxiety is decrease in mathematical achievements [8].The research progress in problem-solving from 1980 to 1995 has been reported. By collecting data from the books and different scientific journals and lesson groups, he concluded that many studies have been conducted after 1980. These researches increased significantly since 1985 and then remained stable. Pointed out that during this period, investigation about mathematical problem-solving is one of the most important issues of university researches and school teachers. It seems that in the recent ten years, the number of studies with the word of (problem-solving) in their titles has been declining. However, there were studies which have not brought (problem-solving) clearly in their research titles, but basically have addressed this issue. For example, some studies in the field of social interactions in learning of mathematical or the process of math modeling and also some studies about the learning process of math content were done. This issue can be interpreted that new problem-solving studies expand the previous ones and everybody evaluates one aspect of it based on their interest [9]. Although mathematics always had been emphasized in the schools but the ability of the students to mastering it is also always questionable.

Due to the importance of the above mentioned, this study was conducted aim to evaluate the effect of K-W-D-L problem-solving model on math self-efficacy, math anxiety and students' understanding of problem-solving. In this research, the K-W-D-L problem-solving model is an independent variable. Math self-efficacy, math anxiety and students' understanding of their problem-solving behavior are the dependent variables. The investigated theories in this research are as below:

1. The K-W-D-L problem-solving model causes an increase in math self-efficacy.
2. The K-W-D-L problem-solving model causes a decrease in math anxiety.
3. The K-W-D-L problem-solving model causes an increase in math function.

MATERIALS AND METHODS

The statistical population were the high school juniors in Tehran and they were selected according to the existing facilities and using the like-cluster sampling method from three high schools. Two classes from each school were selected, one of them as the test group and another one as the control group. The sample size was 145 people.MATHEMATICS SELF-EFFICACY AND ANXIETY QUESTIONNARE (MSEAQ) was used to assess the mathematics self-efficacy and math anxiety. The applied tools of our study are standard and their validity and reliability have been approved before. Also in this research, its validity was evaluated again and Cronbach's alpha was 78%. Due to the high and reverse relevance of mathematics self-efficacy and math anxiety, founder of this questionnaire has measured both the components in a questionnaire. This questionnaire has 29 components, among that 13 components assess mathematics self-efficacy and another 16 components assess math anxiety. This questionnaire is based on Likert scale that give the scores of 1 to 5 to the answers [8]. We referred to the selected classes and share the general purpose of this research with students. Students were asked to answer the questions of the questionnaire accurately and honestly. The mentioned questionnaire was performed in each two classes at the first semester of study, after that in the second semester one class was considered as the test group and the other one as the control group. Problem-solving model of K-W-D-L was performed in the test group. In this way, students were divided into three or four-individual groups. The method of this model was explained for the classroom teachers. Problem-solving model of K-W-D-L was performed in the classrooms of the test group. Then, the questionnaire was given to the students again at the end of the second semester and the result was evaluated. The mathematical function of the students in the first and second semesters was assessed according to the final grades. Then, data were analyzed using SPSS software.

RESULTS

In order to detect the use of parametric and nonparametric tests, we evaluate the normality of data. As it is seen in table 1 and due to the obtained – P which all are higher than 0.05, we concluded that all data follow a normal distribution. So, we use parametric tests to evaluate the hypothesis of the research.

Table 1

Evaluation the normality of pre-test and post-test data in test and control groups

Students' math anxiety in test group	Students' math anxiety in control group	Math self-efficacy in test group	Math self-efficacy in control group	Students' math function in test group	Students' math function in control group	Total numbers of subjects 68	
49	44.05	34.40	38.30	15.80	16.25	Mean	Normality of pre-test data
9.03	7.52	7.24	7.73	2.66	2.67	SD	
0.2	0.2	0.2	0.2	0.2	0.17	Pre-test P	
44.10	49.65	38.05	38.05	16.7	15.2	Mean	Normality of post-test data
7.50	8.77	7.86	7.86	1.80	2.30	SD	
0191	0.2	0.2	0.2	0.2	0.2	Post-test P	

In table 2, the difference in students' math function in both control and test groups were evaluated using t-test. In pre-test function in both test and control groups and according to the obtained P-value (0.05<0.858), the assumption of equality of variances can be accepted. Then, in equality test of the averages and according to the obtained P-value (0.05<0.597), the assumption of equality of averages will be accepted again in both control and pre-test test. In pre-test function of both test and control groups and according to the obtained P-value (0.05<0.429), the assumption of equality of variances will be accepted. In equality test of averages and according to the obtained P-value (0.05>0.028), the assumption of equality of the averages will be rejected. According to the table 3, it is concluded that the average of math function in test group is higher than the control group. Due to the analysis, it is concluded that the implementation of problem-solving KWDL model causes an increase in students' math function. As it is observed in table 3, the average of the test group have received better average compared to the first semester (before implementation of the model). It is while the scores average of the students in the control group were not only has not remained stable, but also it has decreased. This issue can be analyzed that the volume of courses in the second semester has been more than the first semester.

Table 2
Result of t-test in order to evaluate the difference in students' math function in both test and control groups

			Levene test for equality of variances		t-test for equality of the averages		
			F statistic	P-value	T statistic	Degrees of freedom	P-value
Pre-test function	math	In case of equality of variances	0.032	0.858	0.533	38	0.597
		In case of lack of equality of variances			0.533	38	0.597
Post-test function	math	In case of equality of variances	0.638	0.429	-2.28	38	0.028
		In case of lack of equality of variances			-2.28	35.95	0.028

Table 3
Evaluation the average of math function in test and control groups

	code	Mean
Pre-test function	Test group	15.80
	Control group	16.25
Post-test function	Test group	16.7
	Control group	15.20

To evaluate the math self-efficacy in both test and control groups, t-test is used. According to table 4 in each two groups before and after the implementation of KWDL model based on the obtained P-value which is more than 0.05, the assumption of equality of variances was accepted. As it has been observed in averages evaluation, because P-values are more than 0.05, the assumption of equality of math self-efficacy in both groups before and after implementation of the model was accepted. Using this analysis, it is concluded that math self-efficacy in both test and control groups before and after implementation of the model has no difference which shows that this component is the same in each of both groups.

Table 4
Result of t-test in order to evaluation the difference in students' math self-efficacy in both test and control groups

		Levene test for equality of variances		t-test for equality of the averages		
		F statistic	P-value	T statistic	Degrees of freedom	P-value
Pre-test math self-efficacy	In case of equality of variances	0145	0.705	1.64	38	0.108
	In case of lack of equality of variances			1.64	37.83	0.108
Post-test math self-efficacy	In case of equality of variances	1.305	0.36	0	38	1
	In case of lack of equality of variances			0	36.99	1

In table 5, paired tests were used to evaluate self-efficacy of control and test groups before and after implementation of the model. As it has been observed, in the test group and due to the obtained P-value (0.05>0.0), the assumption of equality of averages before and after implementation of the model is rejected and due to value of the averages, it can be concluded that math self-efficacy of these four groups has increased while the results of control group indicated that math self-efficacy value was stable during the year. These results show that the problem-solving KWDL model increases students' self-efficacy.

Table 5
Paired tests in order to evaluate math self-efficacy in both test and control groups

P-value	Mean	
0.609	38.30	Pre-test self-efficacy of the control group
	38.05	Post-test self-efficacy of the control group
0	34.40	Pre-test self-efficacy of the test group
	38.05	Post-test self-efficacy of the test group

Finally in table 6, the difference in students' math anxiety is evaluated, as it can be seen in the table, before the implementation of problem-solving of KWDL model and based on equality of variances and after that, the obtained P-value which is more than 0.05, the assumption of equality of averages was accepted. After implementation of KWDL problem-solving model and according to the below table and the obtained P-value, the equality of variances is accepted, but in continue and according to the obtained P-value (0.05>0.038), the assumption of equality of the averages is not accepted. In continue and according to the table 7, it can be concluded that the average of math anxiety in the test group was less than control group that indicates the positive effect of KWDL problem-solving model on this component, so that KWDL problem-solving model causes a decrease in students' math anxiety.

Table 6
Result of t-test in order to evaluate the difference in students' math anxiety in both test and control groups

		Levene test for equality of variances		t-test for equality of the averages		
		F statistic	P-value	T statistic	Degrees of freedom	P-value
Pre-test math anxiety	In case of equality of variances	0.419	0.521	-1.88	38	0.068
	In case of lack of equality of variances			-1.88	37.79	0.068
Post-test math anxiety	In case of equality of variances	0.12	0.731	2.15	38	0.038
	In case of lack of equality of variances			2.15	37.10	0.038

Table 7
Evaluation the average of math anxiety in test and control groups

	code	Mean
Pre-test function	Test group	49
	Control group	44.05
Post-test function	Test group	44.1
	Control group	49.65

DISCUSSION

K-W-D-L problem-solving method including small groups, in addition to learning the skills to the members of the group, can prepare them to enter into different social groups and help to increase the motivation of disinterested students to lessons. In this method, students learn from each other and explain what they solve in the group, so thinking in the group grows. Small group working in problem-solving of mathematics seems a useful and cost-effective solution. If by this way the person's belief in the evaluated components can be change then it can be a useful step toward changing the students' mathematical point of view and therefore their better mathematical activities. According to the obtained results in this research and since the implementation of this model causes an increase in math function and math self-efficacy and in other words causes a decrease in math anxiety, it is a very effective way in education, especially in mathematics which is the problem of many students. According to the above mentioned, lack of cost for this model, it is convenient and applicable in all classrooms, makes this model as one of the essentials of math classes. The results of Wales' research show that the students with higher self-efficacy skills, do better that the other students in performance field. Also to avoid the parrot-like learning and step towards meaningful learning, the ability to create and solve problems is an important arena [10]. It is recommended to the teachers and parents to note the students' understanding from their abilities, because this perception may predict motivations and next academic choices of students. According to Phalet et al, the people with higher self-efficacy, imagine higher goals and wishes for themselves, so try more to achieve their goals [11]. According to many research results that show math anxiety is one of the important and effective factors on the performance and math learning, K-W-D-L problem-solving model is one of the strategies to reduce math anxiety.

CONCLUSION

After data analysis, it was found that the KWDL problem-solving model leads to improve the math function and self-efficacy.

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