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THE EFFECTS OF CONCEPTUAL CHANGE TEXTS ENRICHED WITH METACONCEPTUAL ACTIVITIES ON THE SYMMETRY OF CLASSROOM TEACHER CANDIDATES

Gülşah Batdal Karaduman

Abstract: This study aims to analyze the effects of conceptual change texts enriched with metaconceptual activities on the semantics of classroom teacher candidates. The sample of the study is made up of 60 3rd grade undergraduate students who study at Istanbul University Hasan Ali Yücel Faculty of Education. Pre-test post-test experimental modelling has been used in the study. As data collection tool, Symmetry Subjects Comprehension Test (SSCT) has been used. The Cronbach Alpha value of SSCT is found to be 0.70. SSCT has been used as a pre-test before the students read the texts and it has been used as a post-test after they have read them. SPSS program has been used for data analysis. As a result, it has been found that there is a meaningful difference between the texts that are enriched with metaconceptual activities and plain texts in terms of students' learning symmetry subject. The findings show that teacher candidates who have read the texts that are enriched with metaconceptual activities can learn symmetry subject better than those who have read the plain text.

Key words: Conceptual Change, Metacognition, Metaconceptual Activities, Mathematics Education.

1. Introduction

It is a well-known fact that learning concepts is crucial for mathematics subject. It is quite difficult for students to comprehend the mathematics subject that includes abstract concepts (Aktümen and Kaçar, 2008). So as to have a better understanding of mathematics, one should learn the related concepts correctly. A concept is defined to be a general term for the notions and events that have the same or similar characteristics (Temizyürek, 2003). According to Resnick (1983), students come to the classroom with the experiences that they gain from daily life, which means they do not come with and empty mind. Generally, the concepts and notions that they learn on an everyday basis do not match the scientific ones. It is called a misconception when students interpret the wrong notions, concepts and facts that they have in their minds in a way that is peculiar to them (Bahar, 2003). Recently there has been an approach called "Conceptual Change Aproach" which aims to replace the wrong concepts with the scientific ones. In short, the process of restructuring concepts is called a conceptual change approach. The conceptual change approach has a process of resolution and reorganization. Assimilating is matching the new concepts with the concepts in the minds of students or adding new concepts to the present ones while the process of replacing the concept in the mind with new concepts is called reorganization (Cerit Berber and Sarı, 2009).

Some of the researchers stated that in the process of conceptual change, metacognition in concept learning is important (Yürük, 2005). The student's awareness of the process of thinking and the control of the process is called metacognition. Metacognition can be listed under two headings: metacognitive knowledge and metacognitive control (Flavell, 1979).

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Since metacognition is a broad concept, it is more accurate to use the term of metaconceptual activities in concept learning and it can be analyzed under three main headings: metaconceptual awareness, metaconceptual monitoring and metaconceptual evaluation (Yürük, 2005).

Some of the metaconceptual awareness activities are being aware of the concepts in their minds, ontological assumptions and models, the concepts that they do not know, the contextual concepts and experiences of their own. The process that aims to gather knowledge about the mental processes and the current cognitive status of the students is the metaconceptual monitoring activities. Interpretation of the present or new ideas'rationality or efficiency, and choosing one of the different situations and having better results by finding better activities for the chosen situation are all metaconceptual evaluation activities (Yürük, 2005).

Symmetry is an important concept of geometry and mathematics. However, it is not only an academic concept but also the importance of symmetry in daily life cannot be denied. Nevertheless, problems are encountered at the point of teaching the subject of symmetry that includes abstract concepts. Aksoy and Bayazit (2010) state that students have some difficulties and misconceptions about the subject of symmetry and that these difficulties and misconceptions are related to four main areas. These areas are:

• Finding the symmetry axis/axes of the given figures

• Difficulties in finding the reflections of the shapes where the symmetry axis is inclined

• Difficulties in determining the distance between shapes in the construction of symmetrical shapes

• Misconceptions arising because of lack of information on the concepts of parity and similarity

Students have misconceptions about symmetry (Yenilmez and Demirhan, 2013). It is obvious that students have misconceptions about the subject of symmetry and that they should be supported with appropriate materials for the students'levels (Bingölbali and Özmantar, 2009). In this sense, symmetry subject that is supported with materials such as conceptual change texts enriched with metaconceptual activities can be facilitated. Conceptual change texts are used in the process of conceptual change and displacement of the misconceptions of students with the scientific ones (Köse, 2011). Conceptual change texts, which are enriched with metaphysical activities, are gathered by adding metaconceptual activities in conceptual change texts (Demir, 2010).

The aim of this study is to examine the effect of conceptual change texts enriched with the metaconceptual activities on understanding of symmetry by the teacher's trainees.

2. Method

2. 1. Research Model and Data Collection Tool

In this study, pretest - posttest experimental model was used. Experimental studies are planned to test the effect of differences created by the researcher on the dependent variable (Büyüköztürk, et al., 2016). 60 3rd grade teacher candidates studying at Istanbul University Hasan Ali Yücel Faculty of Education, Department of Elementary Teacher Education made up of the participants of the study. Symmetry Comprehension Test consisting of 28 questions which were prepared by the researcher was applied. Expert opinion was consulted during the preparation of the test. The Cronbach Alpha value of the test was calculated as .70. Initially, pre-test was applied to teacher candidates. After pre-test, the class is divided into two. In the first group (control group), plain texts related to the subject of symmetry was used, and the second group (experimental group) were taught conceptual change texts enriched with metaconceptual activities. After reading the texts, the Symmetry Topics Comprehension Test (STCT) was applied as a final test.

2. 2. Preparation of Conceptual Change Texts Enriched with Metaconceptual Activities Related to Symmetry

Researches have been done on the common misconceptions by looking at the literature. First it was aimed to provide awareness of the misconceptions about symmetry. The questions in the text were actively used in the metaconceptual process. The teacher candidates were made to choose from different opinions and a metaconceptual evaluation was done.

2. 3. Creating Plain Texts about Symmetry

Information about the concept of symmetry is given directly in plain text format without any differences in the literature.

3. Findings

Independent groups T-test was used to determine whether there was a significant difference between the experimental group reading conceptual change texts enriched with metaconceptual activities and the control group who read plain texts. Table 1 shows that the difference between the arithmetic averages of the groups for the pre-test scores of the scale was not statistically significant. This shows that there is no difference between the groups before the experiment was done.

Table 1. *Unrelated Group T-test Results According to the "Group" Variables of the Grades Got by Students from the pre-test*

Grade	**Groups**	**N**	**X**	**SD**	**SE**	**T test**		
						t	**df**	**p**
Pre-test	Group 1	30	19,2000	4,49060	.81987	.468	58	.641
	Group 2	30	18,7000	3,74304	.68338			

Independent groups T-test was applied to determine whether there was a significant difference between the experimental group who read conceptual change texts enriched with meta-conceptual activities and the control group who read the plain texts. When Table 2 was analyzed, the difference between the arithmetic averages of the groups was statistically significant. The experimental group, which reads the texts of conceptual change enriched with metaconceptual activities, is more effective in conceptual understanding when compared to the control group who reads plain texts.

Table 2. *Unrelated Group T-test Results According to the "Group" Variables of the Grades Got by Students from the post-test*

Grade	**Groups**	**N**	**X**	**SD**	**SE**	**T test**		
						t	**df**	**p**
Post-test	Group 1	30	19,7333	3,96479	.72387	-2,649	58	.010
	Group 2	30	22,1000	2,86898	.52380			

4. Conclusion

According to the findings of the study, a significant difference was found between the final test results of the experimental group studying the conceptual change texts enriched with the metaconceptual activities and the control group who read the plain texts. It is concluded that teacher candidates who read conceptual change texts enriched with metaconceptual activities have a better conceptual understanding about symmetry subjects than the students who read plain text.

When the studies in the literature are examined, there are researches that the conceptual change texts enriched with the metaconceptual activities have a positive effect on conceptual understanding. Demir (2010), in his study on science teacher candidates, found that conceptual change texts enriched with metaconceptual activities contribute to the conceptual understanding of the subjects of force and movement. Demir (2010) found a significant difference between the group studying the plain text and

the text enriched with the metaconceptual activities. This difference is in favor of conceptual change texts enriched with metaconceptual activities. Demir (2010) explains the reason for this difference as: it is because the texts enriched with metaconceptual activities provide more meaningful learning than plain texts leading to meaningful learning by making self-regulation by recognizing that teacher candidates do not know in the texts enriched with the metaconceptual activities. In addition, the only thing plain texts provide is information.

Akgül (2010), in his study on science teacher candidates, found that conceptual change texts enriched with metaconceptual activities contribute to the conceptual understanding of heat and temperature subjects. Akgül (2010) found as a result of the persistency test that the conceptual understanding of the science teacher candidates who are taught heat and temperature subjects with the help of the conceptual change texts enriched by the metaconceptual activities learned these concepts for a longer term. Therefore, it can be said that the conceptual change texts enriched by the metaconceptual activities do not only teach the subject better, but they also teach them more persistently.

Sabancı (2014) found a significant difference in favor of post-test average scores of the students in the group in which activities carried out with metaconceptual activities in the law subjects of social studies course with the 3rd grade students in the secondary school. Ezberci (2014) found a significant difference between the 3rd grade students in the science lesson who were taught the Moon's phases subject supported by the metaconceptual activities along with 5E learning cycle model and the students who were taught the traditional teaching methods. This significant difference was found to be in favor of the students who were taught with the help of 5E learning cycle model supported by metaconceptual activities. In their study on biology teacher candidates, Yürük et al. (2011) reported that the metaconceptual teaching activities that were applied to students so as to change the current concepts in their minds with the alternative ones, have been scientifically accepted to be effective.

Suggestions

All these findings support our study and it is seen that the activities that activate metaconceptual activities are more successful in students' conceptual understanding in comparison with the traditional teaching methods. Based on these results, conceptual change texts which are enriched with metaconceptual activities related to all subjects of mathematics and science courses containing abstract concepts can be prepared. Thus, students' learning can be more meaningful and more permanent. At the same time, misconceptions will be found out and learning subjects correctly will be supported.

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Authors

Gülşah Batdal Karaduman, Istanbul University-Cerrahpaşa, Hasan Ali Yücel Education Faculty, Department of Elementary Education-Primary Education, Istanbul, Turkey, e-mail: gulsah@istanbul.edu.tr

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Appendix

TEXTS ABOUT SYMMETRY

Let's see if we know symmetry that we encounter in our daily life in its scientific meaning. Come here and see!

Define symmetry by considering daily events that we do.

In which subjects do we use the concept of symmetry?

.....

Which characteristics of the symmetry concept would you use to define it?

.....

SYMMETRY AXIS OF SYMMETRY TRANSLATION

Can you draw a concept map describing the relationship between the concepts given above?

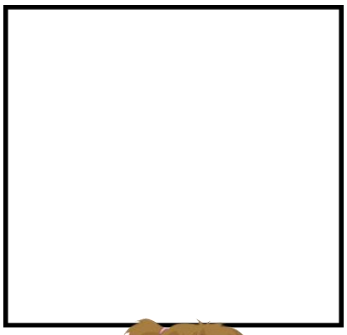
Express the above-mentioned concepts in written form.

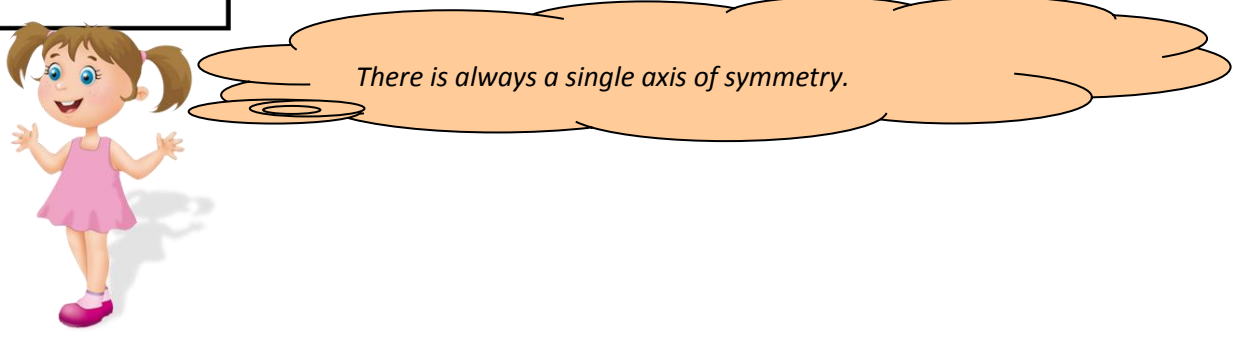
.....

.....

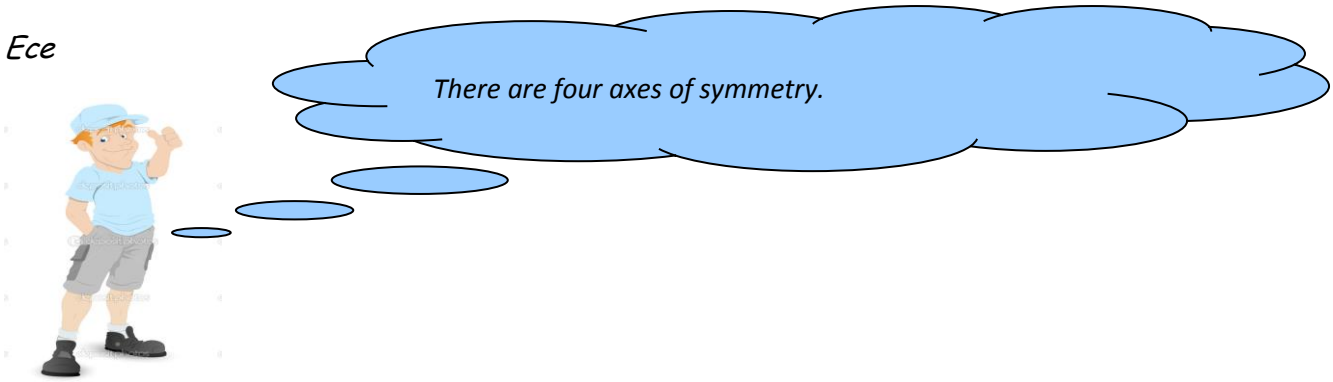
Example 1

A square is given on the left. Explain with whom you agree with the idea of the square's symmetry axis along with your reasons.





Ece

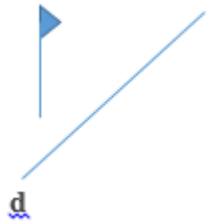


Efe

……

……

Example 2



Draw the symmetry of the object in the figure on the left according to line d.

Example 3

Who do you agree with about how the houses in the above figures are seen in the lake? Why?

This is a reflection translation.

This is a translation.

This is a reflection.

AYLA

CAN

BERKAY

.....

.....

Below are three questions that Efe has in his mind. Can you answer Efe's questions by giving examples?

Does every geometric shape have an axis of symmetry?

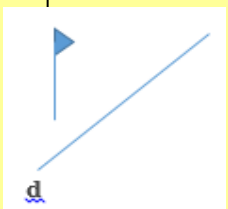
Is the axis of symmetry horizontal or

Do symmetrical shapes resemble

EFE

TIME TO LEARN

Symmetry is an image of an object that is equally distant to a line. The symmetry axis divides a shape into two identical parts. When the new shape is folded along the axis of symmetry, these parts cover each other completely. A shape may have more than one symmetry axis; for example, square has four symmetry axes: horizontal, vertical and two diagonal. However, some students have the wrong idea that a shape can only have one symmetry axis. Because of the traditional education given at schools, many learners have the idea that every geometric shape has to have an axis of symmetry. In order for a shape to have an axis of symmetry, all points of the parts of a figure must be overlapped when they are folded along the axis to be drawn. The idea which is common in the given figures is that the reflections of the vertical/horizontal objects in the axis of symmetry should be in vertical/horizontal positions. When the symmetry of a shape is found, the reference points of the figure are generally based on corner points and center of gravity, projections are taken according to the axis of symmetry and then the points are combined to obtain the symmetry of the initial shape. The symmetrical shapes are similar because they are equal.



However, all similar figures do not have to be identical. In other words, there may be no symmetry between similar figures.

Do you understand the text above? If not, please read it again. Can you summarize the text in your own words when you make sure you understand it?

……
……

Can you reinterpret square sample according to the text above?

……
……

When you compare your first ideas with the information in this text, which ones make sense to you?

……
……

Can you draw a concept map again using your present information about symmetry, symmetry axis, translational concepts?

Is there a difference between the concept map you drew firstly and the concept map you drew secondly?

……
……

Now Ece asks the same questions that Efe has asked you before. Are your answers now the same as your first answers? Which one is more meaningful to you: your first answer or second answer?

Ece

Is there any point from the examples and subjects given so far that confuses your mind? Can you write if there is any?

.....
.....

Thank you for participating in the study. What are your views on the text above?

.....
.....