Int. J. Contemp. Math. Sciences, Vol. 7, 2012, no. 45, 2197 - 2205

The Effect of the 4MAT Model on Student's Algebra Achievements and Level of Reaching Attainments

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Abstract

The purpose of this study is to analyze the effect of the 4MAT teaching model on 8th grade mathematics lesson curriculum algebra learning domain achievement levels and level of reaching attainments. In the study, an experimental design with a pre test-post test control group was utilized. The study was conducted with 105 8th grade students enrolled at the one Primary School in the central district of Balıkesir during the 2011-2012 academic year. Teaching was provided to the experimental group based on the 4MAT teaching model and to the control group in compliance with applications and activities in the text book within the framework of attainments in the algebra learning domain. As a result of the conducted data analysis it was determined that the difference in achievement score averages between the experimental group and control group were significantly in favor of the experimental group and the level of reaching attainments in the experimental group, which was applied the 4MAT teaching model, were higher compared to the control group.

Keywords: 4MAT teaching model, Algebra learning domain, Achievement

Introduction

Mathematics education covers the works of mathematics in the mathematics learning and teaching process. All activities in this process are based on the acquisition of cognitive skills. The acquisition of mathematical attitudes and skills by students is only achieved through the structuring of mathematical concepts in their minds [1]. It is presumed that knowledge will double once every ten days [2]. Then, in a world where knowledge is doubled once every ten days, what type of

mathematics should be taught? How should students be educated in this process? What types of roles await teachers in the process of educating students? Maybe all these questions are the most crucial questions that need to be answered for mathematics. Subjects to be learnt in the traditional setting cannot be individualized and the attention of the student cannot be drawn to the lesson. It should be accepted that more concrete and less abstract concepts can be learnt easier. Whereas, mathematical concepts are abstract concepts that require high level cognitive activeness [3]. Thus, the implementation of learning theories based on cognitive foundations in the mathematics lesson is considered to be more effective than the traditional method. This is because, in the contemporary understanding of education, the student is not perceived as the recipient of knowledge and the teacher as the provider of knowledge. Some cognitive based theories are based on the individual differences of students and the learning process. Styles of models emphasizing the cognitive dimension are concerned with perceiving, processing, and storing information. The cognitive aspect emphasizing the perception and processing of information is of importance for mathematics teaching [3]. Thus, we believe that teaching models based on the cognitive dimension and styles of learning shall achieve success in mathematics teaching. This is because, when the styles of learning of students are known, the teaching strategies and teaching methods and techniques that may be used and requiring teaching material can be selected in an easier manner and teaching can be actualized in line with the interests of students [4].

According to Babadoğan (2000), if the learning styles of students are known, the manner of learning of individuals and what type of teaching design applications are required can be understood in an easier manner. Thus, the teacher will be able to form teaching settings primarily suitable for him/herself and then the student. There are many studies demonstrating the effect of matching teaching styles with learning styles on the achievement of the student [5]. The most numerous of these studies in the literature are studies covering the 4MAT teaching model [6]. When the TIMSS-1999 reports are examined, it can be observed that Turkey's achievement in mathematics is much lower than the international average. The problems in the manner of perceiving mathematics is indicated to be among the reasons for such a result [7]. The problems in the perception and processing of mathematical concepts by students, lead to the low level in mathematical achievement. Due to the existence of problems in the perception and processing of information by students in the mathematics lesson and the inclusion of the dimensions of the perception and processing of information in McCarthy's learning style model, the effect of teaching based on the 4MAT teaching model developed by McCarthy on the achievement of students was analyzed in this study.

The *4MAT (4 Mode Application Techniques)* is a model that converts learning style concepts into educational strategies. It was developed by Bernice McCarthy in 1970. The model is based on Kolb's (1984) experimental learning theory in the brain hemisphere research findings. Even though Kolb (1984) based

the learning theory on management and experimental development research, he has based its structure on the ideas of theorists that are gradually advancing and influencing educational thinking. Kolb (1984) analyzed learning styles as four types consisting of diverging, assimilating, converging, and accommodating. McCarthy changed Kolb‘s theory a little and prepared a learning model for primary and secondary education. He has based the foundation of the model on the learning styles analyzed by Kolb as four types. The 4MAT teaching model is based on a learning cycle that covers the four student types suggested by McCharthy and all the characteristics of the right and left hemispheres of the brain and also makes learning a continual process. In this cycle, while teachers revolve around the reel, they also teach according to personal differences by using educational strategies suitable for each student’s learning style. [8]. In brief, this model is a student centered model based on learning styles occurring based on the relation between the brain and learning and also centering the learning cycle.

Purpose of the Study

The purpose of this study is to analyze the effect of the 4MAT teaching model on 8th grade mathematics lesson curriculum algebra learning domain achievement levels and level of reaching attainments. For this purpose, the problems of the study are as follows:

1. Is there a significant difference in the levels of achievement in the algebra learning domain between the experimental group applied the 4MAT teaching model and the control group applied traditional teaching?
2. What is the level of reaching attainments of the experimental and control groups in the 8th grade mathematics curriculum algebra learning domain?

Method

Model of the Study

The experimental design model with pre test-post test control group was utilized in the study.

Sample

By taking the first term report scores of 165 8th grade students studying at the one Primary School in the central district of Balıkesir during the 2011-2012 academic year into consideration, three equal classes have been included under the scope of the study. Among these classes, 8-B was randomly selected as the experiment, 8-C as the control, and 8-D as the pilot group and 105 students constituted the study group.

Data Collection Instruments and the Data Collection Process

For the purpose of determining the effect of the 4MAT teaching model in the teaching of attainments in the 8th grade algebra learning domain on the achievement of students, the algebra test developed by Övez-Dikkartın (2012)

was applied prior to and after the application as pre-test and post-test. The alpha value obtained as a result of the item test of the test measuring thirteen attainments in the learning domain and prepared in line with opinions of experts, was determined to be 0.818. [9]. Prior to the data collection process, the draft of the 4MAT curriculum that could realize the current curriculum in 5 weeks was prepared. The prepared draft was submitted for the opinion of experts. The draft rearranged in line with obtained opinions, was implemented at the beginning of the term on the pilot group determined for the study with an agreement with the lesson teacher and required arrangements were performed. The actual application was applied by the researcher at the end of the term on the experimental group based on the 4MAT teaching model and applied to the control group in accordance with applications and activities in the textbook.

Data Analysis

The algebra test was applied to a total of 70 students in the experimental and control group prior to and after the sub learning domains of Patterns and Relations, Algebraic Expressions, Equations and Inequalities under the algebra learning domain in the 8th grade mathematics curriculum. From the scores obtained from the tests, standardized absolute achievement scores were calculated and for non-related samples, a comparison was conducted with the t test. For the purpose of determining the level of reaching attainments, the correct percentages of items (item difficult indices) were calculated and the levels of reaching attainments were construed on a criterion of 0.75 [10].

Findings and Interpretations

Findings and Interpretation Pertaining to the First Problem

First of all, in the study an answer was sought for the question of "Is there a significant difference in the levels of achievement in the algebra learning domain between the experimental group applied the 4MAT teaching model and the control group applied traditional teaching?" Based on data obtained in the study, the algebra learning domain achievement levels of the experimental and control groups were compared for independent groups with the “t” test. To this end, the difference between absolute pre and post test score averages within the groups themselves were accepted as achievement scores and a comparison was conducted between the obtained achievement scores. The obtained findings have been provided in Table 1.

Table 1.

Comparison of the Achievement Scores of the Experimental and Control Groups for the Algebra Learning Domain

Group	N	$\overline{X}_{ach}$	S	$\overline{X}_{difference}$	Sd	t	p
Control	35	23.51	34.49	23.5	68	-3.039	.003
Experimental	35	47.00	30.01				

When Table 1 is analyzed, it can be observed that the average algebra learning domain achievement scores of the experimental group is 47,00 and is 23.51 for the control group. There is a difference of average 23.5 points in favor of the experimental group between the average achievement scores of the experimental and control groups. According to the result of the "t" test conducted for the purpose of determining whether or not this difference is significant, it was determined that there is a significant difference between achievement score averages [t = -3.039; (p=.003<.01)]. This finding demonstrates that the 4MAT teaching model applied for the algebra achievement level of the students in the experimental group is more effective than the traditional method implemented in the control group.

Findings and Interpretation pertaining to the Second Sub problem

Secondly, in the study, the answer to the question of "What is the level of reaching attainments of the experimental and control groups in the 8th grade mathematics curriculum algebra learning domain?" was sought. In line with obtained data, the item difficulty index (pj) values obtained from the results of pre-post tests related to the questions measuring each attainment of the groups, the differences between them, and t values were calculated and the results have been provided in Table 2.

Table 2.
Levels of Reaching Algebra Learning Domain Attainments of the Experimental and Control Groups

A.L.D	Attainments	Nn	Control				Experimental			
			Pre Test (Pj)	Post Test (Pj)	Dif. (Pj)	t	Pre Test (Pj)	Post Test (Pj)	Dif. (Pj)	t
Patterns, Relations	1. Explanation of relations between numbers in special number patterns.	1	.14	77	.63	.17	.80	.63	1	.14
Algebraic Expressions	1. Explanation of the difference between identification and equation.	2	.20	.28	.08	.17	.40	.23	2	.20
	2. Explanation of identity with models.	3	.11	.29	.17	.11	.45	.34	3	.11
	3. Factorizing algebraic expressions.	4	.08	.74	.66	.11	.51	.40	4	.08
	4. Operating with rational algebraic expressions and abbreviating expressions	5	.17	.77	.42	.14	.82	.68	5	.17
Equations	1. Explanation of the slope of a line with models	6	.09	.22	.13	.23	.80	.57	6	.09
	2. Determining the relation between the slope of a line and equation.	7	.14	.22	.08	.11	.75	.64	7	.14
	3. Solving equations with one unknown.	8	.23	.82	.59	.17	.91	.73	8	.23
	4. Solving linear equations systems with algebraic methods.	9	.08	.17	.09	.08	.34	.26	9	.08
	5. Solving linear equation systems with graphs	10	.14	.25	.11	.17	.48	.31	10	.14
Inequalities	1. Explanation of the relation between equality and inequality and writing mathematics sentences suitable for problems including inequalities.	11	.22	.77	.55	.17	.88	.71	11	.22
	2. Determining the solution set of unknowns with first degree unknowns and indicating it on the numerical axis.	12	.14	.17	.03	..09	.34	.25	12	.14
	3. Drawing graphs of linear inequalities with two unknowns.	13	.05	.25	.20	.11	.40	.29	13	.05

When Table 2 is examined, it was determined that according to pre test results at the beginning of the teaching process none of the groups could achieve .75 attainment. When post test results were examined, it was determined that the students in the control group could achieve, the attainments measured by items 1,5,8, and 11 and the students in the experimental group could achieve the attainments measured in items 1,5,6,7,8, and 11. Accordingly, the control group could achieve 30.76% of attainments and the experimental group could achieve 46.15% of attainments. A finding obtained concerning the control group is that it demonstrates parallelism with the results of the study conducted by Övez-Dikkartın (2012). Accordingly, it was determined that the level of reaching attainments by the experiential group, which the 4MAT teaching model was applied, was higher than the control group.

Conclusion and Discussion

In this study, the determination of the effect of the 4MAT teaching model on the level of achievement in the algebraic learning domain and reaching attainments was attempted. In line with obtained findings, the following conclusion was reached.

- It was determined that difference in the algebra learning domain achievement scores of the experimental and control groups was significantly in favor of the experimental group. This obtained result suggested that algebra teaching based on the 4MAT teaching model was more successful in increasing student success and thus, achievement. This case demonstrates, parallelism with some studies in the literature [11,12,13,14,15].
- In the study, secondly the manner of how the applied 4MAT teaching method influenced the level of reaching algebra learning domain attainments was analyzed and as a result of the item analysis conducted, it was determined that students of the experimental group achieved attainments more than control groups students at a complete learning level. In addition to this, it was determined that the control group achieved the same attainments at the end of the learning process at a level of .75 in a similar manner with the results of the study conducted by Övez-Dikkartın (2012). Furthermore, it was observed that both the experimental group and the control group were unable to achieve attainments requiring knowledge of coordinate systems and this result were similar to the results of the study conducted by Övez-Dikkartın. [9].

Recommendations

As a result of the reform actions conducted in the mathematics curriculum in

recent years, one of the basic acceptances of the primary mathematics curriculum implemented in the 2004-2005 academic year is the understanding that "Every child can learn mathematics". The actualization of this understanding can primarily be ensured with an education setting that takes the individual differences of the student into consideration. As specified in conducted studies, when the individual is aware of his/her learning style and when the individual is provided education in line with these styles, learning actualizes at a higher rate. In this context, in order to actualize success, the formation of learning settings taking individual differences into account and formed mutually by the student and teacher come into prominence. When it is considered that algebra is one of the fundamental fields of mathematics, success in algebra is an important factor in success in mathematics. The teaching of algebra, which is the language of mathematics, by arranging the learning setting according to individual differences and the teacher having sufficient knowledge on this topic, is of importance. Thus, teachers should be provided in-service and pre-service training on learning style applications. This is because, it is extremely important that teachers, who have an important role in the practice of both the 4MAT teaching model and other teaching models, implement the application in a sound manner and plan the lesson correctly. It is considered that the analysis of the effect of the 4MAT teaching model on the other attainments of the algebra learning domain in future studies and providing teachers reliable sources with developed plans shall facilitate the utilization of this model.

In addition to this, the investigation of why some attainments could not be achieved will be an important step in eliminating unsuccessfulness in mathematics, which has strong precondition relations. It should be determined whether this case is due to the teaching process or the robustness of the program and in this respect, if necessary, it would be suitable to enhance teaching applications and rearrange them.

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Received: July, 2012