

## The Effect of the Differentiated Teaching Approach in the Algebraic Learning Field on Students' Academic Achievements

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### Abstract

*Problem Statement:* Algebra, which is one of the basic principles of mathematical learning, still maintains its importance in mathematics programmes. However, especially starting from the primary school years, algebra represents a complex mathematical factor in the operational stage for many students. In this scope, a differentiated teaching approach that accounts for personal differences within a class, considers different students' different skills and learning needs, and draws on students' strengths gains importance.

*Purpose of the Study:* This study was done with the aim of determining the effect of a differentiated teaching approach in sixth grade mathematics lessons in the algebraic learning field on students' academic successes.

*Method:* This study was designed according to equal status, sequenced, mixed methods research. The sixth grade students of a lower socioeconomic level were chosen from a state secondary school in Saricam County in Adana. Fifty-seven randomly chosen students who were close to each other in terms of gender distribution and first term final grade formed the study group for the research. The research used the data collection tools "Algebraic Success Test" and "Semi-Structured Interview Form Regarding the Differentiated Teaching Approach," which were developed by the researcher. The quantitative data that were obtained were tested by covariance analysis, and the qualitative data were analyzed by content analysis.

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*Findings and Results:* At the end of study, it was revealed that the differentiated teaching approach in a sixth grade algebra lesson increases student success, and during this period, students showed positive cognitive and affective developments.

*Conclusion and Recommendations:* In sum, based on the results, it evident that a differentiated teaching approach applied to sixth grade algebra lessons increases students' academic success, and during this period, such an approach provides positive cognitive and affective developments. Since this study is limited in terms of student dimensions, more studies should be conducted on different subjects and at class levels in which teachers' opinions about application stages can also be investigated. Additionally, this study examined multiple teaching methods of differentiated teaching. In future research, experimental studies regarding the application or comparison of different techniques can be pursued.

*Keywords:* Algebra, primary school mathematics, differentiated teaching, mathematics achievement

## Introduction

Algebra, which is one of the basic principles of mathematical learning, still maintains its importance in mathematics programmes. Primary school algebra, which involves arithmetical skills and numerical patterns, carries great importance for the development of students' algebraic thinking periods. Algebraic thinking periods refers to periods of recognizing and analyzing mathematical structures, understanding and identifying mathematical relations, making generalizations, and analyzing changes (Steele & Johanning, 2004). However, especially starting from the primary school years, algebra represents a complex mathematical factor in the operational stage for many students. (Van De Walle, Karp & Bay-Williams, 2013). When the subject is considered from this viewpoint, the methods and strategies used in teaching periods and class activities have great importance for making subjects more understandable and tangible for students (Ericson, 2010). In this context, a differentiated teaching approach that accounts personal differences within a class, considers different students' different skills and learning needs, and draws on students' strengths gains importance (Gregory & Chapman, 2002; Heacox, 2002; Soldengeld & Schultz, 2008; Tomlinson, 1999, 2000, 2001). The differentiated teaching approach, which was first described by Tomlinson (1999), involves paradigms such as the theories of social constructivism, multiple intelligence, thinking styles, Maslow's hierarchy of needs, and brain-based learning that consider learners the focal point (Bosier, 2007; Stager, 2007; Subban, 2006). In a similar direction, the differentiated teaching approach can also be defined as a learning experience in which various approaches are used to introduce students to the content of programme, and activities and periods are designed so students can learn meaningfully, access their knowledge and opinions, and choose to display what they have learnt (Levy, 2008). According to Good (2006), differentiated teaching is an educational approach that will compensate for students' personal requirements by

increasing both their learning and motivations. Levy (2008) defines differentiated teaching as a series of strategies that help each student from the moment their teacher enters the class.

In the scope of mathematics teaching, the differentiated teaching approach has great importance in that it can multiple learning environments at various levels (Abbati, 2012). In this context, differentiated teaching can extrapolate different students' different skills, interests, or learning styles with many strategies such as station, centers, agendas, complex teaching, trajectory studies, entry points, learning agreements, and multiple teaching methods that can be applied within class periods (Adams and Pierce, 2004; Chamberlin & Powers, 2010; Tomlinson, 1999, 2000). Multiple teaching strategies are used to provide students at all levels a better understanding of the subject, to increase their success and motivation, and to make them responsible for their own learning. As differentiated teaching reaches specific targets, it is also a strategy that offers various approaches based on the instructor's teaching profile, skills, interests, and pre-knowledge as well as the students' learning styles (Adams & Pierce 2004; Levy, 2008; Richard, Omdal, 2007; Tomlinson, 2000). This strategy is generally used to address different readiness levels. With such a design, students with low, medium, and high pre-knowledge are able to learn the same subjects at suitable difficulty levels (Adams & Pierce 2004; Levy, 2008). According to Richard and Omdal (2007), differentiated teaching contributes to students' cognitive learning by basing learning on students' pre-knowledge with the use of flexible group methods. In addition, differentiated teaching also makes parents happy when they observe their children's success and motivation (Sondergeld & Schultz, 2008; Suarez, 2007). Differentiated teaching is especially important for children who lack sufficient knowledge and skills in any subject significant to their academic advancement (Richard & Omdal, 2007).

In the literature, the studies that have examined the effect of the differentiated teaching approach on students' mathematical success generally focus on numbers and geometry (Ahrstensen, 2012; Ericson, 2010; Faulkner, 2013; Kok, 2012; Stager, 2007; Saldirdak, 2012; Yabas and Altun, 2009; William, 2012). However, only a limited number of studies that address algebra (Millikan, 2012) have attracted attention. On this topic, Christensen's study (2007) that was conducted with primary school students reached a conclusion that when the subject "numbers" adopted a differentiated teaching approach, it increased students' success and motivation in mathematics. Similarly, Saldirak's (2012) study conducted with fifth grade students concluded that differentiated teaching applications positively affect students' mathematical success. Stager's (2007) study conducted with third grade primary school students examined the effect of the differentiated teaching approach on students' success with the subject of rational numbers. This experimental study conducted with multiple teaching methods concluded that differentiated teaching approaches positively affect students' success. A study by Yabas and Altun (2009) aimed to determine the effect of differentiated teaching in the subject of decimal numbers on students' mathematical success, metacognition skills, and self-efficacy perceptions. Sixth grade students formed the sampling for this research. According

study's results, which were regulated according to pretest-last test design, they concluded that there is a significant difference in points on an academic success test; a knowledge, comprehension, and application test; and a metacognition skills and self-efficacy perception test in favor of the last test. Similarly, a study by Luster (2008) examined the mathematical success of fourth grade students who were taught with both traditional and differentiated teaching approaches. At the end of this research, it was revealed that the experimental group that was taught with a differentiated teaching approach was more successful than the control group that was taught with traditional methods. A study by Kok (2012) also examined the effect of differentiated geometry teaching on fifth grade students' creativity, spatial skills, and success. In the study, the students in the experiment group were taught by differentiated teaching on the subjects of "polygons" and "geometrical objects," and the students in the control group were taught by the existing teaching methods. The study concluded that there is a significant difference in success on the last academic test between the experiment and control groups in favor of experiment group. Similarly, a study by Millikan (2012) addressed the effect of applied differentiated teaching approaches in high school algebra lessons on student success. At the end of the study, it was revealed that activities that are designed based on a differentiated teaching approach affect academic success in algebra in positive way.

Based on the data above, it is clear that research conducted on differentiated teaching approaches generally focus on numbers and geometry but there are only limited numbers of studies (Millikan, 2012) on algebra. From this starting point, this study aimed to contribute to the literature by addressing the effects of differentiated teaching approaches in algebra lessons on academic success. Toward this general aim, the sub aims below were examined.

1) Is there a significant difference between the last test points on the algebra success test of an experiment group that was taught with differentiated teaching approaches and a control group that was taught with present teaching approaches when the analysis controls for pretest points?

2) Is there a significant difference between the test points on the persistency algebra success test of an experiment group that was taught with differentiated teaching approaches and a control group that was taught with present teaching approaches when the analysis controls for pretest points?

3) What are the opinions of the students in the experiment group that was taught with differentiated teaching approaches about this teaching approach?

## **Method**

### *Research Design*

This study was designed according to an equal status, sequenced, mixed methods research type in which qualitative and quantitative methods are used together in order to determine the effect of a differentiated teaching approach in a primary

school sixth grade mathematics lesson on students' academic achievements (Creswell, 2003). The quantitative data from the research were designed according to the semi-experimental pretest-last test, control grouped model. In the second stage, the data regarding the research's qualitative dimension were provided by taking the students' opinions about the period through semi-structured interviews with the students in experiment group.

#### Research Sample

Sixth grade students during the 2013-2014 academic year from a state secondary school of lower socioeconomic status, located in Saricam County in Adana, formed research population. Students who were similar in terms of final grade and gender distribution were randomly chosen for the study groups and formed class 6B (experiment) and class 6C (control). The data about the sampling are provided in Table 1.

**Table 1.**  
*Personal Information Belongs to Sampling*

Variables	Experiment		Control		
	f	%	f	%	
Gender	Girl	21	63.6	13	54.2
	Boy	12	36.4	11	45.8
	Total	33	100	24	100
The first term grades	2	1	3	3	12.5
	3	18	54.5	9	37.5
	4	8	24.2	7	29.2
	5	6	18.2	5	20.8
	Total	33	100	24	100

When Table 1 is examined, it reveals that 64% of students were girls and 36% were boys for a total of 33 students in the experiment group. In the control group, 54% were girls and 47% were boys for a total of 24 students. In terms of gender, no significant difference was determined between the experiment and control groups, which was examined by chi square analysis ( $\chi^2 = .394$  sd=1  $p > .05$ ). The first term grades of the students in the experiment and control groups were taken from school management. No significant difference was determined between the experiment and control groups in this dimension, either, which was examined again by chi square analysis ( $\chi^2 = 2.806$  sd=3  $p > .05$ ). The study therefore concluded that in terms of academic success, the students in both groups were mathematically close to each other.

Additionally, in order to interview students from the experiment group according to the criterion, a sampling method from purposeful sampling techniques was used. According to this method, the sampling was thought out and obtained beforehand with a specific aim or regarding a focused subject (Punch, 2005). In

addition, this study conducted semi-structured interviews with twelve volunteer students who did not have any education about algebra and had mathematical success levels of 2, 3, 4 and 5.

#### *Research Instrument and Procedure*

The research used the data collection tools of the "Algebraic Success Test" and the "Semi-Structured Interview Form Regarding the Differentiated Teaching Approach," which were developed by researcher. These data collection tools are explained below in detail.

#### *Validity and Reliability*

*Algebraic success test.* In the preparation stage of the algebraic success test, 30 questions were devised by considering gains in understanding algebraic concepts. These questions were subsequently presented to two expert instructors in mathematical teaching and five mathematic teachers simultaneously continuing their post-graduate education and serving at secondary schools of the National Education Ministry. Subsequently, seven questions from algebraic test were removed after reaching an agreement that they were measuring the same gains as other questions. The draft form that consisted of 23 questions total was conducted with a total of 198 seventh grade students. At the end of the application, item and test analysis of the form were conducted to obtain the item difficulty index ( $p_j$ ), standard deviation ( $s_j$ ), and discrimination index ( $r_{jx}$ ), and for 27% segments of sub and super groups, an independent groups t-test was used. As a result of the application, two questions (the fourth and 22nd) with an item discrimination index under .20 were removed. Accordingly, the analysis results for the remaining 21 items are provided in Table 2.

**Table 2.**

*Item Difficulty Indexes (Pj), Standard Deviations (Sj), Discrimination Indexes (Rjx), T And P Values Of Test*

Item number	pj	sj	rjx	t	p
1	.92	.26	.34		-3.478 .001
2	.86	.33	.51		-6.075 .000
3	.69	.46	.52		-7.601 .000
4	.83	.37	.41		-4.264 .000
5	.75	.42	.44		-6.358 .000
6	.89	.30	.46		-4.742 .000
7	.60	.48	.55		-10.987 .000
8	.72	.44	.53		-7.776 .000
9	.75	.42	.60		-9.007 .000
10	.73	.44	.52		-8.902 .000
11	.50	.50	.48		-8.153 .000
12	.52	.50	.62		-17.833 .000
13	.82	.38	.51		-6.064 .000
14	.69	.46	.48		-7.776 .000
15	.65	.82	.42		-4.002 .000
16	.61	.48	.33		-5.063 .000
17	.81	.39	.43		-5.381 .000
18	.50	.50	.56		-12.471 .000
19	.50	.50	.48		-9.702 .000
20	.70	.45	.59		-10.014 .000
21	.77	.42	.63		-9.388 .000

Table 2 reveals that the item difficulty degree changes between .50 and .92 and the discrimination index is between .34 and .63. Test analysis was conducted for the final 21 questions, which revealed that the arithmetic average on the algebra success test is 14.89, the median is 15, the peak value is 14, and average test difficulty is .70. The KR-20 reliability value of the test was calculated as .84, and as this value is larger than .70, the test was deemed acceptably reliable.

*Semi-structured interview form regarding the usage of the differentiated teaching approach.* In order to obtain opinions of the students from the experiment group about the differentiated teaching approach in the algebra learning field, the researcher prepared a semi-structured interview form consisting of eight questions. Using this form, the students were asked to present their general opinions about the differentiated teaching approach, their opinions about how the lesson had been

taught in the classroom environment, their opinions about activities in this period, their opinions about applying this method to other subjects, and their opinions regarding their problems in this period. Thus, some of the questions on the form are as follows: *What do you think generally about differentiated teaching approaches applied in period of teaching algebra in mathematics lessons? What do you think about the activities in this teaching approach? Do you think this teaching approach can be applied to all subjects in mathematic lessons? Did you encounter any problems during the application of this teaching? If there are, can you give an example?* While preparing the interview form, the study sought opinions from a specialist instructor in qualitative research as well as another specialist in mathematic teaching about the suitability and understandability of the questions; the accordance between the opinions of these specialists was observed as .78 in the scope of Cohen's kappa coefficient. In the literature, a value between .61 and .80 shows important accordance between specialists (Landis & Koch, 1977).

#### *Experimental Process*

In the study, one differentiated teaching approach, the tiered teaching technique, was applied to the experiment group. First, the study sought to find terms in arithmetic in the algebra learning field that sixth grade students were encountering for the first time, giving meaning to algebraic expressions and performing addition and subtraction processes in algebraic expressions (MEB, 2013). After determining these topics, lesson plans and activities were prepared that drew on textbooks and source books. Lesson plans and activities were formed according to the students' learning styles and readiness levels. To determine the students' learning styles, a learning style inventory that was developed by Erden and Altun (2004) was used. Based on this inventory, eight students from the experiment group have a kinesthetic learning style, thirteen have an affective learning style, and twelve have a visual learning style. In order to obtain the students' readiness levels, fifteen students who answered between 0-10 questions correctly from a total of 21 questions were considered low readiness, and eighteen students who answered between 11-15 correctly were considered medium readiness; the lesson plan and activities were subsequently regulated as low and medium level. The researcher prepared lesson plans, activities, worksheets, and all materials that were suitable to the tiered teaching technique, and two mathematics teachers examined and confirmed these materials. To apply a differentiated teaching approach the steps below were followed:

1. The lessons for both the experiment and control groups were conducted by a mathematics teacher who is still a post-graduate student and who serves at the school in which the research was conducted. Before the beginning of the study, the teacher was informed about what the differentiated teaching technique is, its aim, how it is applied, the problems that might arise, and how such problems can be solved.
2. Before differentiated teaching was applied, all the participating students took a success test consisting of 21 questions. At the end of the test, two classes equal to each other in terms of gender distribution and academic success were determined



as the experiment (6B) and control (6C) groups. Additionally, the students in class 6B that was randomly chosen as the experiment group took a learning style inventory.

3. Application of the tiered teaching technique lasted for four weeks (16 lesson hours). During the application period, the researcher visited most of the experimental group's lessons and observed the suitability of the lesson plans, activities, worksheets, and games to the tiered teaching technique.

4. During the application period, the students in the experiment group participated in activities according to their learning styles or readiness levels. At the end of the lessons, short meetings were conducted to evaluate student work and to provide necessary feedback to students for the next lesson.

5. At the end of the application period, both the experiment and control groups took the same algebra success test that they had taken at the beginning of the programme, this time as the last test.

6. Four weeks after taking the last test, the students' persistency points were identified when they took the algebra success test again.

#### *Collection of Data*

The lessons were conducted in the experiment group by applying the tiered teaching technique. However, in the control group, the existing teaching approach continued. Before beginning application of differentiated teaching, both groups took the "Algebra Success Test" as a pretest. After taking the pretests, lessons in both groups were conducted by the same mathematics teacher for four weeks. As part of the experimental process, the algebra success test was then given to the experiment and control groups as the last test. After four weeks, the experiment and control groups took the same algebra success test as a persistency test. Finally, the opinions of students from the experiment group about the applied method were obtained through the semi-structured interview form, and their opinions were recorded during these interviews.

#### *Data Analysis*

The study first tested the points from the last and persistency tests by covariance analysis. Again, the data obtained from the students through semi-structured interviews were analyzed by content analysis. The data obtained at this stage were transferred to computer, and codes were derived according to the texts. At the last stage, the study determined common sides by associating codes, and themes were extracted. In presenting the findings, quotations from student opinions were given. In this contexts, the students' genders (M: male F: female) and numbers assigned to individual students (for example M1, F3) were coded by adding their identifiers to the end of quotations.

## Results

In this section, the findings are provided below for the sub-aims of the research. In accordance with the study's first sub-aim, after controlling for the algebra success pretest points of students in experiment and control groups, the corrected last test average points are given in Table 3.

**Table 3.**

*Average and Corrected Average Points on the Last Test of the Experiment and Control Groups*

Groups	N	Average	Corrected Average
Experiment	33	17.39	17.35
Control	24	13.39	13.38

Table 3 reveals that average number of points on the last test among students in the experiment group is 17.39, corrected to 17.35 when controlling for the pretest success points. The control group's average number of points on the last test is 13.39, corrected to 13.38 when controlling for the pretest success points. The results of the ANCOVA that was conducted to determine if the observed difference in corrected average points on the last test is significant are given in Table 4.

**Table 4.**

*Experiment and Control Group ANCOVA Results for Corrected Average Points on the Last Test*

Source of Variance	Total Points	Square	sd	Average of Squares	F	Significance Level (p)
Controlled Variable (Pretest)	199.998		1	199.998	20.331	.000
Grouping Main Effect	218.507		1	218.507	22.212	.000
Error	531.214		54	9.837		
Total	960.316		56			

Table 4 reveals a significant difference in the covariance analysis results in terms of the corrected average points on the last test under the scope of the main effect of grouping ( $F_{(1,54)}=22,212$ ;  $p<.01$ ). According to this analysis, students in experiment group who were taught with differentiated teaching approaches were more successful than students in the control group.

According to the second sub-aim of the research, after correcting for the experiment and control groups' average points on the last test, the corrected average points for the persistency test are provided in Table 5.

**Table 5.***Experiment and Control Group Average and Corrected Average Persistency Points*

Groups	N	Average	Corrected Average
Experiment	33	17.48	17.36
Control	24	14.41	14.60

Table 5 reveals that the average persistency points of students from the experiment group is 17.48, corrected to 17.36 when controlling for success points on the last test. The control group's average persistency points total 14.41, corrected to 14.60 when controlling for success points on the last test. The results of the ANCOVA that was conducted to determine if the observed difference in corrected average persistency points is significant are given in Table 4.

**Table 6.***Experiment and Control Groups ANCOVA Results for Corrected Average Persistency Points*

Source of Variance	Total Points	Square	sd	Average Squares	of F	Significance Level (p)
Controlled Variable (Pretest)	4.042		1	4.042	.311	.579
Grouping Effect	Main	80.961	1	80.961	6.227	.016
Error		702.034	54	13.001		
Total		836.877	56			

Table 6 reveals a significant difference in the covariance analysis results in terms of the corrected average persistency points under the scope of the main effect of grouping ( $F_{(1,54)}=6.227$   $p<.05$ ). According to this analysis, students in experiment group who were taught with differentiated teaching approaches were more successful than students in the control group.

For the last sub-aim, twelve students in the experiment group were asked for their opinions about the application of the tiered teaching technique. The themes, codes, sub codes, and frequency distribution obtained from the interviews are provided in Table 7.

**Table 7.**

*Distribution of Themes, Codes, and Frequency in Terms of Students' Opinions about the Application of the Tiered Teaching Technique of Differentiated Teaching*

Theme	Codes	Sub codes	f
General opinion	Cognitive dimension	Understand	11
		Success	9
		Reinforcement	6
		Self-development	4
		Solving problems easily	3
	Affective dimension	Entertaining	6
		Like lesson	2
		Self-confidence	1
Application period	Innovations of application	Increased number of examples	8
		Learning with fun	7
		Activities suitable to level	7
		Learning based on application	5
	Class environment	Solving different examples	1
		Get help from teacher	7
		Cooperation with friends	5
Applicability	Yes	In all subjects	9
	In some subjects	Depends on class environment	1
		Depends on time	1
Encountered problems	Environment	Noise	8
		Forming group work	1
	Class management	Time management	1

As Table 7 reveals, the general opinions provided through participating students' answers were in four themes: general opinion, application period, applicability, and encountered problems. The first theme collects the students' general opinions in two codes: cognitive and affective dimensions. In the cognitive dimension code, most of the students expressed the opinion that the differentiated teaching approach increased their understanding and successes; also, half of them expressed the idea that it reinforced the subject more. On this subject, student F3 expressed her opinion: "It was much better to have lessons with groups. I got a low mark on the first exam, but I got a high mark from algebra. It helped me to understand algebra subject better ...". Four students emphasized that they experienced self-development, and three of them said they could solve problems related to the subject more easily. In the affective dimension code, five of the students expressed the opinion that the period was entertaining, two of them said they liked the lesson more, and one of them stated that his self-confidence had developed. In this area, student F2 expressed the opinion: "When I first saw the subject, I thought letters in mathematics were very hard. But I

*understand the subject easily with activities and worksheets. I am pretty close to algebra. Activities really did well. I both was entertained and learned."*

The students' opinions about the application period, the second theme, were collected under two codes: innovations of application and class environment. In the code of innovations of application, more than half the students expressed the opinion that the number of examples increased, learning included fun, and they performed activities suitable to their level. On this subject student M2 expressed his opinions as follows: *"...when [differentiated teaching was applied] we could understand things better with the activities. There were examples, and at first I could not understand them totally. But now I can understand all of them."* In the same theme under the class environment code, some of the students stated that they received help from their teacher whereas others said they received help from their friends. For example student M5 said: *"we learned a subject that we did not know. While a friend who did not know the subject was learning, the others who did know the subject were solving many different examples."*

In the third theme, when the students were asked about the application of differentiated teaching approaches to other subjects, most of the students expressed the opinion that it could be applied to all subjects; one of the students said it could be adapted depending on the classroom environment, whereas another said it can be adapted depending on time. Student F4 expressed her opinion as follows: *"... it can be adapted to all subjects. Even the ones who do not like mathematics can learn subjects better with those kinds of game type activities, but they need more time, and subjects cannot be completed."*

The last theme asked students if they encountered any problems during the period the differentiated teaching approach was applied, and they expressed that they had experienced problems generated from the environment and class management. In this scope, eight of the students expressed the opinion that they felt uncomfortable about the noise in the class, one said he had problem during group work, whereas another student said he had problems completing subjects. In this area, student F3 said: *"I could not do some of the questions. When the teacher helped me I could do better. There was too much noise; I felt discomfort about the noise"*.

### **Discussion, Conclusion and Recommendations**

This study was conducted with the aim of determining the effect of the differentiated teaching approach in sixth grade mathematics lesson in the algebra learning field on students' academic successes. First, the research determined that students in the experiment group who had been taught with differentiated teaching method in the scope of mathematical success had higher scores on both the last test and the persistency test than students in the control group did. This result is supported by many other similar research results in which the differentiated teaching approach was applied (Abbati, 2012; Bosier, 2007; Christensen, 2012; Ericson, 2010; Faulkner, 2013; James, 2013; Kok, 2012; Luster, 2008; Richard & Omdal, 2007; Saldirdak, 2012; Williams, 2012). Yabas and Altun's experimental study (2009)

reached the result that the differentiated teaching approach formed a significant difference in favor of the experiment group in terms of mathematical success. Luster's (2008) experimental study conducted with fourth grade students determined that students in the experimental group that adopted a differentiated teaching approach experienced greater mathematical success than the control group for which traditional teaching was applied. Additionally, a semi-experimental study from Scott (2012) that was conducted with second grade students determined that using the differentiated teaching approach in class made a significant difference in improving students' academic success.

In contrast, research exists that does not show similarity with these findings (Millikan, 2012; Stager, 2007). For example, a study by Stager (2007) undertaken to determine the effectiveness of the differentiated teaching approach in mathematics lessons concluded that participant students did not reach the full learning level. Similarly, a study from Millikan (2012) examined teaching programmes in accordance with both traditional teaching and a differentiated teaching approach for a high school algebra lesson that focused on students' mathematical success and teachers' points of view. At the end of this research, the study analyzed interviews with teachers, class observations, and students' exam results, and the study concluded that the differentiated teaching approach is slightly effective in fostering student success. This situation can be a product of the participating students, teachers, or the subject.

In the study's other sub-aim, students from the experiment group were asked their opinions about the application of the differentiated teaching approach within their class. When the answers of students were evaluated, it revealed that the students thought that the applied method was important for their understanding, reinforcing the subject better as well as increasing their success. The findings from this research show similarity with the results of similar studies (Belcer & Avci, 2010; Faulkner, 2013; Luster, 2008; Scott, 2012; Stager, 2007; Williams, 2012). For example, a study by Williams (2012) conducted with fourth grade students determined that the differentiated teaching approach applied to mathematics lessons increases students' mathematical success of students and provides a positive contribution to their education. Similarly, a study by Faulkner (2013) concluded that the differentiated teaching approach applied to third and fourth grade students provides a greater understanding of mathematics and increases students' mathematical success.

Accordingly, participating students from this study emphasized that they found mathematics lessons entertaining, liked the lessons more, learned with fun and were able to solve various examples with this teaching method. The findings obtained from this study demonstrate similarity with the results of similar studies (Avci et al., 2009; Belcer & Avci, 2010; Christensen, 2007; Faulker, 2013; Luster, 2008; Stager, 2007; Williams, 2012). For example, an experimental study by Stager (2007) that examined the effectiveness of the differentiated teaching approach in mathematics lessons reported that students experienced pleasure learning fractions by tiered teaching activities, and prepared worksheets and small group teaching were especially beneficial for them.

In sum, the results above clearly demonstrate that the differentiated teaching approach applied to sixth grade algebra in mathematics class increases students' academic success, and during this period, it provides positive cognitive and affective developments. In other words, applying differentiated teaching approach within class increase students' mathematical thinking and mathematical achievement positively.

Since this study is limited in terms of student dimensions, more studies should be conducted on different subjects and class levels and which also examine teachers' opinions about application stages. Additionally, this study employed only the tiered teaching method of the differentiated teaching approach. Future research should design experimental studies that deal with the application or comparison of different techniques.

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## Cebir Öğrenme Alanında Farklılaştırılmış Öğretim Yaklaşımının Öğrencilerin Akademik Başarıları Üzerine Etkisi

### Atıf:

Bal, A. P. (2016). The effect of the differentiated teaching approach in the algebraic learning field on students' academic achievements. *Eurasian Journal of Educational Research*, 63, 185-204, <http://dx.doi.org/10.14689/ejer.2016.63.11>

### Özet

*Problem Durumu:* Matematiksel öğrenmenin temel ilkelerinden biri olan cebir konusu matematik programlarındaki önemini korumaktadır. Temel aritmetik beceriler ve sayısal örüntüleri içeren ilköğretim cebir alanı öğrencilerde cebirsel düşünme süreçlerinin gelişimi açısından büyük önem taşır. Cebirsel düşünme süreçleri, matematiksel yapıları tanıma ve analiz etme, matematiksel ilişkileri anlama ve gösterebilme, genellemeler yapabilme ve değişiklikleri analiz edebilme süreçlerini kapsar (Steele & Johanning, 2004). Ancak özellikle ilkokul yıllarından başlayarak cebir, pek çok öğrenci için karmaşık matematiksel işlem süreçlerini ifade eder (Van De Walle, Karp & Bay-Williams, 2013). Bu açıdan bakıldığında, öğretim süreçlerinde ve sınıf içi etkinliklerde uygulanacak yöntem ve stratejiler konunun öğrenciler için daha anlaşılır, daha somut bir hale gelmesi açısından büyük önem taşımaktadır (Ericson, 2010). İlk kez Tomlinson (1999) tarafından ortaya konan Farklılaştırılmış Öğretim Yaklaşımı sosyo kültürel teoriye oluşturma, çoklu zeka kuramı ve beyin temelli öğrenme gibi öğrenenleri odak noktası olarak gören paradigmaları kapsamaktadır (Bosier, 2007; Stager, 2007; Subban, 2006). Bu doğrultuda, farklılaştırılmış öğretim yaklaşımı öğrencilerin programın içeriğini keşfetmelerinde çeşitli yolların kullanıldığı, etkinliklerin ve sürecin öğrencilerin anlamlı öğrenmelerine, kendi bilgi ve fikirlerine ulaşmalarına yönelik olarak tasarlandığı ve öğrencilerin öğrendiklerini göstermek ve sergilemek için seçimlerini yapabildikleri bir öğrenme yaşantısı olarak da tanımlanabilir (Hall, Strangman & Meyer, 2010; Levy, 2008). Good'a göre (2006) farklılaştırılmış öğretim öğrencilerin hem öğrenmelerini hem de motivasyonlarını artırarak bireysel ihtiyaçlarını karşılayacak bir eğitim yaklaşımıdır. Levy (2008) de farklılaştırılmış öğretimi öğretmeni sınıfa girdiği andan itibaren her öğrencisine yardım eden bir dizi strateji olarak tanımlamaktadır. Sınıf içerisinde her öğrenci diğerinden farklı olduğundan aynı tip eğitim uygulayarak öğrencilerin ihtiyaçlarına cevap veremeyiz.

Matematik öğretimi bağlamında ise FÖY öğrenenlere çeşitli düzeylerde çoklu öğrenme ortamı sunması bakımından büyük önem taşımaktadır (Abbati, 2012). Bu bağlamda, sınıf içi süreçlerde uygulanabilen istasyon, merkezler, ajanda, karmaşık öğretim, yürünge çalışmaları, giriş noktaları, öğrenme sözleşmeleri ve katlı öğretim gibi birçok strateji ile öğrencilerin farklı yeteneklerini, ilgileri ve öğrenme stilleri ortaya çıkarılabilir (Adams & Pierce, 2004; Chamberlin & Powers, 2010; Tomlinson, 2007). Bu kapsamda, araştırmada tüm seviyelerdeki öğrencilerin konuyu daha kolay

anlamalarını sağlamak, başarı ve motivasyonlarını artırmak ve kendi öğrenmelerinden sorumlu olmalarını sağlamak amacıyla katlı öğretim stratejisi kullanılmıştır. Katlı öğretim belirli hedeflere ulaşırken, öğrencilerin öğrenme profillerine, yeteneklerine, ilgilerine, önbilgilerine ve öğrenme stillerine göre çeşitli yollar sunan bir stratejidir (Adams & Pierce 2004; Levy, 2008; Richard, Omrald, 2007). Bu strateji daha çok hazır bulunuşluk düzeylerinde farklılık olması durumunda kullanılır. Böyle bir tasarımla ön öğrenmesi düşük, orta ve yüksek olan öğrencilerin aynı konuları, kendilerine uygun zorluk seviyesinde öğrenmeleri sağlanmaktadır (Adams & Pierce 2004; Levy, 2008). Richard ve Omrald (2007) göre katlı öğretim stratejisi esnek gruplar yöntemi kullanılarak öğrencinin ön bilgileri üzerine kurularak kavramsal öğrenmelerine katkı sağlar. Ayrıca, katlı öğretim çocuklarının başarısını ve motivasyonunu gören aileleri de mutlu etmektedir (Sondergeld & Schultz, 2008; Suarez, 2007). Özellikle herhangi bir konuda yeterli bilgi ve beceriye sahip olmayan öğrencilerin anlamlı akademik ilerleme yapmalarında katlı öğretim stratejisi önemlidir (Richard & Omrald, 2007).

Literatürde farklılaşmış öğretim yaklaşımının öğrencilerin matematik başarılarına yönelik etkisini inceleyen araştırmalar genelde sayılar ve geometri alanları üzerine yoğunlaşmaktadır (Abbati, 2012; Bosier, 2007; Christensen, 2012; Ericson, 2010; Faulkner, 2013; Kök, 2012; Stager, 2007; Şaldırdak, 2012; Yabaş & Altun, 2009; William, 2012). Ancak, cebir konusunu irdeleyen sınırlı sayıda çalışma (Millikan, 2012) göze çarpmaktadır. Bu bağlamda, Christensen (2007) ilkökul öğrencileri ile yürüttüğü çalışmasında farklılaştırılmış öğretim yaklaşımına göre desenlenen sayılar konusunun öğrencilerin matematik başarılarını ve matematiğe yönelik motivasyonlarını arttırdığı sonucuna ulaşmıştır. Yine, Şaldırdak (2012) beşinci sınıf öğrencileri ile yürüttüğü çalışmasında farklılaştırılmış öğretim uygulamalarının öğrencilerin matematik başarılarını olumlu yönde etkilediği sonucuna ulaşmıştır. Stager (2007) da ilkökul üçüncü sınıf öğrencileri ile yürüttüğü araştırmasında, kesirli sayılar konusunda uygulanan farklılaştırılmış öğretim yaklaşımının öğrenci başarıları üzerindeki etkisini incelemiştir. Katlı öğretim metodu ile yürütülen deneysel çalışmada, farklılaşmış öğretim yaklaşımlarının öğrencilerin başarılarını olumlu yönde etkilediği sonucuna ulaşılmıştır. Yabaş ve Altun (2009) da çalışmalarında farklılaştırılmış öğretimin ondalıklı sayılar konusunda öğrencilerin matematik başarıları, bilişüstü becerileri ve öz-yeterlik algıları üzerindeki etkisini belirlemeyi amaçlamıştır. Araştırmanın örneklemin altıncı sınıf öğrencileri oluşturmuştur. Öntest-sontest deneysel desene göre düzenlenen araştırmanın sonucunda öğrencilerin akademik başarı testi, bilgi, kavrama ve uygulama test puanları, bilişüstü beceriler ve öz-yeterlik algı puanları arasında sontest lehine anlamlı bir fark olduğu sonucuna ulaşılmıştır. Yine, Luster (2008) çalışmasında geleneksel öğretim ile farklılaştırılmış öğretimin uygulandığı 4. sınıf öğrencilerinin matematik başarılarını incelemiştir. Araştırmanın sonucunda farklılaştırılmış öğretimin uygulandığı deney grubunun geleneksel yöntemin uygulandığı kontrol grubuna göre daha başarılı olduğu sonucuna ulaşılmıştır. Kök (2012) de çalışmasında farklılaştırılmış geometri öğretiminin beşinci sınıf öğrencilerinin yaratıcılıkları, uzamsal yetenekleri ve başarıları üzerine olan etkisini incelemiştir. Araştırmada, deney grubundaki öğrencilere “çokgenler” ve “geometrik cisimler” üniteleri

bağlamında kendileri için farklılaştırılmış bir öğretim programı uygulanırken kontrol gurubundaki öğrencilere ise mevcut öğretim programı uygulanmıştır. Araştırmanın sonucunda deney grubu ile kontrol grubu son test akademik başarı puanları arasında deney grubu lehine anlamlı bir fark olduğu sonucuna ulaşılmıştır. Öte yandan, Millikan (2012) ise çalışmasında lise cebir derslerinde uygulanan farklılaştırılmış öğretim yaklaşımlarının öğrenci başarıları üzerine etkilerini irdelenmiştir. Araştırmanın sonucunda farklılaştırılmış öğretim yöntemine göre desenlenen etkinliklerin cebir konusuna yönelik akademik başarıları olumlu yönde etkilediği gözlemlenmiştir.

Yukardaki bilgilerden yola çıkarak matematikte farklılaştırılmış öğretim yaklaşımı bağlamında yapılan araştırmaların genelde sayılar ve geometri öğrenme alanları üzerine yoğunlaştığı; Ancak cebir alanında ise sınırlı sayıda (Millikan, 2012) çalışma yapıldığı göze çarpmaktadır.

*Araştırmanın Amacı:* Bu çalışmayla cebir dersinde uygulanan farklılaştırılmış öğretim yaklaşımlarının akademik başarı üzerindeki etkileri irdelenmeye çalışılarak literatüre bir katkı sağlanması amaçlanmıştır.

*Araştırmanın Yöntemi:* Bu araştırma, ilköğretim altıncı sınıf matematik dersinde farklılaştırılmış öğretim yaklaşımının öğrencilerin akademik başarılarına etkisini belirlemek amacıyla nicel ve nitel yöntemlerin birlikte kullanıldığı ve eşit statülü birbirini izleyen karma araştırma türüne göre desenlenmiştir

*Araştırmanın Bulguları:* Araştırmada, altıncı sınıf matematik dersi cebir konusunda farklılaştırılmış öğretim yaklaşımının öğrencilerin akademik başarılarını artırdığı ve bu süreçte öğrencilerin bilişsel ve duyuşsal yönden olumlu gelişmeler gösterdiği bulgusuna ulaşılmıştır.

*Araştırmanın Sonuçları ve Önerileri:* Araştırmadan elde edilen sonuçlar, farklılaştırılmış öğretim yaklaşımının sınıf içerisinde uygulanmasının öğrencilerin matematik başarılarının artmasına, matematik derslerini sevmesine yardımcı olduğunu göstermektedir. Bu bağlamda, özellikle matematik öğretim programlarında yer alan cebir öğrenme alanı gibi öğrenciler açısından karmaşık olarak algılanan kavramların farklılaştırılmış öğretim yaklaşımı ile öğretilmesi ve öğretmenlerin hizmet içi eğitim seminerleri ile bu konu hakkında bilinçlendirilmesi önerilebilir.

*Anahtar Kelimeler:* Cebir, ilköğretim matematik, farklılaştırılmış eğitim, matematik başarısı.