

THE EFFECT OF CLUSTER TEACHING WITH WORKSHEETS ON STUDENTS' ACADEMIC ACHIEVEMENT IN DISTANCE EDUCATION

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ABSTRACT

The aim of this study is to examine the effect of teaching with worksheets prepared for the 6th grade clusters in distance education on the academic achievement of students. The research was conducted with 39 students studying in a public secondary school in eastern Turkiye in the first semester of the 2020-2021 academic year. In the study, a quasi-experimental design with pretest-posttest control group was practiced to collect data. In the experimental group, the subject of cluster was taught with worksheets prepared in accordance with the constructivist teaching, and in the control group, with general teaching methods. After the practice, the "Clusters Achievement Test" was applied to the experimental and control group students as pre-test and post-test. The academic achievement of the experimental and control groups were compared and it was determined that there was a statistically significant difference in favor of the experimental group. Data analyzes showed that the worksheets prepared for the subject of clusters in distance education increased the academic achievement of the students. At the end of the practice carried out within the scope of the study, semi-structured interviews were conducted with 5 students in the experimental group who fully participated in the studies and activities. The findings obtained from the interviews showed that the students adopted the lessons taught with the worksheets. In addition, it was determined from the statements of the students that they were satisfied with the teaching of the lessons using worksheets in the distance education process, they participated more actively in the online lessons, and they made extra efforts in using materials and completing the activities.

Keywords: Distance education, mathematics teaching, cluster teaching, worksheets.

INTRODUCTION

National or international pandemic periods affect education and training fields as well as living conditions. In this sense, the effects of the new type of corona virus, which emerged in Wuhan, China in 2019, on the education and training process accelerated the digitalization process in education and highlighted distance education. Many countries around the world, using various education portals (UNESCO, 2020), have decided that students continue their education with distance education during the Covid-19 process. Online lessons and online courses have started to be run by teachers and school administration in almost every

country to support communication with students and parents (Chang & Satako, 2020). With the detection of Covid-19 cases in Türkiye, face-to-face education was suspended and distance education was started as of March 23, 2020. Thus, the distance education process began at all education levels. In this process, the Ministry of National Education [MEB] started to carry out distance education activities through the Education Information Network [EBA] platform and TRT EBA TV (Primary, Secondary and High School) channels.

Distance education is a planned open access learning method that requires special instructional designs and technologies, where learners and instructors are in different environments (Moore & Kearsley, 2011). At the same time, it is a learning activity that provides flexibility of time and space with special communication methods (Altıparmak, 2011). According to Zhou, Wu, Zhou and Li (2020), distance education is a method of disseminating content and fast learning through information and internet technologies. The increase in digital communication opportunities in today's conditions has been effective in the web-based conduct of distance education. Web-based distance education activities; synchronous (synchronous), asynchronous (asynchronous) and mixed education models are used (Sen, Atasoy & Aydin, 2010). Thus, students with different characteristics and backgrounds can continue their education. Particularly in the synchronous model, there is an interactive learning, and the instructor and learners attend online classes at the same time, even though they are in different environments. Eventually, interacting with students helps students understand the course content and structure their knowledge. However, there are studies showing that the lack of sufficient interaction (student-content, student-teacher, student-student) in distance education causes various negativities such as lack of motivation, lack of participation in the course, and decrease in success (Demir & Gologlu Demir, 2021; Kilit & Guner, 2021; Niemi & Kousa, 2020; Uzoglu, 2017).

The pandemic process forces educators, students and parents to work collaboratively, communicate, solve problems and be active (Anderson, 2020). In addition, this process reveals that more investments should be made in open and distance education systems in order to continue education and training without interruption, and that alternative learning approaches should be given importance instead of traditional education approaches (Can, 2020). One of the basic elements that create success in distance education is the use of active learning methods (Cagiltay, 2001). As a matter of fact, many studies show that teachers mostly prefer the lecture method in distance education (Bakioglu & Cevik, 2020; Basaran, Dogan, Karaoglu, & Sahin, 2020; Ozdemir Baki & Celik, 2021). In addition, these studies reveal that the materials that teachers use most in distance education are documents (slides, tests, books) and z-books. However, it is necessary for a quality distance education process to prefer methods and materials with high student interactions in mathematics teaching. It is very important to use materials that embody the subjects in mathematics teaching (Inan & Erkus, 2017).

Worksheets are a material used in modern teaching methods with their ease of use in mathematics teaching, the possibility of being prepared in accordance with the content and the way to save the lesson from stagnation (Demirel, 2004). At the same time, they are important tools that include the steps of the process in which students are told what to do, help them to establish their knowledge in their own minds, and enable the whole class to participate in the given activity at the same time (Sands & Ozcelik, 1997). According to Mortensen and Smartt (2007), worksheets are a strategy that allows students to control their own learning. Lee (2014) stated that using worksheets for different purposes (in addition to textbooks and adding information for certain grade levels) may be beneficial for academic success. In addition, the researcher emphasized that the activities in the worksheets are an opportunity for students to build their knowledge. Because worksheets guide the student about what to do, make the student active in the lesson, and enable the student to access information by making them think. In addition, it has a special importance as it is a material that teachers and students can prepare themselves in accordance with the conditions and situations. Thus, since teachers get to know their students better, they can prepare worksheets suitable for students' levels by predicting what they like and how they can learn more easily (Isik & Ozdemir, 2014). At this point, the most important thing is to associate the learned information with daily life and transfer it to the student successfully. This highlights the design of the worksheets.

Lee (2014), who stated that the basic way of conveying the message given in the worksheets to the students correctly, is the order, and suggested that when well-designed questions are matched with appropriate teaching methods, they can attract the attention of the students. For example, Trisnowati and Sumardi (2019) examined students' critical thinking and conceptual understanding skills by using worksheets developed with a problem-solving approach in their research. It was observed that the experimental group

using worksheets had higher critical thinking and conceptual understanding. The researchers suggested that student worksheets are a student guide used for conducting research activities or solving problems. Similarly, many studies reveal that worksheets increase students' interest in the lesson, enable them to take responsibility for their own learning (Kisiel, 2003), provide effective concept teaching (Aktepe, 2012; Aydina, 2015; Isik & Ozdemir, 2014; Keskin, 2019), eliminate students' misconceptions (Atasoy, Kucuk & Akdeniz, 2011) and increase academic success (Buniel & Monding, 2021; Celikler, 2010; Ev, 2003; Gocer, 2012; Saka ve Akdeniz, 2001). There are also studies showing that e-learning-based worksheets used in recent years improve mathematical problem solving and mathematical problem posing skills (Putra, Herman & Sumarno, 2017). However, related studies point out that worksheets have some limitations. In this direction, Bozdogan (2007) stated that visuality is important in worksheets, but the student should not focus only on visuality. At the same time, she emphasized that the duration of the lesson should be well-arranged and suggested that the paragraphs should not be long so that the interest of the student does not decrease. Tan (2008), on the other hand, stated that when students see themselves as inadequate due to their individual learning speed, their motivation decreases. Lesley and Labbo (2003) observed that improper preparation and use of worksheets hinders learning. Researchers noted quality issues such as lack of free space for students to write, complex language, only one correct way, and difficult tasks.

In distance education, keeping students' attention for a long time, motivating them and making them willing to learn is more difficult than face-to-face education. While some studies conducted in this direction reveal that online learning has many advantages for students and teachers and is as effective as face-to-face learning (Bernard et al., 2004; Ward, Peters & Shelley, 2010; Zhao, Lei, Yan, Lai & Tan, 2005), while others show that online learning limits face-to-face classroom interactions (Demir, & Gologlu Demir, 2021; Murphy, 2020; Sengil Akar & Kurtoglu Erden, 2021; Xu & Jaggars, 2014). For this reason, worksheets, which are one of the interactive teaching materials; It is estimated that it will increase the participation, interest and motivation of the students in the online lesson and may have positive effects on the development of distance mathematics teaching. There are also studies suggesting that preparing worksheets for subjects that students have learning difficulties may be beneficial (Atasoy, Akdeniz & Baskan, 2007; Demircioglu & Atasoy, 2006). In this respect, since the subject of cluster is one of the abstract concepts in mathematics (Baki, 2001), it is obvious that students may experience some learning difficulties in learning this concept. There are studies that show that students have various misconceptions about basic concepts (different representations of cluster, element, number of elements, empty set, union, intersection) in cluster teaching and therefore make basic mistakes (Gur, 2009; Yazici, Albayrak & Aslan, 2020). Regarding this, Ipek, Albayrak, and Isik (2009) argued that it is necessary to give examples of the concepts based on daily life in teaching the concept of cluster. Although cluster is one of the important subjects of mathematics, numbers and operations take place in the field of learning in the curriculum (MEB, 2018). In cluster teaching, which is associated with many mathematical concepts, it is very important to associate it with concretization and daily life. Therefore, the use of visually rich tools will enable the concept of cluster to be learned in a meaningful way (Baykul, 1999) and will guide the effective organization of distance education activities.

Considering all these situations, cluster teaching with worksheets is important for this research as it will attract the attention of 6th grade students and make them willing to learn and provide effective teaching. In addition, the fact that there is no study in which worksheets are used for teaching the basic concepts of the cluster subject in distance education reveals the importance of the study. In addition, it is thought that the use of worksheets in distance education will contribute to the execution of synchronous and asynchronous education activities. In synchronous lessons, worksheets will be used to teach the concept of set, to motivate students and to receive feedback at the end of the lesson, while in asynchronous applications, they will be used to provide pre-preparation and reinforcement for the lesson. As a result, it is thought that a high-quality interaction will be ensured through both synchronous and asynchronous applications in the study and this situation will also improve the students' sense of belonging to a web-based classroom environment. The aim of the study under this perspective is to examine the effect of the worksheets prepared for the 6th grade "understands the basic concepts of the cluster subject" acquisition in distance education on the academic achievement of the students. The research problems that guide the study are as follows:

What is the effect of teaching 6th grade clusters with worksheets in distance education on students' academic success?

What are the opinions of the 6th grade students about the worksheets prepared for the cluster teaching?

METHOD

In this research, the effect of the worksheets prepared in accordance with the constructivist approach to the subject of “Cluster” in the 6th grade mathematics lesson on the academic achievement of the students was examined. For this reason, a quantitative research approach was adopted in the study. In the study, a quasi-experimental design with pretest-posttest control group was used. The “Clusters Achievement Test” prepared by the researchers was applied to the experimental and control groups as a pre-test before the experiment and as a post-test after the practice. In other words, the effects of worksheets prepared in accordance with constructivist teaching, which are independent variables, and general teaching on student achievement, which is the dependent variable, were determined.

Participants

The study group of the research consists of 39 students studying in the 6th grade of a secondary school located in Turkiye. The school where the researcher worked was chosen as the practice school. The research was conducted in the first semester of the 2020-2021 academic year. In this research, there is an experimental group, which is taught with worksheets prepared in accordance with constructivist teaching, which is formed by neutral assignment, and a control group, where the methods approved by the Ministry of National Education are practiced. During the practice, 6A class students, who were selected by impartial assignment, continued their distance education with online lessons as the control group and 6B class students, who were chosen randomly, as the experimental group.

Data Collection

As a data collection tool in the research, the Cluster Achievement Test related to the teaching cluster of the 6th grade mathematics course was used as pre-test and post-test. Before the question items of the Cluster Achievement Test were created, the achievements related to the cluster in the 6th grade mathematics program in the 2020-2021 academic year were taken into account. In addition, different sources, especially the school textbook, were examined. The Cluster Achievement Test consists of 21 questions in total. The prepared questions were examined by two branch teachers and two field experts. A pilot study was conducted with eighth grade students in order to determine the deficiencies of the test items prepared according to the achievements determined by the Ministry of National Education. As a result of the examinations in the item analysis, it was decided to exclude one question from the test, since the discrimination of one question in the test was low, and the Cluster Achievement Test containing 20 question items was prepared. The scoring of this test, which consists of 20 items, was made with 5 points for each correct answer, and zero points for the items that were incorrectly made or left blank. With this scoring, the highest score that can be obtained from the test is 100, and the lowest score is 0. The KR-20 technique was used in the reliability calculation of the achievement test and the reliability coefficient was found to be 0,86. Therefore, it was concluded that the test has a level of reliability that can be used in this study. In addition, at the end of the practice, semi-structured interviews were conducted with 5 students determined among the students who participated in the studies and activities completely in the experimental group. Volunteering was taken into account in the selection of students. Since five of the students were volunteers, the interviews were limited to five students. Since the studies were carried out during the pandemic period, students who volunteered to be interviewed were selected in the interviews. In order to determine the effect of the worksheets on the students, an interview form consisting of five questions was developed by the researchers. In order to decide whether the questions in the interview form are clear, understandable and suitable for the level of the student, the opinions of a faculty member and two teachers were taken.

In the research, it was investigated whether the worksheets to be created are suitable for the subject of cluster by examining the literature studies on cluster, worksheets and constructivist learning approach. In addition, a plan was created on how to prepare the cluster subject according to the steps in accordance with the constructivist approach using worksheets. At this stage, worksheets prepared by experts on many different subjects and practiced to different samples were examined (Aktepe, 2012; Aydina, 2015; Ev, 2003; Ozdemir, 2012; Keskin, 2019). How the cluster subject was handled in the textbook was examined, and the

acquisitions that were deemed appropriate by the Ministry of National Education and appropriate questions, problems and activities were determined. After the researches, it was decided to prepare 11 worksheets. The worksheets have been prepared by taking into account the students' prior knowledge, learning processes and development levels. In order to check whether the prepared worksheets are suitable for the language development of the students, the Turkish teacher was contacted and some corrections were made in line with the teacher's warnings. In order for the worksheets prepared in this context to be more understandable for the students, words suitable for the level of the students who will use the worksheet were used and the sentences were kept as short as possible. In addition, the final version of the prepared worksheets was discussed with two mathematics educators who are experienced in preparing worksheets. At this stage, it has been determined that some visuals in the designed worksheets can distract students. For this reason, some images have been reduced in size, and some have been completely removed from the worksheets. An example of the changes made in the worksheets is given below.



Figure 1. Changes to worksheets

After the changes, the page layout of the worksheets was redesigned and an interesting look was tried to be given to the worksheets. In line with the suggestions of the experts, the representations were made simpler. In addition, attention was paid to the order of the instructions in the worksheets and to give only one instruction at a time. Students' participation in the lessons during online lessons in distance education was taken into account. In this context, it has been tried to create worksheets that provide opportunities for individual activities or group work in accordance with the way of teaching. Before applying the worksheets, a pilot study was conducted by the researcher in a different class and with different students. According to the feedback from this study, due to the fact that the students attend classes from home and their teachers cannot be with them in distance education, care has been taken to make the instructions more understandable. In addition, due to time constraints, some guidelines have been revised and shortened.

Before starting the lesson teaching processes in the experimental and control groups, it was investigated whether there was a significant difference between the two groups and the previously prepared Cluster Achievement Test was applied. In terms of Cluster Achievement Test results, it was determined that the experimental and control groups were homogeneous and there was no significant difference between the

two groups, and the lessons were started. In both the experimental and control groups, the practice lasted for two weeks, that is, 10 lesson hours. The subject was explained to the experimental group with worksheets prepared in accordance with constructivist teaching, and to the control group with the methods approved by the Ministry of National Education. At the end of the two-week teaching period, the Cluster Achievement Test was applied to both groups as a post-test. Before the practice, the preliminary information that should be explained before the achievements intended to be given in the worksheets was given to both groups. For this purpose, powerpoint presentations prepared by the researcher on Clusters were shared with all of the experimental and control group students before the lecture, via the EBA program. The students' reports of completing the power point presentations sent as homework were followed by the researcher.

When the practice was started, a brief information was given to the students in the first lesson about the teaching method, learning and teaching processes and worksheets. Later, distance education lessons were taught to students via EBA and Zoom. In these lessons, worksheets were opened on the screen with screen sharing and students were asked to try to do the activities mentioned in the instructions. They were told that they could get help from their teachers when they did not understand. While giving answers to the questions of the students, care was taken to give small clues that would lead them to the correct answer instead of saying the answer directly. The answers from the students in the activities given in the worksheets were taken from each student one by one, thanks to the 'chat' button available in the program (zoom). From this point of view, it was observed that the students generally achieved the intended gains. Private messages were sent to the students who could not reach the result, necessary directions were made, and they were provided to reach the answer with their own efforts. One of the students who gave the correct answer wrote the answer in the blank on the worksheet by using the pen feature in the online lesson. Below are examples of the worksheets made by the experimental group students.

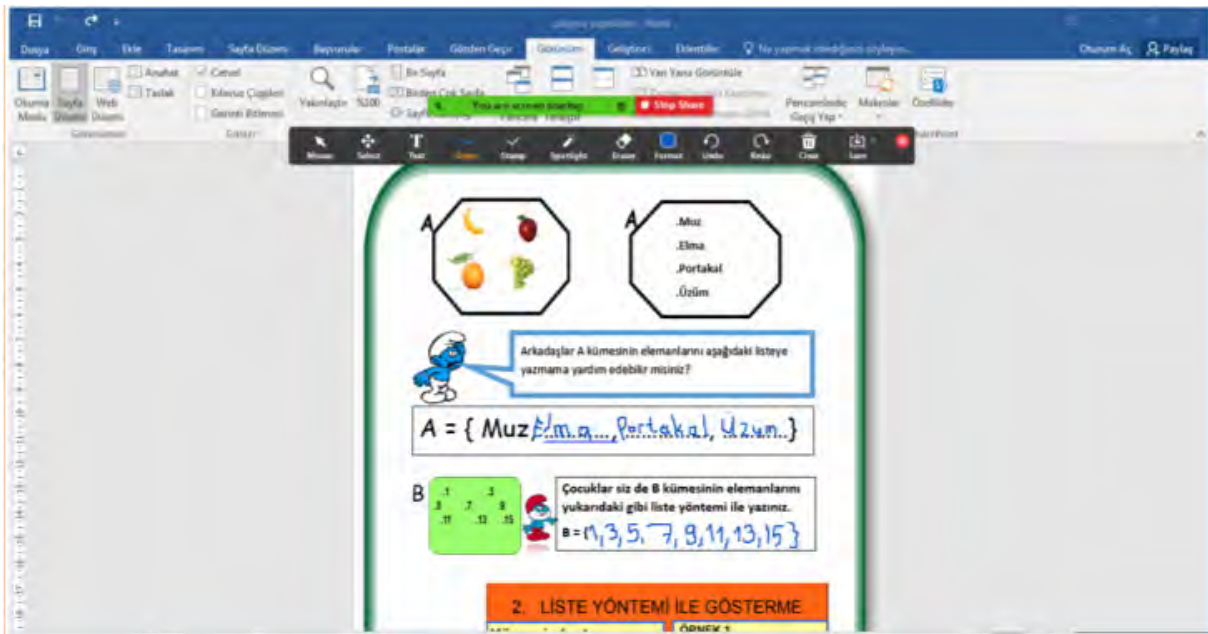


Figure 2. Experimental group cluster worksheet 1

In the control group, general teaching methods approved by the Ministry of National Education were used. In line with the current gains in the research, the desired behaviors were tried to be formed. During the research process, concepts were explained to the experimental and control groups in equal time. The videos and tests in the eba program were used in the online lessons in the control group. In the visuals given below, the activities performed by the students in the online lessons taught with the control group are shown.

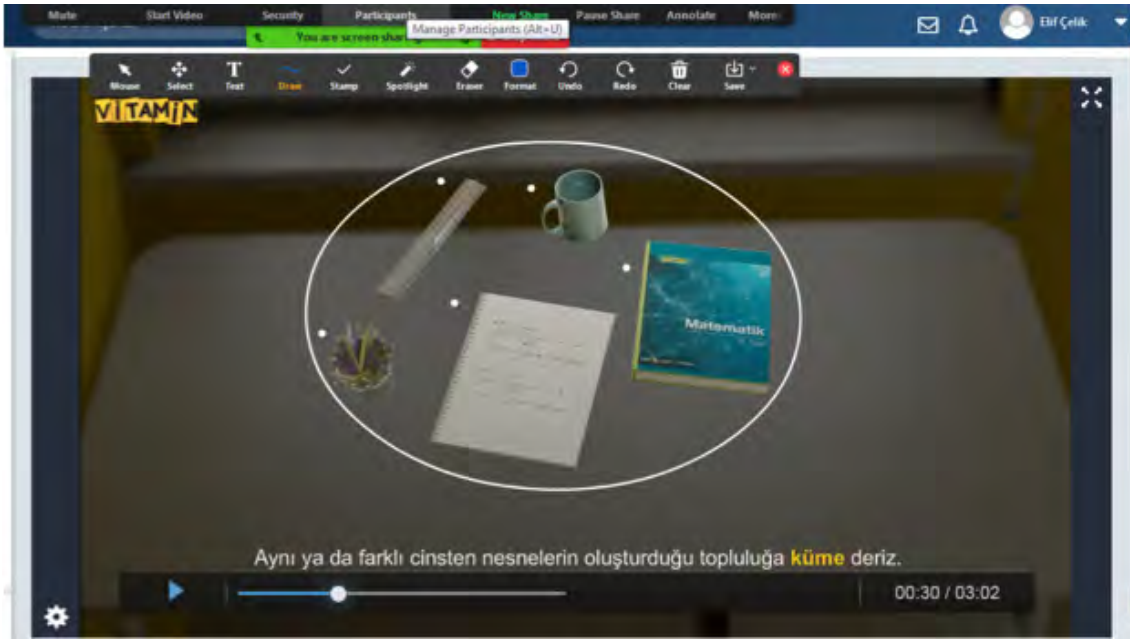


Figure 3. Control group cluster activity 1

Above are the images of the cluster-related activities of the experimental and control groups, whose screenshots were taken during the online lessons.

After the practice, semi-structured interviews were conducted to get opinions from the students about the worksheets. The researcher's participation in the lessons of the same students before the practice had a positive effect in terms of creating a trust-building environment. In addition, the researcher gave information about the interview before interviewing the students and emphasized that the interviews would not be evaluated with grades, they would not be used for any purpose other than the research, their identity information would be kept confidential and code names would be used in the research. In this way, the students, who were relieved of their uneasiness, willingly participated in the interview. During the interview, the student's answers were listened carefully, the points that were considered important were noted, and a voice recorder was used during the whole process. Interviews lasting 5-10 minutes were converted into written text and analyzed. Codings were created for each student to be used instead of students' names.

Data Analysis

In the analyzes made after the pilot study of the achievement test prepared by the researchers to be used in the research; Item difficulty index, item discrimination index, variance, standard deviation, KR 20 reliability, mean, maximum and minimum value, range, skewness and kurtosis were calculated. SPSS (Static Package Social Science) 20.00 statistical package program was used to analyze the data obtained from the Cluster Achievement Test. The results obtained were evaluated according to the 0.05 significance level, and comparisons of the pre-test and post-test scores applied to the experimental and control groups were made. In order to determine the applicability of the t-test, which is one of the parametric tests, it was checked whether the data, which is one of the assumptions of the parametric hypothesis tests, had a normal distribution and the variances were homogeneous. In the research, the data were analyzed using the t-test, as it met the assumptions of the parametric hypothesis tests. Descriptive analysis technique was used in the analysis of the qualitative data obtained in the research. At this stage, the data were described, explained and interpreted in a clear and systematic way. In addition, direct quotations were included in order to reflect the ideas of the interviewed students in a striking way.

FINDINGS

In the study, it was tried to determine whether there was a significant difference between the academic achievements of the students in both groups before the practice by using the t test. For this purpose, descriptive statistics of students' pre-test scores were examined first.

Table 1. Descriptive statistics of cluster achievement test pre-test scores

Groups	Experimental Group	Control Group
N	19	20
Mean	35.53	33.50
Median	35	27.50
Mode	35	30
Standart Deviation (SD)	18.7	21.649
Variance	349.7	468.7
Max	80	80
Min	10	5
Range	70	75
Skewness	.891	.642
Kurtosis	.545	-.567

The fact that mode, median and arithmetic mean values in all groups in the pre-test scores of the Cluster Achievement Test are close to each other can be interpreted as the scores show a normal distribution in all groups. In addition, skewness and kurtosis values in all experimental and control groups are between -1 and +1, which seems to be in accordance with the normal distribution. In the study, the histogram graphs of the achievement test were also examined, and since it was determined that they had a bell-shaped frequency curve, it was seen that the data were suitable for normal distribution. The Shapiro-Wilks Test was used as the third method for normality, since the group size was less than 50. The data of the Shapiro-Wilk Test applied for the Cluster Achievement Test pretest scores are shown in the table below.

Table 2. Shapiro-Wilk test results for cluster achievement test pretest

Group	Test	Statistic	df	p
Experiment	Pre Test	.934	19	.202
Control	Pre Test	.927	20	.137

In the Shapiro-Wilk test, the p value for the experimental group was $p=0.202$, and $p>.05$ was obtained. The p value for the control group was $p=0.137$, $p>.05$. This was interpreted as the scores were normally distributed. After these studies, when the pre-test results of the Cluster Achievement Test were examined, it was seen that the assumptions of the applicability of the t-test, which is one of the parametric tests, were met. For this reason, the pre-test scores of the experimental and control groups were compared with the t-test.

Table 3. T-test results for cluster achievement test pretest

Group	N	\bar{X}	SD	t	df	p
Experiment	19	35.53	18.7	.313	36.68	.756
Control	20	33.5	21.649			

When the t-test results applied to the pre-test mean scores of the Cluster Achievement Test given in Table 3 are examined, $t(36.68)=0.313$ and $p=0.756$, there is no statistically significant difference between the groups since $p>0.05$. In order to decide on the test to be used in comparing the post-test scores of the students in the experimental and control groups, it was checked whether the parametric hypothesis tests met the assumptions. For this purpose, descriptive statistics of students' post-test scores were examined first.

Table 4. Descriptive statistics of cluster achievement test pre-test scores

Groups	Experimental Group	Control Group
N	19	20
Mean	77.89	58.50
Median	80	55
Mode	85	55
Standart Deviation (SD)	12.836	13.089
Variance	164.77	171.32
Max	95	80
Min	55	40
Range	40	40
Skewness	-.487	.129
Kurtosis	-.894	.992

The fact that mode, median and arithmetic mean values in all groups in the post-test scores of the Cluster Achievement Test are close to each other can be interpreted as the scores show a normal distribution in all groups. In addition, skewness and kurtosis values in all experimental and control groups are between -1 and +1, which seems to be in accordance with the normal distribution. In the study, the histogram graphs of the achievement test were also examined, and since it was determined that they had a bell-shaped frequency curve, it was seen that the data were suitable for normal distribution. The Shapiro-Wilks Test was used as the third method for normality, since the group size was less than 50. The data of the Shapiro-Wilk Test applied for the Cluster Achievement Test pretest scores are shown in the table below.

Table 5. Shapiro-Wilk test results for cluster achievement test post-test

Group	Test	Statistic	df	p
Experiment	Post Test	.924	19	.133
Control	Post Test	.919	20	.097

In the Shapiro-Wilk test, the p value for the experimental group was $p=0.133$, and $p>.05$ was obtained. The p value for the control group was $p=0.097$, $p>.05$. This was interpreted as the scores were normally distributed. After these studies, when the post-test results of the Cluster Achievement Test were examined, it was seen that the assumptions of the applicability of the t-test, which is one of the parametric tests, were met. For this reason, the post-test scores of the experimental and control groups were compared with the t-test.

Table 6. T-test results for cluster achievement test post-test

Group	N	\bar{X}	SD	t	df	p
Experiment	19	77.89	12.836	4.671	36.96	.000
Control	20	58.50	13.089			

The t-test results applied to the Cluster Achievement Test Post-Test mean scores given in Table 6 are $t(36.96)=4.671$ and $p=0.00$, and since $p<0.05$, there is a statistically significant difference between the groups. The data in Table 6 show that the academic achievement scores of the students in the experimental group, who were taught with worksheets prepared in accordance with constructivist teaching, were higher than the students in the control group.

At the end of this study process, semi-structured interviews were conducted with a total of 5 students selected from among the students who participated in the activities in the experimental group, which were taught with worksheets prepared in accordance with constructivist teaching. In the interviews, it was first asked whether the worksheets prepared for the cluster in distance education were productive. It is understood from the answers given by the students to this question that they understand the subjects better thanks to the worksheets, and that they think that the lessons taught with the worksheets are fun and productive for them. In addition, the students stated that they did not want this method, which they encountered for the first time, because it was difficult at first, but they got used to the activities and studies over time. From the answers given, it was determined that the students thought that the worksheets were good for them and that they felt that their self-confidence increased when they could successfully complete the activities given on these sheets. In this regard, one of the students said that the worksheets were useful. Because he stated that he did not understand the subject much before, but he started to understand it thanks to the examples in the worksheets. He also stated that he felt that his responsibilities increased while learning with this method, he was happy when he could do the activities individually, and the time passed very quickly when he studied with worksheets. Another student stated that he had a little difficulty in the beginning because he was not used to learning with worksheets, but then he started to study very well, he understood the subject of cluster better than other subjects, and that the problems related to cluster were easier for him when he learns with worksheets. He also stated that when he started to be able to answer the questions, his self-confidence increased and the lessons taught with the worksheets were fun and enjoyable.

Secondly, during the interviews, the students were asked which activity they liked most in the worksheets and the reasons for liking them. When the student answers were examined, it was seen that each of the students liked different activities according to their interests in the worksheets. For example, one student stated that she liked the event where Ms. Aysel prepared food for her guests because she loved to eat and cook. The student coded S1 stated that he liked the cluster building activities because it was fun to create clusters. On the other hand, the student coded S3 stated that he liked the activity of writing the elements of the set with the list method because he could easily find the elements of the set in this activity. The answer given by the student coded S2 to this question is as follows:

“Who is smarter I liked the activity. In fact, when I said I am smarter, you asked me why. My other friends objected. They claimed that they were smarter. There was no definite result. I got a better understanding of that subject.”

When the students' opinions were examined, it was determined that the students were more active in the lessons taught with the worksheets, they did the activities with their own efforts and they put more effort to do the activities. For this reason, it is understood that the students like to solve the questions in the worksheets and therefore they think that the lessons are more fun.

When the answers of the students given to the question asked to determine where they had difficulties in the worksheets were examined, it was seen that most of the interviewed students did not have any activity in the worksheets that they had difficulty in. On the other hand, it was determined that a student had difficulty in creating a Venn diagram and finding the common properties of the elements in the list in the common property method activity. It was observed that some students had difficulties because they were not used to the worksheets at first, but they got used to it over time. It was observed that some students had difficulties in the activities but they understood the subject in the continuation of the studies.

As the fourth question in the interviews, the students were asked whether they wanted the worksheets to be used in the teaching of other subjects, along with the reasons. The students stated that they understood better than the worksheets in general, and therefore they wanted to learn other subjects in this way. Sections of the students' explanations in this direction are presented below:

“...I think it could be useful. While our teachers were lecturing on the board or in online meetings, we were just watching. But we make an effort in this method, we need to do something to make our minds work. We read the activities and try to find the answer that best suits us. We try to understand the questions together, we ask where we do not understand. In this case, we understand better because we try harder. I would like to learn about other subjects by this method.” (S1)

“After I started doing these activities, some of my friends started to be more successful. Even my friends who do not study much began to ask the teacher for tasks and to have a say while making these worksheets. That’s why I was more willing to do homework and participate in studies. Their energy was also reflected in me. I would like to study further topics with worksheets in order to learn more willingly and energetically.” (S3)

S4, on the other hand, stated that she could not understand some subjects and that she could understand it more easily when she taught with worksheets and she thought that the worksheets were more efficient. S4 also said, “*I felt that I became more social when I studied with worksheets. As we do the activities on the worksheets by taking the ideas of our other friends and try the methods they say, we both see a different perspective and feel more like in a classroom environment in online lessons.*” he stated. The student coded S5 stated that he liked the fact that he could do the operations on the worksheets individually, and that he could not solve the math questions on his own before the worksheets, but that he could easily find the answers without the need for help, thanks to the questions being asked in the worksheets gradually. S5 also stated that this situation increased his self-confidence. When the answers given by the students to the fourth question are examined, it is seen that some students think that it would be beneficial for them to use this method on different subjects, as they produced different ideas during the activities in the worksheets, discussed these. The students stated that they felt more like in a classroom environment in online lessons because they did the activities on the worksheets by taking the ideas of their other friends and trying the methods they said. The students stated that they felt that they were more socialized in this situation.

As the fifth question in the interviews, ‘Which subject would you like to be treated with these leaves? Why?’ was asked to the students. When the answers given by the students to the fifth question were examined, it was seen that some students wanted to handle the subjects they had difficulty in understanding with this method. These students think that they can understand these subjects more easily with worksheets. For example, S1, who said that he wanted to deal with decimal notation and polygons with worksheets, had difficulties in decimal notation, he thought he could understand better with worksheets, and he also liked polygons. He stated that he guessed that it would be fun to deal with this subject with leaves. Some students stated that it would be more enjoyable to process their favorite subjects with this method. Similarly, student coded S4 said, “*I want the subject of fractions and data collection methods to be covered with these leaves. I think I can understand better with worksheets because I have difficulty with fractions. I think data collection methods will also be visually rich worksheets. It would be fun to learn with pictures and rich leaves.*” made statements. S5 stated that he wanted to deal with the subject of angles with worksheets because he thought it would be more fun. On the other hand, the student coded S2 stated that he wanted this subject to be explained with worksheets because he could not understand decimal notation very well. The student coded S3 said, “*I would like to deal with the subjects of fractions and polygons with worksheets. Because I love fractions. I am very happy when I do activities related to this subject on my own. Unraveling leaves is just as enjoyable as fractions. Last year, I prepared homework on polygons, it was very nice. I think the worksheets will be good in this regard as well.*” expressed as.

DISCUSSIONS AND CONCLUSION

In the current study, the effect of teaching with worksheets prepared for the 6th grade clusters in distance education on the academic achievement of students was examined. There was no statistically significant difference between the pre-test scores of the experimental group, in which the worksheets were taught, and the control group, in which the general teaching methods were applied. When Figure 4 is examined, it can be said that the experimental and control group students’ prior knowledge about the subject of

clusters is close to each other. It is natural for the control and experimental group students who do not have sufficient prior knowledge about the subject of clusters before the instruction to acquire information about the subject during the instruction. When the post-test achievement scores of the groups are compared, it is seen in Table 6 that there is a statistically significant difference between the experimental and control group students. It was determined that this observed difference was in favor of the experimental group taught with worksheets. This increase in the post-test scores of the experimental group students shows that teaching with worksheets is more effective in distance education. This result supports many research results (Ihwan, Prasetyo & Septiyono, 2020; Isik & Ozdemir, 2014; Trisnowati & Sumardi, 2019) showing that teaching with worksheets increases the academic success of students. Isik and Celik (2017) concluded in their research that teaching algebraic equations with worksheets increased student achievement more than teaching with general teaching methods. Similarly, Aydina (2015) revealed that teaching fractions with worksheets significantly increased the academic achievement of 6th grade students. Inan and Erkus (2017), on the other hand, stated that mathematics worksheets prepared based on the theory of multiple intelligences positively affect the academic achievement of primary school 4th grade students.

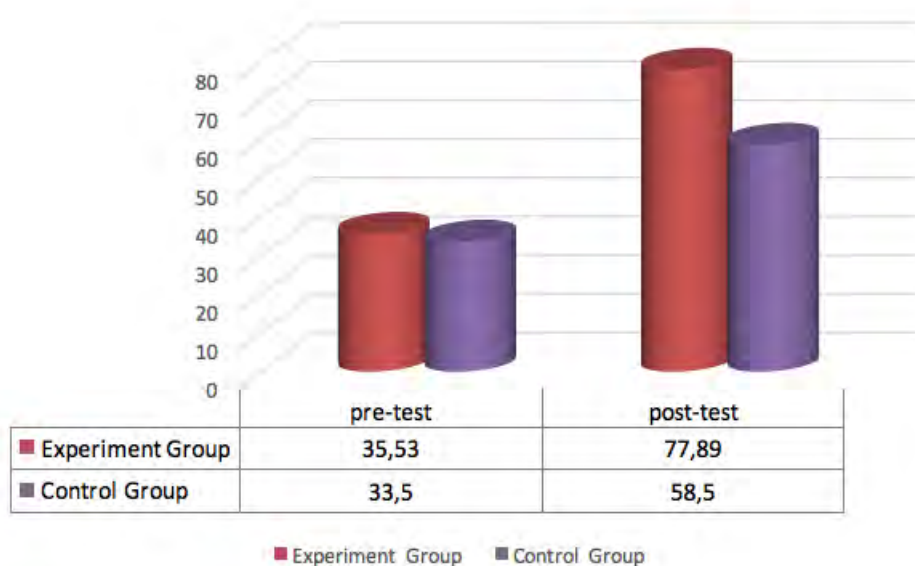


Figure 4. Comparison of the pretest and posttest scores of the groups

In the study, students' individual responses to the activities in the worksheets and developing discussions enabled the students to be more active in online lessons. Therefore, worksheets in distance education have been one of the ways for students to express their thoughts. Considering the high level of interaction for an effective distance education, it can be said that the worksheets take the student away from the position of a passive listener in this process. This finding, made in the relevant field; It is consistent with the results of many studies such as Ceyhan and Turnuklu (2002), Celikler (2010), Isik and Ozdemir (2014). In addition, teaching with worksheets helped students to reveal their ideas and to be responsible for their own learning (Kisiel, 2003). The findings obtained from the students' opinions reveal that they are satisfied with the worksheets in the online lessons, that the worksheets make the online lessons fun and that they make more effort to complete the activities in the worksheets outside of the classroom. Similar findings are also found in Keskin (2019) study. The researcher stated that the students enjoyed studying with the worksheets very much and they developed a positive attitude towards mathematics. In addition, studies (Atasoy & Akdeniz, 2006; Isik & Celik, 2017; Kurt & Akdeniz, 2002) show that worksheets make learning enjoyable and increase students' interest and motivation. From this point of view, it can be said that teaching with worksheets prepared in accordance with the constructivist approach is effective in increasing student success in distance education and making learning fun. Using worksheets through synchronous and asynchronous practices can improve the student's sense of duty and responsibility in distance education. For this reason, it may be useful to apply the worksheets prepared

for teaching different concepts through mixed education models. An important point is that the worksheets can be used not only for teaching a concept or eliminating misconceptions, but also for providing process-based evaluation in distance education. As a matter of fact, teaching practices can be developed with worksheets in order to provide different types of interaction in distance education.

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