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INVESTIGATING 8TH GRADE STUDENTS' THINKING MANNERS ABOUT FRACTAL PATTERNS

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ABSTRACT
Completing the missing steps of fractal patterns whose some steps were given and explaining the reasons of the answers were expected from the students within the interview questions. By deeply analyzing the answers of the students, it is aimed to investigate thinking manners about patterns are in fractal shapes. Due to the data that was obtained from the interviews, strong relationship was deduced between the students' knowledge about properties of self similarity and iteration of fractal shapes and their success about realizing of relationship between the steps of fractal patterns.
Keywords: Fractal Pattern, 8th grade students, Thinking manner, fractal geometry.

INTRODUCTION

The Geometry taught in schools is the Euclidean geometry, which has a two thousand years history. But in reality nature does not indicate an appropriate structure with the concepts of Euclidean Geometry. In this sense, Euclidean geometry failed to respond to the new theories that were developed in 20th century (Gündüz, 1998). Under these conditions a new geometry emerged and began to give its products. The name of this new geometry is Fractal Geometry.

The general purpose of geometry teaching could be examined under two main headings as students' using geometry to understand his physical world and his developing the skills of problem solving (Baki, 2001).

The geometry taught at schools is composed of idealized abstractions however the appearances of objects in nature are very complex. Mandelbrot expressed that it is almost impossible to come across Euclid geometry in nature and stated "Why is geometry often described as cold and dry? One reason lies in its inability to describe the shape of a cloud, a mountain, a coastline, or a tree. Clouds are not spheres, mountains are not cones, coastlines are not circles, and bark is not smooth, nor does lightning travel in a straight line" (Karakuş, 2010). When we consider the general purpose of geometry teaching it is understood that the relation between school geometry and daily life must be established stronger. In this sense of general purpose of geometry teaching fractal geometry is more effective than the Euclidean geometry for students to explain his own physical world, environment and the universe and to use geometry for solving problems.

There are questions about which features of students about fractal shapes must be taken into account during the activities of fractal geometry in primary level (Vacc, 1999). So determination in perspectives of students to fractal shapes and their thinking manners related to these shapes can contribute to the development of fractal geometry course programs and activities.

According to this knowledge, for future studies on the fractal geometry, acquired knowledge about the cognitive process that students go through is thought to lead teachers and researchers to the method that will be applied to the lesson activities.

The purpose of this study is to investigate thinking manners of 8th grade students who are in different success levels about fractal patterns. From this point it is aimed to investigate which process of thinking the students go through while drawing the missing steps in given specific steps of fractal patterns.

METHOD

In the research, case study was used for the purpose of examine the thinking manners of students related to fractal patterns. According to Yin (2003), case study is a method which is used for cases in which the details about studied subjects cannot be distinguished easily (Blaxter and et al., 2006). Interview method is used in the case study for the purpose of examining students' viewpoint and thinking manners to fractal patterns. In order to determine the students to be interviewed "Fractal Geometry Achievement Test" which is developed by researchers applied to a chosen sample.

Sample

In the first part of research fractal geometry achievement test was applied to 194 students in order to determine the success level of 8th grade students in fractal geometry. The universe of case study consists of these students. According to the test results three different groups were created as low, intermediate and high. By choosing 4 students from each group, study was done with 12 students.

Data collection tools

In order to determine the success levels of students in fractal geometry "Fractal Geometry Achievement Test" with 22 questions was developed by the researchers. A pilot research within the validity and item analysis of the test was done and Cronbach Alpha reliability coefficient was found as.812.

Interview questions were developed for 12 students in the case study. Students were asked to give oral statements about the rules of given fractal patterns. In the first of these patterns, the first two steps were given but next steps were not given. In the second pattern, the first, third and fourth steps were given, the second step was asked to be drawn. In the third pattern, the first two steps were given, the third step was asked to be drawn. First of all, students would examine fractal patterns explain the steps of fractal pattern in the process. Later, they are asked to draw the missing steps of the fractal patterns and explain the reason of these drawings. Creation steps of fractal patterns are given below.

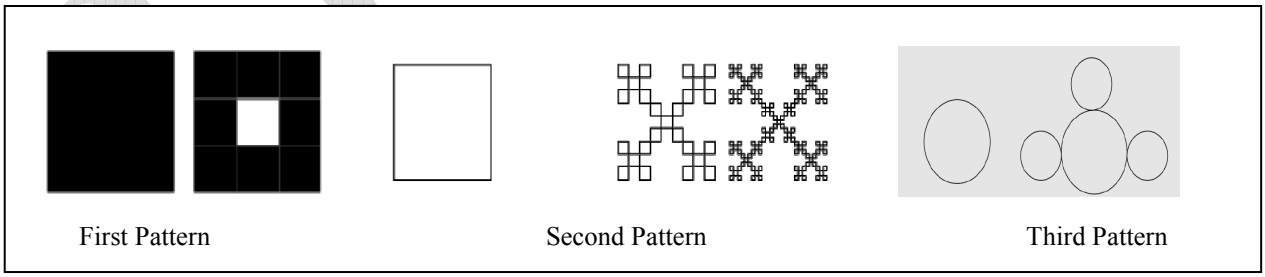

Figure 1. Fractal patterns in the interview questions

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FINDINGS AND COMMENTS

In this section findings and comments of answers to the interview questions are given.

Findings related to first fractal pattern

It is observed that two of the low success level students could express the rule of the first fractal pattern correctly. Nevertheless these students could not apply the rule to the next step of the pattern. For instance one of the students could draw the third step of pattern as follows.

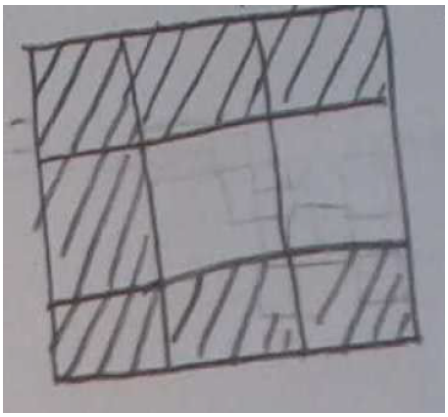

Figure 2. The third step that the low success level student draw for the first fractal

This student stated the rule about fractal pattern as follows: *square is divided into 9 parts and they took the middle part and there are 8 parts left.*

One of the high success level students stated the rule as follows: *In this figure a square is divided into nine equal squares and then the square in the middle is painted white.* This student defined the rule properly and could draw the third step of the fractal correctly.
Another student from high success level drew the third step incorrectly follows although he could define the rule correctly.

Figure 3. The third step that the high success level student draw for the first fractal

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A student from intermediate success level stated the rule as follows: *The middle is emptied when 3 squares are placed from up to down and right to left.* He drew the 3rd step as follows:

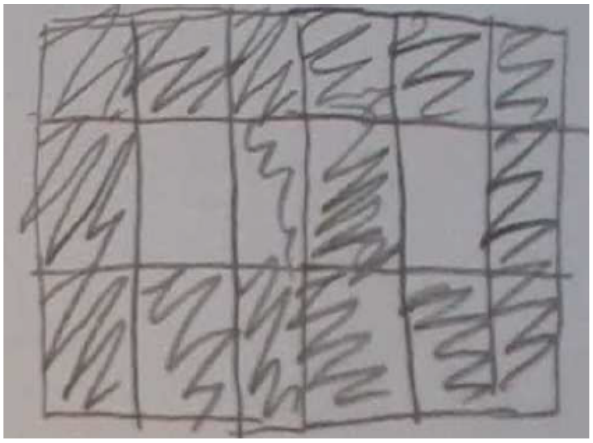

Figure 4. The third step that the intermediate success level student draw for the first fractal

When students' answers about fractal pattern examined, some mistake attract attention. The first one is student can understand the formation system and the rule of the fractal however he makes mistakes while applying this rule to the next step. This may be caused by disregard of "initiator step" and "generator step" of fractal patterns. These concepts that explain the formation of a fractal pattern let us find the requested step of the fractal easily. Another difficulty that students come across is misplacing "removed part", "shaded part" or "painted part" in the requested step of fractal drawing. This situation may be caused by not understanding the formation rule properly.

Findings related to second fractal pattern

Students who answered this question wrongly generally said that pattern was formed by adding new squares to the initial square. Therefore, they failed to apply the self-similarity to the fallowing steps. For instance, the second step drawing made by a student at low success level is as follows.

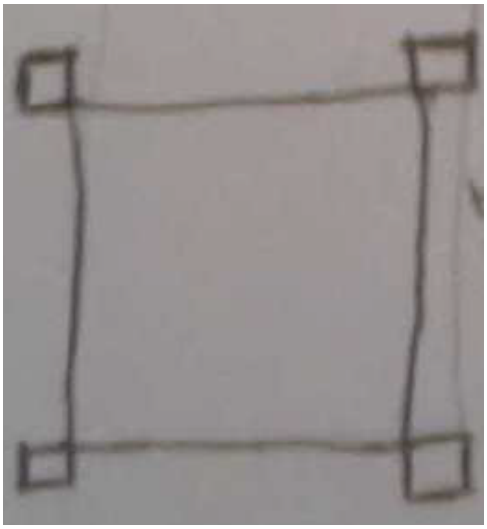

Figure 5. The second step that the low success level student draw for the second fractal

Students at high success level made detailed explanation about the pattern. For example, a student defined the rule as follows. *A square is divided into nine equal pieces. Then, the second squares on the line and on the column are taken out to shape the pattern. We apply this rule to all newly produced squares*. The student emphasized the fractals' iteration property as well.

Most of the students had difficulty in explaining the rule in the second fractal pattern question. The most important reason for making mistake is that they try to find out the rule without paying attention to the initial shape of pattern. Because whether the measure of the initial shape or whether it is shaded or not is an important clue to see the result on the second and on the following steps.

Findings related to third fractal pattern

Students didn't have difficulty in finding out the rule; however, they made some mistakes while drawing the third step of the pattern. For instance, a student at low success level defined the rule as follow: *First, it has given a circle and then it has added another circle to the right, to the left and on the top of this given circle. On the third step, I put one more circle on these circle.* Here is the drawing.

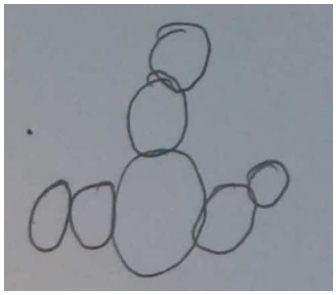

Figure 6. The third step that the low success level student draw for the third fractal

A student at intermediate success level explain the rule as follows: *first, a circle was drawn, then by drawing other circles to the left, to the right and on top of the circle the second step was formed.* Here is the drawing.

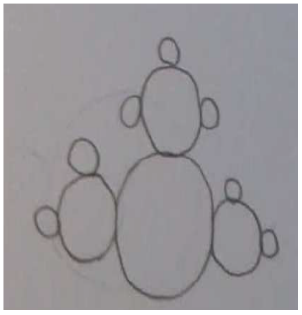

Figure 7. The third step that the intermediate success level student draw for the third fractal

A student at high success level defined the rule correctly: *In each step we add other three circles to the given circle and we make them smaller gradually.* Here is the drawing.

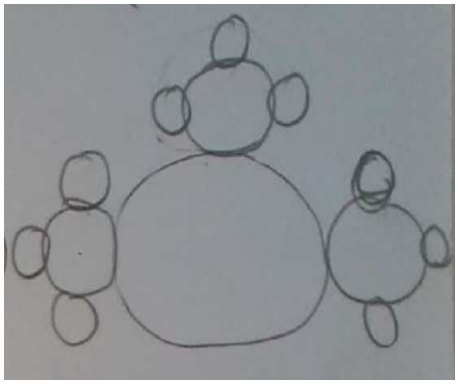

Figure 8. The third step that the high success level student draw for the third fractal

It is seen that the student paid attention to the number and the measure of the circles but he failed to draw their places.

In the third pattern, students generally made incomplete explanations about the rules. They also made various mistakes because of not considering the change in the shape numbers and measures.

As a result of the interviews, it is seen that students have difficulties in finding out the rules. It is not taken into consideration whether they need to add or take out a shape to form a pattern. This causes to find out a wrong rule and as a result to draw a wrong finite drawing.

Another problem that the students experienced is that the students cannot apply the rule to the following steps even though they successfully find out the rule. It is thought that if the students don't relate the initiator step to the following generator step, naturally they will draw a wrong drawing.

It is identified that some students had difficulties in finding out the changes occurred in numbers while they were moving to the second step. The difficulty caused the students both to define the rule of the pattern and to draw the finite step drawing in a wrong way.

In given questions, the students who didn't notice the features that differ fractal patterns from other patterns had difficulty in applying the rule to the following steps of fractal patterns.

CONCLUSION AND RECOMMENDATION

The students' answers in activities which aim to find out the rule of the patterns have shown that they don't have enough knowledge related to self similarity and iteration features of fractals. It is suggested to emphasize self similarity and iteration features during classroom activities. Furthermore, it is thought to be necessary to include significant concepts such as the initiator and generator step of fractal patterns in those activities.

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