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Raising Awareness in 7th Grade Students with Educational Games on Waste and Recycling

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Abstract

This research was conducted to determine the effect of educational games developed on "Household Wastes and Recycling" on raising awareness of this issue. In the research, a quasi-experimental design with a pre-test-post-test control group was used. The study group consisted of ninety-six 7th-grade students in total from two secondary schools located in the province of Rize and the district of Çayeli of Rize province. In the province experimental and control group, 29 students were included while the district experimental and control group comprised of 19 students. In teaching the subject of Household Wastes and Recycling, instructional plays called "Who Won the Cup?", "I Got it?", "Reflection" and "Ring!" developed by the researcher were played with the experimental groups while instructional program activities of the science lessons were used with the control groups. The quantitative data of the research were collected with the "Household Wastes and Recycling Knowledge Test" administered to all groups as the pre-test and post-test, and the qualitative data were collected with the "Semi-structured Interview Form" administered to the experimental groups. Quantitative data were analyzed using parametric and non-parametric techniques, while qualitative data were analyzed using content analysis. It was determined that the instructional plays used in teaching the subject of household waste and recycling are effective in enhancing the knowledge level and awareness of the students regarding household waste, recycling, the advantages of recycling, and what needs to be done for effective recycling and reuse. Instructional plays were determined to be evaluated as an effective tool in cognitive and affective aspects by students. In this regard, it was concluded that instructional plays facilitate learning, ensure effective learning, inform, raise awareness, develop affirmative emotions for the subject or lesson, hinder the boringness in the course of the lesson or subject, and help assure concentration.

Keywords: Science education, household wastes, recycling, educational game, awareness.

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Introduction

Our world is subject to change due to global trade, consumption, to increase in human population, and urbanization. With the new world order, nature is losing its unique characteristics, the rate of extinction is increasing, and natural resources are being depleted (WWF, 2020a). Öktem (2016) argues that natural resources are limited, which creates the risk of not being able to meet future needs due to uncontrolled consumption. This consumption leads to waste production that creates problems for the environment, health, and economy, which in turn affects society, families, and individuals (BSTB, 2014; Gündüzalp and Güven 2016). Thus, it is crucial to control waste production and aim for minimal waste production and consumption, in order to create a habitable world (BSTB, 2014). Waste control strategies such as the 4Rs (Reduction, Reuse, Recycling, and Recovery) are essential in this effort (Singh and Sushil, 2017). Although waste control is determined by the state through laws and regulations, sensitivity, volunteerism, awareness, and a sense of responsibility are necessary for effective waste control. Adopting environmentalist approaches, reviewing priorities in life, and shaping vital activities in line with sustainability reveal recycling awareness.

Today, waste has become a major problem in a changing world due to global trade, consumption, human population growth, and urbanization (WWF, 2020b).

According to the World Wildlife Fund 2020 Annual Report (WWF, 2020c);

- ✓ In the present century, half of the world's wetlands have disappeared.
- ✓ There are problems in accessing fresh water. In fact, 1.1 billion people in the world do not have access to fresh water.
- ✓ Based on pre-industrial revolution data, there was a global temperature increase of 1.2˚C in 2020.
- ✓ Approximately 10 million hectares of forests are destroyed every year in the world.

Additionally,

- ✓ Poorly managed wastes pollute the oceans, clog sewers and cause floods.
- ✓ Particles released into the air by waste incineration cause respiratory problems, harm animals that consume waste, and negatively affect economic development by reducing tourism (WB, 2018).

Waste management is therefore becoming a global issue that affects every single person on Earth. Hence, the importance of effective waste management is to help solve the problems affecting the world (WB, 2018).

Sustainable development requires a focus on waste management in educational institutions (Moqbel, 2018). It is seen that knowledge, attitudes, and behaviors towards waste management can be changed through education (Chow, et al., 2017). Studies show that an increase in the level of education leads to a decrease in waste generation (Grazhdani, 2016), and students who are educated about waste and recycling are willing to find solutions to waste-related problems, inform and encourage their immediate environment about recycling (Çelikler, et al., 2015). It is seen that the training given on this subject is effective in helping students gain knowledge on the subject, increase their sensitivity to the environment and realize that recycling is important for the environment (Aksan & Çelikler, 2019). For this reason, to reduce the waste problem, well-planned and awareness-raising training in schools will be effective in changing students' habits, behaviors, and attitudes that cause waste generation (Desa, et al., 2011). It is important to include programs that will encourage students to think in order to develop attitudes towards waste recycling and to have a high level of awareness towards the environment (Çelikler, et al., 2015). Therefore, it plays an important role in the education system to renew the curricula and to include curricula integrated into life in order to raise individuals with the knowledge and awareness that can meet the needs for sustainability in the age we live in. For this reason, the inclusion of waste management topics and concepts in schools at all levels of education, integrated with environmental education and school curricula, will enable students to understand waste

management, increase environmental awareness for a sustainable future and develop positive behaviors in waste management (Ifegbesan, 2010).

Curricula are prepared in line with the general objectives and basic principles of Turkish National Education. Among the main objectives of the Science curriculum prepared in this direction are to recognize the interaction between the individual, environment, and society, to develop an awareness of sustainable development regarding society, economy, and natural resources, to take responsibility for daily life problems and to use knowledge, scientific process skills and other life skills related to science in solving these problems, as well as to arouse interest and curiosity in the events occurring in nature and the immediate environment and to develop attitudes. In order to achieve these goals, the activities carried out with the education and training program progress in a complementary manner at all levels of education (MoNE, 2018).

Educational games, which means games designed for educational purposes (TDK, 2020), are games designed and used for education and training (Al-Azawi, et al., 2016). Educational games used for educational purposes have useful content (Lee & Lee, 2008) and include achievements such as a specific sub-discipline or basic competencies expected from individuals (Aytaş & Uysal, 2017). Educational games create an effective learning environment (Song & Zhang, 2008), because they combine fun and educational elements to increase students' participation and motivation in educational activities (Al-Azawi, et al., 2016). For this reason, students' motivation to learn increases and they move from passive learning to active learning. This leads to a change in learning quality (Song & Zhang, 2008).

The Fun Toolkit game, which was adapted into an educational board game, was found to contribute to 7-12-year-old students' knowledge about recycling and the development of their self-efficacy (Mostowfi, et al., 2016). It was found that training including educational games was effective in sorting waste (Taghdisi, et al., 2016). In the research conducted by Chow, et al. (2017), it was aimed to determine the effect of direct, applied, and simulation-based instruction on knowledge, attitudes, and behaviors towards plastic waste management. For this purpose, the research was conducted with 4th-6th grade (8-12 years old) students. In this direction, students were divided into 3 groups to learn about plastic waste problems and how to manage them. In direct teaching, students were given information about plastic problems and waste management by teachers with PowerPoint slides. In applied teaching, teachers guided students to learn actively through observation, experimentation, and interaction with the environment. In simulation teaching, a simulation game called Plastic City was played with the students. In order to test the changes in knowledge, attitudes, and behaviors related to recycling and plastic waste management, pre-test and post-test applications were carried out. As a result of the analysis of the tests applied, it was determined that all of the teaching methods increased student knowledge, while practical and simulation game-based teaching were slightly effective on attitudes and behaviors. In Kamar's (2018) study, it was aimed at raising recycling awareness among kindergarten and primary school students within the borders of AFAD Viranşehir Refugee Camp. For this purpose, individuals living in the camp area and included in the study group were given training on recycling. The study included painting competitions, computer games, and theater. During the one-year study, it was observed that 90% of the waste generated in the camp area was collected in waste collection containers. In another study aiming to raise awareness about recycling, it was determined that activities such as dramatization, improvisation, role-playing, travel-observation, show-and-tell, station, game, performance, music, and dance provided learning by having fun (Tosun & Demir, 2018). It is stated that learning about waste management and environmental protection issues can be provided with an Android-based educational adventure game (Satria, et al., 2020).

Within the framework of recycling awareness, it is important to think for future generations about the use of limited natural resources, to be aware of individual duties and responsibilities, and to take responsibility in this regard (Bozkurt, 2012; Harman, et al., 2015). Therefore, the importance of raising individuals emerges with recycling awareness who are aware that irresponsible behaviors will negatively affect the environment, understand the concept of sustainability, and organize their lives with this understanding. Studies show that training is effective and important for students in creating knowledge and awareness about household waste and recycling (Ifegbesan, 2010; Asmatulu & Asmatulu, 2011; Onur, et al., 2016). It is thought that this research will be a guide to reveal the

missing and incorrect information about waste and recycling with a validated and reliable knowledge test and to organize teaching activities that are important in raising individuals with awareness on the subject. It is also thought that the educational games within the scope of the research will help students recognize household wastes, know waste control, learn their roles in waste control, understand the importance of recycling and reusing, and develop positive behaviors on these issues.

The research was conducted to determine the effect of educational games developed on "Household Wastes and Recycling" on raising awareness of this issue. Although it is known that waste is recycled, it is seen that communication channels, training, and information on recycling are inadequate, a recycling culture is not formed, individual responsibilities are not fulfilled in the separation of waste, and recycling bins are not used sufficiently. Accordingly, it is noteworthy that the importance of recycling is not fully understood, and the necessary care is not shown in behaviors towards this issue (Ak & Genç, 2018). For this reason, in order to increase awareness about recycling, the transformation must first start with people (Kök, 2021). The most effective tool for this transformation is education (Schultz, 2002).

With the education given in schools, students should learn that the world's resources are limited and that wastes remain in nature for a long time without degradation, which harms the environment (Çimen & Yılmaz, 2012). The importance of waste and recycling in terms of sustainability, and the need to raise individuals who have a global perspective on waste generation and who are aware of the behaviors that guide recycling efforts reveal the necessity of conducting this research.

It is seen that educational games in schools are effective in raising environmental awareness (Akbayrak & Turaşlı, 2017). In addition, educational games ensure the comprehensibility of the subjects in students and reveal the behaviors of obeying the rules, and being helpful and respectful (Karamustafaoğlu & Kaya, 2013). Educational games create positive emotions such as pleasure, excitement, and fun during classes (Tosun, 2022). It’s set forth in research by Dolunay and Karamustafaoğlu (2021) that educational games can be efficient in both cognitive and sensory domains. It is thought that the educational games developed in the research and used in practice will contribute to raising awareness about “Household Wastes and Recycling” in students and to the development of behaviors that reduce waste generation and support recycling in this framework.

Method

The Research Model

The quantitative structure of the research consisted of the data belonging to the multiple-choice questions in the knowledge test on household waste and recycling. In addition, it was aimed at reaching the opinions of the experimental groups about the educational games used in the application and teaching of educational games. For this reason, the questions in the semi-structured interview form were asked to the experimental groups. In this regard, qualitative data were obtained through a semi-structured interview form.

Research Design

In the research, a quasi-experimental design with a pre-test-post-test control group was used. Quasi-experimental designs based on pretest and posttest measurements between experimental and control groups (Evers, et al., 2006) are used to test the causal relationship between two or more variables (Bickman & Rog, 2009). The quantitative data of the research were collected with the "Household Wastes and Recycling Knowledge Test" administered to all groups as the pre-test and post-test, and the qualitative data were collected with the "Semi-structured Interview Form" administered to the experimental groups. In the research, the Household Wastes and Recycling Knowledge Test was applied to the experimental and control groups before the application. During the implementation process, the experimental groups were taught through educational games within the scope of the study, and the control groups were taught in line with the curriculum. After the application, the Knowledge Test on Household Wastes and Recycling and Semi-structured Interview Form were applied to the experimental groups, and the Knowledge Test on Household Wastes and Recycling was applied to the control groups.

Study Group of the Research

The study group of the research consists of a total of 96 students studying in the 7th grade in one middle school in Rize province and Çayeli district affiliated with the Ministry of National Education. The experimental and control groups in the middle school affiliated with the Provincial Directorate of National Education consisted of 29 students each, and the experimental and control groups in the middle school affiliated with the District Directorate of National Education consisted of 19 students each. The study group was selected using random sampling, which is a sampling method in which the elements in the population are given equal chances to be selected for sampling. In random sampling, all individuals have the same probability of being selected and the selection of one individual does not affect the selection of the other individual (Özen & Gül, 2007).

The research was conducted by obtaining the necessary permissions from the Ondokuz Mayıs University Social and Human Sciences Ethics Committee and Rize Governorship Directorate of National Education.

Research Process

The research was conducted with two 7th-grade classes of two middle schools, one in Rize province and the other in the Çayeli district of Rize province. The topic of "Household Wastes and Recycling" was taught with educational games developed within the scope of the research (Altunbey & Çelikler, 2021a) in the experimental groups and with the activities of the Science curriculum in the control groups. The lessons were conducted by two Science teachers working in the schools participating in the research and teaching 7th-grade classes. For the application to be carried out well, the teachers who would carry out the application were introduced to the educational games within the scope of the research and informed about how to apply the educational games. The knowledge test on household wastes and recycling used in the research was administered as a pretest to all groups included in the research at the beginning of the research. At the end of the research, the knowledge test was applied to all groups for the second time as a post-test. Opinions about the educational games used in the lesson and teaching with educational games were also collected with the questions in the semi-structured interview form.

Data Collection Tools Used in the Research

A test consisting of 38 items with four options, where each question contains one correct answer and three distractors, was prepared by reviewing the literature on the subject of Household Wastes and Recycling in line with the achievements in the Science curriculum prepared for the 7th grade of secondary school. The test was evaluated by a science teacher and four field experts for validity studies. As a result of the evaluations, it has been established that the test exhibits content validity and is suitable for the level of 7th graders. In addition, recommendations were made regarding the preparation of test items.

In this regard;

- ✓ There should be at least one question assessing one of the achievements;
- ✓ All questions should be multiple-choice questions;
- ✓ All questions should be easy to read;
- ✓ The expressions in the options should be compatible with each other and their length should be similar;
- ✓ The questions should be on the same page in such a way that their integrity remains intact without any division;
- ✓ Expressions to be noticed in the test should be written in bold and underlined, and a suitable standard font should be chosen in this regard.

After the revision, the revised test consisting of 25 items became ready for pilot application. The developed test has been administered to 248 8th-grade students who had previously received education on household waste and recycling. The data obtained at the end of the application were analyzed using the Microsoft Excel program (Altunbey & Çelikler, 2021b). Difficulty and selectivity indices of the items in the test were calculated. Items that were found to be non-fitting as a result of the analysis were excluded from the test. Afterwards, the Kuder Richardson (KR-20) reliability coefficient was

calculated, and the final version of the test was prepared. The values of the 18-item test, which was formed by removing 7 items from the test as a result of item analysis, are given in Table 1.

Table 1.
Test Values

	Values
Number of students who took the test	248
Item Number	18
Average	10.24
Difficulty	.57
Variance	18.76
KR_{20}	.825

After the item analysis, the number of questions related to the achievements related to the subject of household waste and recycling is given in Table 2. In the final version of the test, there are questions for all achievements.

Table 2.
Number and distribution of questions prepared for learning achievements regarding the subject of Household Wastes and Recycling.

Achievement	Number of questions
F.7.4.5.1. Distinguishes recyclable and non-recyclable materials among household wastes.	4
F.7.4.5.2. Designs projects for the recycling of household solid and liquid wastes.	3
F.7.4.5.3. Questions recycling in terms of effective use of resources. The contribution of recycling facilities to the economy is emphasized.	5
F.7.4.5.4. Pays attention to waste management within routine environments such as school, home, etc. a.The efforts of public and non-governmental organizations related to waste management are mentioned. b.It is reminded that medical waste should not be contacted.	4
F.7.4.5.5. Develops a project to deliver reusable items to those in need.	2

Interviews allow us to see people's perspectives and make these perspectives known, clear, and meaningful. Qualitative data can be collected through interviews, direct observation, and written documents. Interviews, one of these data collection methods, provide researchers with direct information about people's experiences, opinions, feelings, and knowledge (Patton, 2002). The interview form provides both flexibility for the researcher or interviewer and systematic and comparable information from different individuals. With this approach, it is also easy to organize and analyze the data. As a result of these features, interview forms have more positive aspects than conversational style interviews (Yıldırım & Şimşek, 2008).

In this research, it was aimed to reach the opinions of the experimental groups about the educational games used in the application and teaching through educational games. For this reason, the questions in the semi-structured interview form were asked to the experimental groups. These interview questions were developed by taking expert opinions.

Data Analysis

Quantitative Data Analysis

In the research, a multiple-choice Household Wastes and Recycling Knowledge test consisting of 18 questions was used to obtain quantitative data. In the analysis of the quantitative data obtained from the test, it was first checked whether the groups showed normal distribution for statistical evaluations. Shapiro-Wilk and Kolmogorov-Smirnov tests were used to determine the normality of the scores. If the group size is smaller than 50, the Shapiro-Wilk test is used, and if the group size is larger, the p-value of the Kolmogorov-Smirnov test is used. If this value is greater than .05, it is interpreted that the

scores are suitable for normal distribution (Büyüköztürk, et al., 2009). Since the size of the groups in this study was smaller than 50, the p values of the Shapiro-Wilk test were taken into consideration. Table 3 shows the p values of the Shapiro-Wilk test obtained from the pre-test and post-test data of the 'Household Wastes and Recycling Knowledge Test' applied in the study.

Table 3.
Pre-Test-Post-Test Scores of the Groups on the Knowledge Test on Household Wastes and Recycling Shapiro-Wilk Test Results

Group	Test	p
Province Experimental Group	Pre-test	.074
	Post-test	.000*
Province Control Group	Pre-test	.857
	Post-test	.061
District Experimental Group	Pre-test	.375
	Post-test	.257
District Control Group	Pre-test	.000*
	Post-test	.004*

*p<0.05

In the Shapiro-Wilk test, when the p-value is greater than .05, it can be accepted that the data are normally distributed (Can, 2017). According to Table 3, the province experimental group in the post-test and the district control group in the pre and post-test did not show a normal distribution ($p < .05$). For this reason, nonparametric tests were used in the analyses involving the district control group and the province experimental group in the post-test.

Qualitative Data Analysis

The qualitative data in the research were obtained from the answers given in writing to the semi-structured interview form used to determine the opinions about educational games and teaching with educational games in line with the educational games applied to the experimental groups and the student models prepared. Content analysis was used to analyze the data obtained from the semi-structured interview form.

First of all, the students' written answers to the interview questions were transcribed directly without any changes. Then, the answers given to each question were read one by one and the expressions in them were divided into meaningful parts. The meanings expressed by the concepts in the sentences formed by the students while answering the questions were determined and common expressions were brought together. Common codes were created from these expressions. All coding procedures were performed manually without using any computer application. While creating the codes, the data were read many times, and rearrangements were made where necessary. In line with these arrangements, there were changes in the number of codes from time to time. After all these procedures, the common points of the codes were determined. Finding the common points between the codes is called thematic coding and this process is the categorization of data through codes (Yıldırım & Şimşek, 2016). The codes were categorized in line with the common points between the codes. After this stage, the data were tabulated. The data were expressed numerically by determining the frequency of responses. Numerification of qualitative data increases the reliability of the research, reduces bias, allows comparisons to be made between emerging themes or categories, and allows small-scale research to be tested again later by reaching a larger study group (Yıldırım & Şimşek, 2016). In addition to all these practices, noteworthy student opinions were included in direct quotations.

For the data analysis to be reliable, the data must be coded separately by two different coders. For this reason, the codings made by each of the coders should be compared. After the comparison, the number of codes with consensus and disagreement should be determined. At the end of these processes, the reliability of the data analysis should be determined by using the formula $\frac{\text{Consensus}}{\text{Consensus+ Dissent}} \times 100$

(Miles & Huberman, 1994). Accordingly, in this research, the codings made by the coders were compared and the mean reliability was determined as 90%.

Validity of the Research

In scientific research, research results are expected to be accurate and reliable. For this reason, the researcher must conduct the research impartially as well as present the research data correctly. Therefore, the concept of validity comes to the fore in research (Akan, 2018). Validity is related to the research being reliable and free from errors. It is whether the feature to be measured can be measured (Zohrabi, 2013). It is the absence of errors that would harm the general accuracy of the research (Kazan, 2016).

Internal Validity of the Research

Internal validity in research is to believe that the results observed in the research are caused by the application (Akan, 2018). It is the power of the application carried out in line with the objectives of the research to reveal the reality studied (Karataş, 2015). The research was completed in accordance with the time allocated for teaching the subject of household waste and recycling in the Science Curriculum. Data collection tools were applied to the experimental and control groups in the same way. The path followed in the research process, data analysis, and analysis results were examined by experts.

External Validity of the Research

The external validity of the research is the generalizability of the research results. For generalization, information about the group, place, and time of the study can be expressed. In this way, research results become valid and applicable in other groups, places, and times (Kazan, 2016). The research was conducted in public middle schools and the conditions of these schools. The research was conducted in both middle schools within the time interval specified in the curriculum.

Findings

In this section, the findings obtained from the Household Wastes and Recycling Knowledge Test and the Semi-structured Interview Form are presented to answer the problems of the research.

Findings Related to Household Wastes and Recycling Knowledge Test

Descriptive statistics information about the pre-test and post-test scores of the province experimental and control group students in the Household Wastes and Recycling Knowledge Test are given in Table 4.

Table 4.
Descriptive Statistics of the Household Wastes and Recycling Knowledge Test of the Province Experimental and Control Group Students

Group	Test	N	$\bar{X}$	median	mode	S
Province Experimental Group	Pre-test	29	12.82	13.00	13.00	3.14
	Post-test	29	14.48	15.00	15.00	2.86
Province Control Group	Pre-test	29	12.72	13.00	11.00	2.81
	Post-test	29	13.96	14.00	12.00*	2.78

According to Table 4, it is seen that the pre-test mean scores of the province experimental and control group students in the Household Wastes and Recycling Knowledge Test are close to each other. The mean score was 12.82 in the province experimental group and 12.72 in the province control group. In the post-test, the mean score was 14.82 in the province experimental group and 13.96 in the province control group.

Unpaired t-test results for the pre-test scores of the province experimental and control group students are given in Table 5.

Table 5.
Household Wastes and Recycling Knowledge Test of Province Experimental and Control Group Students Unpaired T-Test Results for Pre-Test Scores

Test	Group	N	$\bar{X}$	S	sd	t	p
Pre-test	Province Experimental Group	29	12.82	3.14	56	.132	.895
	Province Control Group	29	12.72	2.81			

According to Table 5, it was determined that there was no significant difference between the pre-test scores of the province experimental and control group students in the Household Waste and Recycling Knowledge Test ($t_{(56)}$= .132; p > .05). It was determined that the knowledge levels of the province experimental and control group students about household wastes and recycling were close before the application. The Wilcoxon Signed Ranks Test results for the pre-test and post-test scores of the province experimental group students are given in Table 6.

Table 6.
Wilcoxon Signed Ranks T-Test Results for the Pre-Test and Post-Test Scores of the Household Wastes and Recycling Knowledge Test of the Province Experimental Group Students

Post-test - Pre-test	N	Rank Mean	Rank Total	z	p
Negative rank	8	9.81	78.50	-2.049	.040*
Positive rank	16	13.84	221,50		
Equal	5				

*p<0.05

According to Table 6, there was a statistically significant difference (z= -2.049; p < .05) between the pre-test and post-test scores of the province experimental group students in the Household Wastes and Recycling Knowledge Test. The fact that the mean positive rank (13.84) of the province experimental group students was greater than the mean negative rank (9.81) indicates that the significant difference was in favor of the positive rank that is, the post-test. Paired t-test results for the pre-test and post-test scores of the province control group students are given in Table 7.

Table 7.
Paired T-Test Results for the Pre-Test and Post-Test Scores of the Household Wastes and Recycling Knowledge Test of the Province Control Group Students

Test	N	$\bar{X}$	S	sd	t	p
Pre-test	29	12.72	2.81	28	-2.180	.038*
Post-test	29	13.96	2.78			

*p<0.05

According to Table 7, there was a statistically significant difference ($t_{(28)}$= -2.180; p < .05) between the pre-test and post-test scores of the province control group students in the Household Wastes and Recycling Knowledge Test. The fact that the post-test arithmetic averages of the province control group students (13.96) were higher than the pre-test arithmetic averages (12.72) shows that the significant difference was in favor of the post-test. The Mann-Whitney U Test results for the post-test scores of the province experimental and control group students are given in Table 8.

Table 8.
Household Wastes and Recycling Knowledge Test of Province Experimental and Control Group Students and Recycling Knowledge Test of the District Experimental and Control Group Students

Test	Group	N	Rank Mean	Rank Total	U	p
Post-test	Province Experimental Group	29	31.24	906,00	370,000	.428
	Province Control Group	29	27.76	805,00		

According to Table 8, there was no statistically significant difference (U=370.000; p > .05) between the post-test scores of the province experimental and control group students in the Household Wastes and Recycling Knowledge Test. However, the fact that the mean rank of the experimental group students (31.24) was higher than the mean rank of the control group students (27.76) shows that the post-test results were in favor of the experimental group students. This result shows that educational games about household waste and recycling had a positive effect on the province experimental group students. Descriptive statistics information about the pre-test and post-test scores of the district experimental and control group students in the Household Wastes and Recycling Knowledge Test are given in Table 9.

Table 9.
Mann-Whitney U Test Results Regarding the Post-Test Scores of the Household Wastes Household Waste and Recycling

Group	Test	N	$\bar{X}$	median	mode	S
District Experimental Group	Pre-test	19	7.94	8.00	7.00*	1.80
	Post-test	19	12.05	11.00	11.00	2.48
District Control Group	Pre-test	19	11.10	12.00	11.00	2.74
	Post-test	19	13.52	14.00	14.00*	2.89

According to Table 9, the average pre-test score of the Household Wastes and Recycling Knowledge Test was 7.94 in the district experimental group and 11.10 in the district control group. In the post-test, the average was 12.05 in the district experimental group and 13.52 in the district control group. The Mann-Whitney U Test results for the pre-test scores of the district experimental and control group students are given in Table 10.

Table 10.
Mann-Whitney U Test Results for the Pre-Test Scores of the Household Wastes and Recycling Knowledge Test of the District Experimental and Control Group Students

Test	Group	N	Rank Mean	Rank Total	U	p
Pre-test	District Experimental Group	19	12.55	238,50	48.500	.000*
	District Control Group	19	26.46	502,50		

*p<0.05

According to Table 10, it was determined that there was a statistically significant difference (U=48.500; p < .05) between the pre-test scores of the district experimental and control group students in the Household Wastes and Recycling Knowledge Test. It was observed that the knowledge levels of the experimental and control group students about household waste and recycling were different from each other before the application. Paired t-test results for the pre-test and post-test scores of the district experimental group students are given in Table 11.

Table 11.
Paired T-Test Results for the Pre-Test and Post-Test Scores of the Household Wastes and Recycling Knowledge Test of the District Experimental Group Students

Test	N	$\bar{X}$	S	sd	t	p
Pre-test	19	7.94	1.80	18	-5.72	.000*
Post-test	19	12.05	2.48			

*p<0.05

According to Table 11, it was determined that there was a statistically significant difference ($t_{(18)}$= -5.72; p < .05) between the pre-test and post-test scores of the district experimental group students in the Household Wastes and Recycling Knowledge Test. The fact that the arithmetic average of the district experimental group students in the post-test (12.05) was greater than the arithmetic average in the pre-test (7.94) shows that the significant difference was in favor of the post-test. The results of the Wilcoxon Paired Rank t-Test for the pre-test and post-test scores of the district control group students are given in Table 12.

Table 12.
Wilcoxon Signed Ranks T-Test Results for the Pre-Test and Post-Test Scores of Household Wastes and Recycling Knowledge Test of District Control Group Students

Post-test - Pre-test	N	Rank Mean	Rank Total	z	p
Negative rank	4	8.38	33.50	-2.488	.013*
Positive rank	15	10.43	156,50		
Equal	0				

*p<0.05

According to Table 12, it was determined that there was a statistically significant difference (z= -2.488; p < .05) between the pre-test and post-test scores of the district control group students in the Household Wastes and Recycling Knowledge Test. The fact that the positive rank averages (10.43) of the district control group students were greater than the negative rank averages (8.38) indicates that the significant difference was in favor of the post-test. The Mann-Whitney U Test results for the post-test scores of the district experimental and control group students are given in Table 13.

Table 13.
Mann-Whitney U Test Results Regarding the Post-Test Scores of the Household Wastes and Recycling Knowledge Test of the District Experimental and Control Group Students

Test	Group	N	Rank Mean	Rank Total	U	p
Post-test	District Experimental Group	19	16.05	305,00	115,000	.054
	District Control Group	19	22.95	436,00		

According to Table 13, there was no statistically significant difference (U=115.000; p > .05) between the post-test scores of the district experimental and control group students in the Household Wastes and Recycling Knowledge Test. The pre-test and post-test mean scores of the students in the experimental groups are given in Table 14.

Table 14.
Pre-Test-Post-Test Mean Scores of the Students in the Experimental Groups

Group	Test	N	$\bar{X}$
Province Experimental Group	Pre-test	29	12.82
	Post-test	29	14.48
District Experimental Group	Pre-test	19	7.94
	Post-test	19	12.05

According to Table 14, the mean scores of the experimental group students in the pre-test of the Knowledge Test on Household Wastes and Recycling were $\bar{X}_{(\text{Province experimental group})}$= 12.82, $\bar{X}_{(\text{District experimental group})}$= 7.94; and in the post-test, $\bar{X}_{(\text{Province experimental group})}$= 14.48, $\bar{X}_{(\text{District experimental group})}$= 12.05. When the pre-test-post-test score differences are taken into consideration, the score increase is 1.66 for the province experimental group students and 4.11 for the district experimental group students. In this case, it can be seen that the highest score increase belongs to the district experimental group students.

Findings from the Semi-structured Interview Form

The findings obtained from the "Semi-Structured Interview Form" applied to the students in the experimental group in order to obtain the opinions of the students in the experimental group regarding educational games and teaching using educational games are given below.

The frequency distributions of the answers given by the students in the province and district experimental groups to question 1 of the interview form are given in Table 15.

Table 15.
Frequency Distribution of Responses to Question 1 of the Interview Form

Question 1: Have you ever learned a subject of a course by playing educational games?	Province	District
	Frequency (f)	
Yes	14	16
Math lesson	-	9
Digits	-	5
Angles	-	1
Science lesson	7	4
Organelles	2	-
Effort	-	1
Turkish lesson	3	2
Words	1	-
English lesson	1	1
Words	1	1
Religious Culture and Ethics lesson	-	1
No	15	3

According to Table 15, it is seen that most of the students in the province group encountered educational games for the first time within the scope of this research. It is seen that the students who encountered educational games in their lessons learned the subjects of Science, Turkish and English lessons through educational games. It is seen that the students who answered "Yes" to question 1 in the province experimental group learned the subjects of the Science lesson with educational games to a greater extent.

The statements of some students in the province experimental group who had previously encountered educational games in their lessons are given below.

> S_3: In science class at school, the teacher was taking someone to the blackboard. And others were telling their characteristics and I think I learned faster that way.
> S_6: Yes, we improved by playing games in English lessons. We learn English words better by playing hangman.

S_{24}: Yes, it happened. “Taboo” for words in Turkish lessons, and “What does it have?” for tasks of organelles in Science lessons, etc.

It is seen that almost all of the students in the district group encountered educational games in their lessons. In this group, it is seen that the students who encountered educational games in their lessons learned the subjects of Mathematics, Science, Turkish, English, and Religious Culture and Ethics lessons through educational games. It is seen that the students who answered “Yes” to question 1 in the district experimental group learned the subjects of the Mathematics lesson with educational games to a greater extent. The statements of the students in the district experimental group who had previously encountered educational games are given below:

S_1: I learned about digits in mathematics lessons thanks to the game I played.
S_{11}: Yes, it happened. In English, we had a vocabulary contest on the board and there were some words I didn't know and I learned them.”
S_{16}: Yes. In math, we played with digits and angles. Thanks to the game, I was able to understand the subject.

The frequency distributions of the responses of the students in the province and district experimental groups to question 2 of the interview form are given in Table 16.

Table 16.
Frequency Distribution of Responses to Question 2 of the Interview Form

Question 2: How would you evaluate the educational games about household waste and recycling in terms of their suitability for your age group?	Province	District
	Frequency (f)	
Age Groups	23	19
Effective in creating positive thoughts towards the lesson/games	10	6
Subject/games are understandable	3	7
Informational	2	4
Facilitates learning	2	-
Can be used in all age groups	2	1
Suitable for Generation Z	2	2
Tools and equipment used	1	1
Pawn, bells, cards, riddles	1	-
Board game	-	1
Enabling effective learning	1	1
Not Suitable for the Age Group	6	-
Can be used in lower age groups	4	-
Games are hard to understand	1	-
Games are not a learning tool	1	-

According to Table 16, it is seen that the majority of the students in the province and district experimental groups found the games suitable for their age groups. The reason why educational games are found suitable for the age group is that they are effective in creating positive thoughts towards the lesson and games, that the subjects and games are understandable, informative, and suitable for use by all age groups as well as Generation Z, and are thought to facilitate effective learning. The reasons for not being suitable for the age group were that it was found suitable for use by lower age groups, there were difficulties in understanding the games and the game was not seen as a learning tool. The statements of some students in the province experimental group who found the educational games suitable for their age group are given below.

S_1: I think learning with games is more enjoyable and better. It is both memorable and fun. By the end, I understand the subject.
S_3: I think that the games played do not need to be suitable for any age group. Because the games we played were educational games suitable for all ages and they were all very fun.
S_{24}: Actually, I can evaluate it in a good way. Because it's normal for kids our age to like games like this in this new generation, and that's why we inevitably learn while we play. So it is suitable both in terms of game and education.

Only a few of the students in the province experimental group found the educational games unsuitable for their age group. The reason for this is that it is thought that educational games can be used for

lower age groups, that games are difficult to understand, and that games are not learning tools. The statements of some students in the province experimental group who did not find the educational games suitable for their age group are given below.

> S_6: I think these games are not suitable for seventh graders. I think these games should be played by 5th or 6th graders.
> S_{11}: I think it is quite below my age group, so children between the ages of 8-9 can play.
> S_{18}: "It is childish because when I listen to the lesson, it is a lesson, it is compulsory, it is a subject, but the game is fun.

It is seen that all of the students in the district experimental group found the educational games used in the research appropriate for their age group. The statements of some students in the district experimental group who found the educational games suitable for their age group are given below.

> S_{10}: I think it is very suitable, I learned many things. We learn while playing and have fun while learning.
> S_{13}: "It is suitable because the lesson was more enjoyable.
> S_{18}: It was suitable for our age. Because we always play, we can learn these subjects by playing games.

The frequency distributions of the responses of the students in the province and district experimental groups to question 3 of the interview form are given in Table 17.

Table 17.
Frequency Distribution of Responses to Question 3 of the Interview Form

Question 3: Did you have any difficulties in understanding the educational games on Household Waste and Recycling? If your answer is 'Yes', for which reason did you experience difficulties?	Province	District
	Frequency (f)	
No I did not experience any difficulty	20	16
Level of game		
Understandable	6	7
Impact on affective domain		
It was fun and good	6	1
Impact on the cognitive domain		
Reinforced knowledge	-	1
It was informative	-	1
Yes I had difficulties	9	3
Application Process		
I found the "I Got it!" game confusing/ hard to understand	2	3
Reflection game	2	-
It was a bit complicated	2	-
It was noisy	1	-
Time was insufficient in "Who Won the Cup?"	1	-

According to Table 17, it is seen that most of the students in the experimental group did not have any difficulty in understanding the educational games. A small number of students had difficulty in understanding educational games. It is also stated that the difficulties experienced are due to the environment or the nature of the game.

Some of the statements of the students in the province experimental group who did not have difficulty in understanding the educational games are given below:

> S_7: No, I had no difficulty at all. Everything was very clear and obvious. I loved the games because they were clear and it was a lot of fun.
> S_{12}: No, I had no difficulty. Not all the games were very good. The best was the last game we played, ring!.
> S_{19}: It was very clear and obvious.

Some of the statements of the students who had difficulty in understanding educational games in the province experimental group are given below:

> S_1: Yes, in the game I Got it! it was too complicated. When we ask the question, we come up with different answers and when we mix it up, we get indecisive and confuse the game.
> S_8: Yes, in the reflection game, but I think because it was too noisy.
> S_3: Yes, I had difficulty in some of them, but I think that the information I learned will be very useful for me after the games are over.

In the district experimental group, only one of the three students who had difficulty in understanding the educational games expressed the reason for their difficulty. The difficulty experienced by this student was due to the fact that the game "I Got it!" was found confusing by the student. Some of the statements of the students who did not have difficulty in understanding educational games in the district experimental group are given below:

> S_2: No, it had a subject that I think everyone can understand.
> S_{10}: No, I did not have any difficulty. The games are very enriching and informative.
> S_{14}: No, I did not have any difficulty because it was easy and fun.

Some of the statements of the students who had difficulty in understanding educational games in the district experimental group are given below:

> S_{16}: Yes, I had difficulties in understanding the game of I Got it!
> S_{18}: Yes, the I Got it! game. It was hard to find the answers while playing the game.
> S_{19}: Yes. I had a hard time understanding the I Got it! game.

The frequency distributions of the responses of the students in the province and district experimental groups to question 4 of the interview form are given in Table 18.

Table 18.
Frequency Distribution of Responses to Question 4 of the Interview Form

Question 4: Was it useful to use educational games about household waste and recycling? If so, what kind of effect did it have?	Province	District
	Frequency (f)	
Yes, it was useful	28	19
Impact on the cognitive domain		
Provided information	9	3
Institutions and organizations	2	-
Recyclable wastes	-	2
Waste management	1	-
Enabled effective learning	7	12
Made learning easier	6	4
Raised Awareness	1	-
Impact on affective domain		
Developed positive emotions towards the lesson/subject	11	5
Made learning fun	4	1
Saved the lesson/subject from being boring	3	2
Enabled learning in a different way	1	-
Improved concentration	-	1
Increased environmental awareness	1	-
No, it was useless.	1	-

According to Table 18, it is seen that the students in the province and district experimental groups found the use of educational games in teaching the subject of household wastes and recycling useful in cognitive and affective domains. Students found educational games cognitively effective in terms of informing, providing effective learning, and making learning easier, and emotionally effective in terms of developing positive feelings towards the lesson and the subject and increasing environmental awareness.

Some of the evaluations of the students in the province experimental group regarding the benefits of the educational games played within the scope of the research are given below:

> S_5: Yes, for example, I did not know that recyclable materials can be given to Mukhtar's office.
> S_{13}: Yes. I learned more in less time.
> S_{19}: Yes. I have become more conscious about this subject. My sensitivity to the environment has increased even more.
> S_{24}: Yes. Some parts of it I would definitely have to memorize and it is difficult to memorize. But it stayed in my mind after repeating it. So it was a great help.

It is seen that a student in the province experimental group did not find the educational games played within the scope of the research useful; however, he did not make any explanation on this issue. The evaluations of the students in the district group regarding the benefits of the educational games played within the scope of the research are given below:

> S_5: Yes. Maybe we couldn't understand it by writing, but we learned it through the game.
> S_{18}: Yes. I learned about recyclable waste through games.
> S_{19}: Yes, it did. I understood what recyclables are.

The frequency distributions of the answers given by the students in the province and district experimental groups to question 4 of the interview form are given in Table 19.

Table 19.
Frequency Distribution of Responses to Question 5 of the Interview Form

Question 5: What are your thoughts on the use of educational games in science lessons?	Province	District
	Frequency (f)	
Positive thoughts	26	19
Impact on affective domain		
The lesson/subject is fun and enjoyable	16	11
Increases motivation to study	4	-
Saves the lesson/subject from being boring	2	3
Helps to concentrate on the subject	1	-
Impact on the cognitive domain		
Facilitates learning	5	-
Enables effective learning	2	4
Informing	2	2
Raises awareness	1	-
It is better to use educational games together with traditional ways of learning	-	1
Applicability		
Can be included more	3	3
Can be used in other lessons	3	1
Can be used for other subjects	1	3
Negative thoughts	3	-
Games make the subject incomprehensible	2	-
It is better to teach with traditional ways of learning	1	-

According to Table 19, it is seen that the students in the province and district experimental group had positive opinions about the use of educational games in the Science lesson. It is seen that students find the use of educational games in Science lessons effective in terms of affective aspects as it provides positive development towards the lesson and the subject; and in terms of cognitive aspects as they find it more useful to facilitate learning, provide effective learning, inform, raise awareness and use educational games together with traditional learning methods.

It was determined that the students wanted more educational games to be included in the Science lesson and that they wanted to encounter educational games in other lessons and subjects other than

the Science lesson. The statements of some students in the province experimental group who had positive thoughts about the inclusion of educational games in the Science lesson are given below:

> S_2: Science lesson is very enjoyable but it is a difficult lesson to understand. When we enjoy the games, we want to play more and understand more.
> S_{11}: I think if it is played in difficult subjects, the subject can be understood faster and it provides a great motivation.
> S_{24}: Actually, science is a lesson that sometimes requires memorization, sometimes requires thinking, and sometimes requires both. The game is very good because it's good for thinking and intelligence, and it's good for sticking in our minds as we play.

In addition to the positive statements about the use of educational games in the Science lesson, negative thoughts were expressed by three students in the province experimental group. The reason for these negative statements is that they think that the subject is not understood with educational games and that it is better to teach the lesson with traditional learning methods.

The statements of the students in the province experimental group who had negative thoughts about the inclusion of educational games in the Science lesson are given below:

> S_{13}: It is fun to play games but I cannot learn very clearly. I need to ask some things, but I can't when I'm playing."
> S_{18}: Bad. I tried to understand the lesson and I couldn't.
>
> S_{29}: I think it would be better if it was a normal lesson.

The statements of some students in the district group who had positive thoughts about the inclusion of educational games in the Science lesson are given below:

> S_8: It was good, but it would be better if there was such a game for other lessons too.
> S_{11}: I think we should keep playing. It is good
> S_{15}: I learned the subject in a fun way. It should be in other subjects as well.

Discussion, Conclusion and Recommendations

When the pre-test and post-test scores of the province and district experiment group students on the household wastes and recycling knowledge test were analyzed, it was concluded that the educational games were effective in raising awareness on the subject of household wastes and recycling (Tables 4, 6, 9, 11). In reaching this conclusion, it is thought that the information and visuals in the educational games and the structure of the games that enable students to interact with their peers are effective in information and awareness. Similarly, Can (2010) examined the effect of science teaching with educational games on the academic achievement of 8th-grade students and concluded that teaching with educational games was more effective than traditional teaching methods. It was stated that the fact that students were active in educational games and interacted with their peers, that students liked educational games, that the subjects became fun with educational games, and that they appealed to the sensory organs could be effective in the emergence of this result. Güler (2011) concluded that the educational games used in teaching the subject of cells and organelles were more effective in increasing student achievement than the teaching carried out in line with the activities in the science curriculum. The reason for the increase in students' achievement was stated as the fact that teaching with educational games increased the motivation of the students and the lesson became more efficient due to motivation. Likewise, Kaya and Elgün (2015) found that the educational games used in the teaching of our planet Earth unit; Alıcı (2016) in the unit of cell division and heredity; Yıldız, et al. (2016) in the teaching of the circulatory system subject were more effective in increasing student achievement than the teaching carried out in line with the activities in the Science curriculum. Mariscal, et al. (2012) found that the educational card games used in the periodic table and elements subject had an educational effect even on students with low achievement and no interest in chemistry subjects. Rastegarpour and Marashi (2012) stated that educational cards and computer games are effective in learning abstract concepts. In the study conducted by Gülsoy and Uçgun (2013), it was concluded that educational games were effective in the development of students' vocabulary. In the study conducted by Liu and Chen (2013), it was determined that educational card games increased

students' knowledge. Rachman, et al. (2019) concluded that Android-based educational games used to explain fruits and vitamins were effective in understanding the types of vitamins in fruits. The results obtained from the studies support the results of the research conducted.

When the mean score change of the province and district experiment group students in the household wastes and recycling knowledge test is examined, it is seen that the pre-test and post-test mean score difference of the district experiment group students is higher than the mean score difference of the province experiment group students (Table 14). This shows that the teaching using educational games was more effective on the district experiment group students. Although they were in the same age group and at the same level of education, it was determined that more students in the district experiment group than in the provincial experiment group stated that educational games provided effective learning (Table 18) and that they wanted to learn with educational games in subjects other than household wastes and recycling (Table 19). In line with these statements about educational games used in the learning environment, it is thought that awareness about household waste and recycling is affected by students' cognitive and affective characteristics. Because cognitive and affective areas in learning are a part of education and are affected by each other (Biber, 2012). Besides, each student has a different learning style. Learning styles also vary due to the developmental characteristics and expectations of students (Eyinç & Engin, 2022).

It was determined that most of the students encountered educational games in many of the basic courses. It is seen that the courses in which educational games are encountered are Mathematics, Science, Turkish, English, and Religious Culture and Ethics Knowledge. In İnce's (2021) study, it was found that most of the students in the research group had previously encountered educational games in Mathematics, Science, Turkish, English, and Social Sciences lessons.

In the research, the students stated that they encountered educational games in the teaching of digits and angles in Mathematics, organelles and effort in Science, and vocabulary in Turkish and English. Among these results, it is noteworthy that they stated that they played educational games, especially in the teaching of digits and angles in Mathematics. Because the topic of digits is included in the 5th-grade "Numbers and Calculations" and the topic of angles is included in the 6th-grade "Geometry and Measurement" learning area. Considering that the applied students are studying in the 7th grade, the fact that they remember the lesson and the subject taught by playing educational games in the 5th and 6th grades shows how effective the educational game technique is on students. Because, as Uskan and Bozkuş (2019) stated, all senses of students are active in educational games. This situation ensures the internalization of knowledge, skills, and behaviors and the realization of permanent learning.

It is seen that the games played in the classroom environment are "What does it have?" in the Science lesson, "Taboo" in the Turkish and Religious Culture and Ethics lessons, and "Hangman" in the English lesson. It is seen that the educational games identified in the research and seen to be included in basic courses are also included in the literature. In the study of Genç, et al. (2012), "Taboo", which includes the concepts in the 6th, 7th, and 8th grade Science and Technology course curriculum, was prepared and students were allowed to play the game. Students were videotaped while playing the game. After the games, interviews were conducted to obtain students' opinions about the game. Based on the findings, it was stated that it is important for teachers to benefit from similar activities in determining misconceptions. Gürdal and Arslan (2011) stated in their study that educational games such as "Hangman", "What does it have?" and "Deriving words from the last letter" can be utilized while teaching Turkish words. In the research, S_3 student who encountered educational games in the science lesson in the province experiment group said, "In the science lesson at school, the teacher would take someone to the board. The others would say its characteristics and I think I learned faster in this way." In line with these statements, it is seen that the student encountered a cryptic game in the lesson. Karasan (2013) discussed educational games that can be used in the Religious Culture and Ethics lesson in 6 groups under the titles of memorization games, writing games, discussion games, drama-role games, communication games, and card puzzle games. While he included "Taboo" and "What does it have?" games under the title of communication games, he stated that the "Cipher text" game can be included under the title of card puzzle games.

It was determined that the educational games were suitable for the age groups of the students. It was stated by the students that the educational games were understandable, and informative, facilitating learning, and enabling effective learning. It was determined that the structure of the games and the materials used were suitable for Generation Z. In addition, it was seen from the statement of S_{18} student in the province experiment group, "It is childish because while listening to the lesson, it is a lesson, it is compulsory, it is a subject, but the game is fun" that educational games have an entertaining structure, but because of this feature, they cannot be a learning tool. However, educational games cannot be considered without educational activities (Dolunay & Karamustafaoğlu, 2021).

It was determined that students had no difficulty in understanding educational games. In line with the students' opinions, it was determined that the educational games used in the research were understandable, cognitive, and affective learning tools that had an impact on students. Kılıç and Karamustafaoğlu (2020) also took the opinion of teachers about the educational game they included in their research. Teachers found the educational game can be understandable and the instructional level of the game should be high. They also stated that the students approached the educational game with interest and found the educational game good in general. In line with the opinions received from the teachers, it was concluded that educational games are effective in gaining cognitive and affective skills in students. In addition, it was determined that there were students who had difficulty in understanding educational games. It is seen that the difficulties experienced are due to the environment or the game structure and duration. Such evaluations of educational games help to transform the negative aspects of the related subject into positive ones and to further improve the successful points (Akandere, 2013).

It is seen that students find the use of educational games about household waste and recycling useful. In line with the opinions of the students, it was determined that they had information about institutions and organizations, recyclable wastes, and waste control within the scope of household wastes and recycling through educational games. In line with the opinions of the students, it is seen that educational games are learning tools that facilitate learning, enable effective learning, and raise awareness. These features show that educational games are an effective learning tool in the cognitive field. It was determined that educational games make learning fun, save the lesson or subject from being boring, are seen as a different way of learning, and are effective in improving concentration and increasing environmental sensitivity. These features show that educational games are an effective learning tool in the affective domain. In the research conducted by Hazar and Altun (2018), in which the importance of educational games for the learner was discussed, the participants emphasized that they found educational games important in terms of providing permanent learning, making the lesson fun, and increasing motivation. Teachers' opinions on educational games are that educational games provide easier motivation for the lesson, concretize the subject, are effective in learning by having fun, and provide permanent learning (Ertuğrul & Karamustafaoğlu, 2021; Karamustafaoğlu & Coşgun, 2021). In addition, research shows that educational games are also effective in motivating science learning (Yıldız, et al., 2016; Yenice, et al., 2019). Educational games are effective in scientific concept learning (Al-Tarawneh, 2016). Due to the positive effects of educational games on cognitive and affective domains, educational games can be utilized in learning environments (Castellar, et al., 2014). Students become active and interact socially during the game. For this reason, the presence of entertainment, which is effective in student success, should not be ignored in learning environments (Gibbon, et al., 2017). Students also state that they learn by having fun with educational games and that they engage in cognitive activities such as thinking and predicting through games (Gençer & Karamustafaoğlu, 2014).

Students expressed that they would like educational games to be used in Science lessons and other lessons as well. In addition, it was determined that they wanted educational games to be included in subjects other than household waste and recycling. These expressions show that educational games can be applied in the Science lesson and other lessons other than it, as well as in subjects other than household waste and recycling. It is seen that educational games help to develop positive emotions towards the lesson or subject, increase motivation, save the lesson and subject from being boring, and help to improve concentration. These positive effects of educational games on students show that educational games affect students in the affective field. In addition, students stated that educational games facilitate learning, enable effective learning, inform, and raise awareness and that it would be

better to use educational games and traditional learning methods together. These statements of the students show that educational games affect students in the cognitive domain. In this case, it can be said that educational games used in Science lessons are an effective tool in cognitive and affective domains. Although positive opinions about the use of educational games in Science courses were dominant, a few students stated that the subject could not be understood with games and that it was better to use traditional learning methods. It is thought that the different opinions identified in the research are also due to individual differences in students. Because not all students in the class have the same characteristics, but each student has a different personality and world. For this reason, not every child may show the same interest and desire in a lesson with educational games (Akandere, 2013).

It was concluded that the lessons conducted with educational games positively affected the knowledge and awareness of the experimental group students about household waste and recycling. In this context, it is recommended to include educational games in the teaching of different subjects in the Science lesson or other lessons and to investigate the effect of educational games on students.

Educational games have led to the formation of positive feelings and thoughts towards the lesson, subject, and applied technique in students. For this reason, it is recommended to include educational games at various education levels.

In the research, it was determined that educational games made the subject comprehensible, enabled learning while having fun, and saved the lesson from being boring. Considering the advantages of educational games, it is recommended that educational games should be included more in the in-class activities of students.

Since the educational games used in the research are card games, they are also suitable for use outside the classroom without time and space limitations. For this reason, it is recommended that the educational games used in the research should also be used in out-of-class learning.

It is recommended that the educational games used in the research be transferred to the computer environment and made available to students through Web 2.0 tools.

Education on household waste and recycling has gained a visual and auditory structure through educational games. For this reason, it is recommended to investigate the effect of educational games on knowledge retention on household wastes and recycling.

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