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Relieving of Misconceptions of Derivative Concept with Derive

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Abstract

The purpose of this study is to determine students' learning levels in derivative subjects and their misconceptions. In addition, this study aims to compared to the effects of the computer based instruction and traditional instruction in resolving these misconceptions. For this purpose, 12th grade 70 students were chosen from high schools in Ağrı city with simple random sampling method. With the pre-test results, the misconceptions were determined and these misconceptions were tried to be relieving in two groups of students with computer based instruction and traditional instruction, separately. The result of the study showed that both the computer based instruction by using Derive software and traditional instruction methods were effective in resolving misconceptions that students constructed. However, it was found that the computer based instruction was more effective than traditional in relieving them.

Key words: Derivative; Derivative misconceptions; Computer Algebra System; Computer based instruction

Introduction

In today's world, computer technology developed sharply and it provided the development of instructional technologies, too. Therefore, there is an increasing change and development process in different areas (Yildiz, 2012). This technology influenced individual's thinking power and powered the systematic knowledge. Therefore, it brought a period of mental production [MEB, 2005]. As it influenced many disciplines, instructional technologies also influenced the mathematics. It provides students with better understanding of mathematical concepts by means of computers' dynamic representations in innovative mathematics education (Bottino & Kynigos, 2009). It helps students to learn the interaction concepts between students and computer (Balacheff, 1993).

Computers in education environments are classified into three groups as computer controlled instruction, computer based instruction and computer assisted instruction (Köse, 2009; Uşun, 2004; Yıldırım Kayabaş, 2007). In this study, computer assisted instruction will be taken into account and the data will be evaluated accordingly. In general, computer assisted instruction can be defined as using computer in learning environment (Baki, 2001; Tatlı, 2009).

Some of the productions in instructional technologies are CAS (Computer Algebra System) and DGS (Dynamic Geometry Software). These technologies are used in mathematics instructions frequently (Ersoy & Baki, 2004). High level computer software which performs numeric and symbolic operations, and draws graphics is called as computer algebra system. Some of the computer assisted software such as Derive, Sac, Theorist, Converge, Macsyma, Reduce, Magma, Maple, Axiom, Mathematica and similar ones are examples of computer algebra systems ([MEB,2005]; Ersoy, 2003; Ersoy & Baki, 2004; Zotos, 2008).

According to Ersoy and Baki (2004), Derive, one of the CAS software, is easy to use and it has a feature to use advanced calculator. The studies about CAS begins in 1970s and although they developed separately, studies about CAS is combined with the same research area of artificial intelligence (Zotos, 2008).In this study, derive, one of the instructional technology software: CAS, is used appropriate to programming approach.

Misconception

Misconception can be defined as the perception (conception) that is far from the consensus of the experts' perceptions for a specific subject (Zembat, 2010). İşleyen, Tatar, Akgün, Soylu, and Işık (2010) asserted that misconceptions are not simple mistakes and students have a tendency to insist on repeating the same mistakes

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(Zembat, 2010). Mistake can be considered as errors in learning while misconceptions can be considered as factors that blocks the learning (Keçeli, 2007; Ubuz, 1999). Misconceptions appears while students do not learn the concepts comprehensively or while they make incorrect reasoning if they learn the concept incorrectly (Umay & Kaf, 2005).

According to İsmail (1993), incorrect construction of the knowledge results in problem which is called misconception in the further times. In addition, the hardness of some subjects may also causes misconceptions for students. Moreover, Baki and Güveli (2008) states that there are few number of subjects that do not cause misconception in our mathematics curriculum. Students need to gather old one to new knowledge for constructing their intellect. That's why it is important that investigate old knowledge which existing and relieving of misconceptions (Güneş, Dilek, Demir, Hoplan & Çelikoğlu, 2010).

Having recommend these three sequence for relieving of misconception: first of three investigate the gap of knowledge and have got misconceptions of students. Secondly enhanced materials and learning method according to attainment for relieving the gap and misconceptions. Lastly try to relieving misconceptions and gap knowledge by means of developed materials and learning method (Büyükkasap, Düzgün, Ertuğrul & Samancı, 1998; Kaplan, Altaylı & Öztürk, 2014).

Derivative

There are many different definitions for derivative. Based on the limit, derivative is limit of the ratio to increase in the independent variable of the increase in the function while change of independent variable approaches to zero (Balcı, 2012). From the geometric meaning of the derivative, the derivative of the function is equal to the tangent of the angle between the indicated point of the function and x-axes that is the slope of the tangent (Karadeniz, 2003). Hugges-Hallet et al. (1996) defined the derivative using relationship between average speed and average change rate. They used the first movement and average change ratio concepts. The derivative is defined as the slope of tangent line at a point on the curve (as cited in Berry & Nyman, 2003).

The derivative subject is a basic subject for many areas. Some of the areas are in solving various numeric questions in numeric analysis in mathematics (İbrahimoğlu & Bayram, 2008), velocity, acceleration and experimental time series in physics, population increase in biology ([MEB, 2005]; Yılmaz & Güler, 2006), marginal concepts in economy (Balcı, 2012), and many other science branches (Gür & Barak, 2007).

When examine of literature show that there are several studies investigate of misconceptions toward derivative subject (Aksoy, 2007; Amit & Vinner, 1990; Bezuidenhout, 1998; Bingölbali, 2010; Gür & Barak, 2007; Ferrini-Mundy & Graham, 1991; Hähkiöniemi, 2005; Orton, 1980; 1983; Özkan & Ünal, 2009; Ubuz, 2001; 2007). Seen these studies that students have got misconceptions such as given derivative function of derivative in a point, considered as if derivative function of tangent equations, given tangent equations of derivative in a point. Some of cause of this misconception is incomprehension geometric interpretations of derivative, not understanding relation between limit and derivative etc. based on derivative definition (Ubuz, 2001; 2007).

According to Zembat (2010), for a specific subject, trying to relieving misconceptions is as important as determining misconceptions for teachers. Therefore, teachers should have high level of pedagogical content knowledge and they should relieving the obstacles that may blocks students' conceptions (Özmantar & Bingölbali, 2009). Concepts and knowledge sometimes become easy and concrete. However, they sometimes become hard to understand and abstract. There is a need for some models for students to learn abstract mathematical concepts to concretize them. For these purpose, the learning environment should be enriched with concrete materials ([MEB,2005]; Bottino & Kynigos, 2009; Ersoy & Baki, 2004; Kaplan, 2005). Different methods and materials can be used to relieving misconceptions that students constructed. One of these materials is computers and computer software which are appropriate to today's technology.

The Significance of This Study

The Project of Fatih maybe the largest of altered for have carrying more forward Turkish Educational System in recent years. Succeed of this project will be possible encourage of teachers via made study in this field. In this connection made each study regard with utilize of computers in educational system is important, because they will provide contribute to development of education. This study is seen one of the studies supported The Project of Fatih.

Reason of selected of software of Derive is attracted interested of students that have got specifications easy accessible, drawing graphs, solving equivalent, taking derivative and the integral. Moreover use of this software is not difficult. This study in conducted with the expectations of being a guide for secondary school mathematics teachers in derivative subject, of encouraging to increase the number of software in related areas in education, and of introducing different software in universities.

In this study, the effectiveness of computer assisted instruction method is investigated. The study will determine the effectiveness of computer assisted instruction in resolving misconceptions. This study investigated what kind of misconceptions students have in derivative subject and whether "Derive", one of the CAS software, is effective in resolving misconceptions in derivative concept and if it is effective, whether there is a significant difference between it and traditional instruction method.

Method

This study was conducted to nonequivalent groups posttest-only design by using quasi-experiment design. The groups were subjected to pre-test and post-test. In this design, random assignment cannot be applied. The groups were tried to be matched according to some criteria prepared before and based on specific variables. The matched groups are randomly assigned as experimental and control group. Definitely, it is impossible to consider the groups as equal. The quasi-experiment method can be designed as applying or not applying pre-test (Büyüköztürk, Kılıç - Çakmak, Akgün, Karadeniz, & Demirel, 2010; Çepni, 2010; Fraenkel, Wallen & Hyun, 2012; McMillan & Schumacher, 2014). In this study, two mathematics classrooms were chosen for applications. Both classes' teachers were the same. First of all, pre-test was applied to both groups. Then, one of them was randomly selected as experiment group while the other was as control group. The subject was presented to experiment group by using Derive, one of the CAS software. In the control group, the subject was presented with traditional direct lecturing method.

Sampling

For choosing the sample of this study, simple random sampling method, one of the random sampling methods, is used. With this method, high schools are listed and two schools were chosen randomly. In addition, one of these schools was chosen randomly for pilot study and the other was chosen for administering the final form of the research tool. For the last application, 12th grade two classes of the school were assigned as experiment and control groups. The sample of this study was 12th grade 70 students in two different high schools in Ağrı city.

Table 1. The Distribution of the Students in the Study

Test Administration	Number of the Student
Pilot Study	32
Final Administration	38
Total	70

Data Collection Tool

To collect data, a question pool is prepared. It includes questions used in the previous literature (Çelik, 2000; Gür & Barak, 2007), some questions asked in the university entrance exam, the activities in the secondary school mathematics curriculum prepared by National Ministry of Education and some questions prepared by different teachers. Among those questions, 12 open ended questions were selected based on four attainments which are appropriate to mathematics course for 12th grade secondary school mathematics curriculum. These questions were selected by two teachers. According to the results of the pilot study, some questions were revised by choosing different questions in the question pool. In this process, the attainments were not changed. Then, the final version of data collection tool was prepared for pre-test and post-test. For validity concerns, the tool was subjected to four expert in this area and five teachers. Lawshe content validity coefficient with view of expert is measurement 0.77. This level is sufficient for content validity (Lawshe, 1975). The pilot study was conducted to satisfy the reliability of the study and the reliability coefficient (Cronbach Alpha) of the test was found to be 0.85. Then, there was no need to change any questions to increase the reliability of the test. This reliability level is considered to be highly reliable according to (Kayış, 2009; Field, 2009). This data collection tool was administered in the application school as pre-test (to determine the misconceptions) and as post-test.
In this study, attainments related to derivative subject and numbers of questions for each attainment were presented in the table below for satisfying the validity of the test.

Table 2. Table of specifications for attainment

Attainment No	Attainments	Number of
1.	Finds the derivative of a function at a specific point by using the definition of the derivative.	2
2.	Determine the domain of the derivative of a function.	1
3.	Explains the derivative concept with the help of geometric applications.	2
4.	Explains the relation between distance of an object which moves through a line in t-time and its velocity and acceleration at t with examples.	3
5.	Explains the derivative concept with the help of physical applications.	2
6.	Writes the tangent and normal equations of a graph of a function at a point	2

Experiment Process and Data Collection

At the beginning of the study, the students' misconceptions were tried to be determined. Then, the pre-test was administered to both experiment and control group. After determining students' misconceptions in derivative subject, misconceptions were tried to be relieved by using traditional method (by means of paper-pencil) in control group. For the experiment group, on the other hand, computer assisted instruction method is administered by means of Derive, one of the CAS software, as an instruction tool. In this study is used to learn through program (Baki, 2002). In teaching process, the students had opportunity to work on the same program as an individual. First of all, the subject was presented without using computer and examples were given. Then, each of students the same examples were solved with the computer software again and controlled their correct in own computer. Program called monitor and students see reel of program, and then they uncover logic, algorithm and formula there. At the end of the research were applied as post-tests measure.

The Analysis of the Data

Descriptive statistics is used in analyses of collected data in this study. Descriptive statistics utilize summarized of results. If study that univariate use statistical technics such as frequency, percentile and mean, analysis of data is more clear and understandable (McMillan & Schumacher, 2014).

Students' answer to questions for each attainment in pre-test and post-test were evaluated and four categories were constructed accordingly. These are "understanding", "incorrect understanding", "not understanding" and "non-response" (Çepni, Bayraktar, Yeşilyurt, & Coştu, 2001). In the results of this study, types of misconceptions that students have were tried to be determined with this categorization. Then, whether they coincide with the misconceptions mentioned in the literate was investigated. The results of the pre-test and post-test were compared with MS Excel and whether the instruction method used to resolve the determined misconceptions was effective was evaluated. With two groups' post-test results, superiorities of "Derive", one of the CAS software, and traditional instruction methods were compared. In the data analysis, the findings are given in the table according to the attainment numbers. There are six attainment for this study.

The Limitations of This Study

The purpose of this study is relieving of misconceptions which derivative subject of junior high school students. Some students that achievement highly level is not participant this study, because students prepare the License Placement Exam while carry out the study. This state is limitations for this study. In addition to sampling numbers is quite a few and some schools unable to fit subject of derivate on plan, thus they couldn't participant in this study. This is secondly limitations. Data that derived in this study is applied only descriptive statistic and it is block generally of the study. This related with statistical result validity.

Results

The table below presents the pre-test results of the experiment and control group according to the attainments and related questions.

Table 3. Pre-test results of the experiment and control group

Attainment No	Questions	Understanding				Incorrect Understanding (Misconceptions)				Not Understanding				Non- Response			
		f		%		f		%		f		%		f		%	
		E*	C*	E*	C*	E*	C*	E*	C*	E*	C*	E*	C*	E*	C*	E*	C*
1	1	4	1	21	5	14	15	74	79	0	0	0	0	1	3	5	16
	2	13	11	68	58	2	3	11	16	1	3	5	16	3	2	16	11
2	1	4	1	21	5	11	10	58	53	3	2	16	11	1	6	5	32
3	1	3	4	16	21	5	5	26	26	5	5	26	26	6	5	32	26
	2	2	4	11	21	2	7	11	37	4	6	21	32	11	2	58	11
4	1	11	9	58	47	4	4	21	21	1	2	5	11	3	4	16	21
	2	8	9	42	47	2	5	11	26	4	1	21	5	5	4	26	21
	3	7	9	37	47	1	3	5	16	6	2	32	11	5	5	26	26
5	1	16	8	84	42	0	5	0	26	2	4	11	21	1	2	5	11
	2	1	1	5	5	2	2	11	11	2	5	11	26	14	11	74	58
6	1	6	7	32	37	3	5	16	26	8	3	42	16	2	4	11	21
	2	1	7	5	37	6	3	32	16	6	3	32	16	6	6	32	32

E*: Experiment Group (n=19)
C*: Control Group (n=19)

For the first attainment related to definition of the derivative, there were two questions. Students in both experiment and control group were expected to find the derivative of the function by using definition of the derivative. Students solved the questions by using practical derivative rule; however, they experienced difficulty when they try to solve it by using the definition of the derivative. In the first question, students were expected to write the definition of the derivative by themselves. Majority of the students solved this question by using the practical derivative rule but not the definition of it. In the second question, on the other hand, the definition of the derivative was presented and they were expected to explore that the definition of the derivative is actually the derivative of the function. Majority of the students correctly solved this question. However, 11 % of experiment group students and 16 % of control group students fell into misconceptions. Students' misconception was rooted from doing operations by memorization. In addition, they did not know the definition of the derivative. These findings were also determined in the Gür and Barak's (2007) study.

In the second attainment, there is a question which seems like an easy one. The derivative of the function in the question can easily be taken if the domain of the function is not considered. However, if the domain is taken into account, the derivative of the function does not exist. Since majority of the students does not take the domain of the function into account, they made misconceptions. 58 % of experiment group students and 53 % of control group students made misconceptions in this question.

Third attainment is related to geometric meaning of the derivative. First question about this concept requires to solve it by equalizing the derivative of the function with the slope of the tangent at that point. Students who have misconception tried to solve this question by equalizing the derivative of the function with the equation of line that the function is tangent. In the second question, especially experiment group students could not solve the question correctly. Students who have misconceptions tried to use minimum point in order to find the distance of the parabola to line. The fourth attainment is composed of three questions that necessitates from students to find slope by using the first derivative of the function. In these questions, students experienced misconceptions because they thought the derivative of the function as the slope of the tangent.

There were two questions for fifth attainment that are related to physical interpretation of the derivative. First question is related to finding the instant velocity of a moving object. 84 % of students in experiment group correctly solved this question. In addition, there was no student who has misconception in this question. Students who have misconception in control group generally did not know general meaning instant velocity as derivative and they tried to find the instant velocity by substituting the value of the given second in the function. 74 % of experiment group students and 58 % of control group students could not answer the second question.

The source of the misconception in this question is that students tried to use Pythagoras theorem and special triangle equations in order to find the shortest period of time instead of simply finding the derivative.

The sixth attainment is related to the slope of the tangent and normal. The first question is asked for the slope of the tangent, while the second question is related to the slope of the normal. In the first question, some of the students made misconception because they incorrectly know the practical derivative rules while some others thought the first derivative as the slope of the tangent. In the second question, on the other hand, students could not differentiate the difference between the slopes of tangent and the normal. Some other students also had misconceptions because they learnt the practical derivative rules incorrectly (Gür & Barak, 2007).

Table 4. Pre-test and post- test results of control group students

Attainment No	Understanding		Incorrect Understanding (Misconception)		Not Understanding		Non - Response	
	%		%		%		%	
	Pre-test	Post-test	Pre-test	Post-Test	Pre-Test	Post-Test	Pre-Test	Post-Test
1	32	71	47	18	8	0	13	11
2	5	63	53	26	11	0	32	11
3	21	55	32	16	29	8	18	21
4	47	74	21	11	9	2	23	14
5	24	50	18	13	24	3	34	34
6	37	61	21	16	16	3	26	21

According to the pre-test and post-test results, there was a decrease among the students who received traditional instruction method for all attainments in the number of students who had misconceptions. In addition, there was an increase in the "understanding" category for all attainments.

Pre-test and post-test results for the first attainment revealed that there is 39% increase in "understanding" level and there is 29 % decrease for students' misconceptions. Moreover, decrease in "not understanding" and "non-response" categories was observed for the first attainment. Decrease for all categories except "understanding" category was observed in the second attainment's questions. 58 % increase occurred in "understanding" category. For the questions of third attainment, there was a 3 % increase in "non-response" category. The levels of "misconception" and "not understanding" decreased, but there is 24 % increase in "understanding" category. In the fourth attainment, students' misconceptions decreased with 10 % and their "understanding" level increased with 27 %. Moreover, there is a decrease observed in the "not understanding" and "non-response" categories. The increase level in "understanding" category of the fifth attainment was 26 %. The percentage of "non-response" did not change, but there were decreases in "misconception" and "not understanding" categories. The decrease was observed in "misconception", "not understanding" and "non-response" categories in the sixth attainment. On the other hand, there was a 24 % increase in "understanding" category.

Table 5. Pre-test and post-test results in experiment group

Attainment No	Understanding		Incorrect Understanding (Misconception)		Not Understanding		Non - Response	
	%		%		%		%	
	Pre-test	Post-test	Pre-test	Post-Test	Pre-Test	Post-Test	Pre-Test	Post-Test
1	45	79	42	21	3	0	11	0
2	21	84	58	11	16	5	5	0
3	13	55	18	13	24	18	45	13
4	46	84	12	5	19	7	23	4
5	45	63	5	0	11	8	39	29
6	18	87	24	3	37	3	21	5

According to the pre-test and post-test results, there was a decrease among the students who received computer assisted method for all attainments in the number of students who had misconceptions. In addition, there was an increase in the "understanding" category for all attainments. In addition, it is important to state that any

misconception was not determined in two questions of the post-test related to physical interpretation of derivative for the fifth attainment.

There is a 24 % increase in "understanding" category while there is a 21 % decrease in "misconception" category for the first attainment. For this attainment, the post-test results revealed that there is no "not understanding" and "non-response" categories observed from students' responses. In the second attainment, "understanding" category increased by 63 %. In addition, the students' misconceptions' decreased by 47 %. Moreover, there was no student in "non-response" category for this attainment. While 45 % of student could not correctly solve the question for the third attainment in the pre-test, it is important to mention that students in "incorrect understanding" decreased to 13 % and those in "understanding" category increased to 42 % in the post-test results. There was decrease in "misconception", "not understanding" and "not understanding" categories for the fourth attainment, there was 38 % increase in "understanding" category. In the fifth attainment, there was no student in "misconception" category observed. While there was decrease in "not understanding" and "non-response" categories, "understanding" category had an increase of 18 %. There was 69 % increase in "understanding" category for the sixth attainment. In addition, there was decrease in "misconception or incorrect understanding", "not understanding" and "non-response" categories.

Table 6. Post-test results for experiment and control group

Attainment No	Question	Understanding				Incorrect Understanding (Misconception)				Not Understanding				Non - Response			
		f		%		f		%		f		%		f		%	
		E*	C*	E*	C*	E*	C	E*	C*	E*	C*	E*	C*	E*	C	E	C
1	1	12	11	63	58	7	7	37	37	0	0	0	0	0	1	0	5
	2	18	16	95	84	1	0	5	0	0	0	0	0	0	3	0	16
2	1	16	12	84	63	2	5	11	26	1	0	5	0	0	2	0	11
3	1	12	12	63	63	1	2	5	11	3	2	16	11	3	3	16	16
	2	9	9	47	47	4	4	21	21	4	1	21	5	2	5	11	26
4	1	16	14	84	74	3	3	16	16	0	0	0	0	0	2	0	11
	2	16	15	84	79	0	1	0	5	2	0	11	0	1	3	5	16
	3	16	13	84	68	0	2	0	11	2	1	11	5	1	3	5	16
5	1	18	14	95	74	0	1	0	5	0	0	0	0	1	4	5	21
	2	6	5	32	26	0	4	0	21	3	1	16	5	10	9	53	47
6	1	17	13	89	68	1	2	5	11	0	1	0	5	1	3	5	16
	2	16	10	84	53	1	4	5	21	1	0	5	0	1	5	5	26

When comparing the post-test results, the "understanding" level of experiment group is higher than that of control group for all attainments except the third attainment. In general, there was a decrease in percentages of "misconception" category.

When investigating the questions in the first attainment, number of students in experiment group who correctly solved both first and second questions is higher than number of students in control group. For the questions in this attainment, there was no student who did not give any response in experiment group. On the other hand, there was a few numbers of students in control group. Instead of using the definition of the derivative, students who had misconception in the first question tried to solve it by using the practical derivative rules as observed in the pre-test. In the second question, on the other hand, only one student in experiment group had misconceptions. The source of this misconception is that student did not know the definition of the derivative correctly. No student was observed in the control group who had misconception. On the other hand, there were three students who did not give any answer. In the second attainment question, some of the students resolved the misconception of not considering the domain of the function while taking its derivative. However, some other resisted on doing the same misconception.

In the question for the third attainment related to geometric interpretation of the derivative, the percentages of students in control and experiment groups were equal in "understanding" category. While 58 % of students in experiment group could not answer the second question in the pre-test, the percentage decreased to 11 % in the post-test. In the second question, the levels of misconception for both group were equal, while control group's

percentage in "not understanding" category is lower than experiment group's. In the first question, on the other hand, 11 % of control group students and 5 % of experiment group had misconception. For both groups, the "understanding" level was 63 %. In the three questions for the fourth attainment, the number of students in experiment group was higher than that of students in control group. There was no student in experiment group who had misconception in the second and third questions. On the other hand, the numbers of students who had misconception in both control and experiment groups were equal.

In the two questions for the fifth attainment related to physical interpretation of derivative, number of student in the experiment group in "understanding" level is higher than that of control group. There was no student who had misconception in experiment group for both of these questions, while 5 % of students had misconception in the first question and 21 % of them had misconception in the control group. However, 53 % of experiment group students did not give any response to second question, while 47 % of control group students did not solve the question. For two of the question asked for the sixth attainment, the percentage of experiment group students is higher than that of control group students in "understanding" category. On the other hand, the percentage of control group students in "misconception" category is higher than the other.

Discussion and Conclusion

In this study, the purpose was to determine the misconception in derivative concept and to resolve it with Derive software. The results are indicated below:

1. Students have misconceptions that they were unable to use the operations with the definition of the derivative (Gür & Barak, 2007; Hähkiöniemi, 2005; Orton, 1980),
2. Students have misconceptions that they did not consider the intervals while finding the derivative of the functions (Orton, 1980),
3. Students experienced difficulty in doing the geometric interpretation of derivative and they had misconception by thinking the distance (Ferrini-Mundy & Graham, 1991; Ubuz, 2001),
4. The misconception rooted from thinking the derivative of the function as the derivative at a specific point (Amit & Vinner, 1990; Orton, 1980; Özkan & Ünal, 2009; Ubuz, 2007),
5. They have misconception rooted from not knowing the general derivative rules (Gür & Barak, 2007),
6. They have misconceptions rooted from not knowing the physical interpretation of the derivative (Bezuidenhout, 1998; Bingölbali, 2010),
7. They cannot construct a relation between the slopes of the tangent and the normal (Bingölbali, 2010; Ferrini-Mundy & Graham, 1991; Gür & Barak, 2007; Orton, 1983; Ubuz, 2001).

The subjects were presented to students with the Derive software in order to resolve students' misconceptions. Therefore, they received computer assisted instruction. Traditional instruction method was administered to the control group. After the comparison of both groups, both methods were found to be effective in resolving students' misconceptions. However, the computer assisted instruction method was more effective than the other. Especially for the questions related to visualization, the physical and geometric interpretations of the derivative, as it is expected, students who received instruction with Derive software were more successful to resolve the misconceptions. This is because software increased students' interpretation power (Bingölbali, 2010). In addition, students who cannot give any answer to questions in the pre-test passed to the other categories and at least they tried to solve the questions. Considering that students have misconceptions due to incorrect reasoning about the question (Kaplan & Ozturk, 2012), students' learning level was observed to increase.

It was observed that students experienced difficulty especially in physical and geometric interpretations of the derivative. Some of the reasons for students' difficulties are that 12th grade mathematics curriculum is very dense, that instead of studying the geometric interpretations of the derivative, students generally give attention to the derivative's practical rules, that students experience in visualization of the derivative due to insufficiencies in classroom environment, and that even some schools have computer facilities, the necessary software and experienced staffs do not exist in schools.

Recommendations

Some mathematical concepts are hard to learn and they require to be concretized. To teach such hard concepts, technology should be used. Therefore, students should construct or explore their own knowledge by means of

such technology. So, the learning can be permanent. In education environment, classrooms should be satisfied with computers and visualization tools such as CAS and DGS software, so students should benefit from them.
The researchers in this area can develop teaching environment that does not allow to the construction of misconceptions in students' mind especially in the hard subjects to learn such as derivative and integration. To resolve the misconceptions in students' mind, some instruction strategies should be used such as active learning strategies, cooperative learning, project based instruction, analogy, concept maps, concept cartoons, conceptual change texts which are the examples of effective instruction methods and approaches. In addition, difficult subjects should be investigated to find students' misconceptions with the clinical qualitative researches, and the findings should be investigated in detail to find the reasons for students' misconceptions observed.

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