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A Study to Increasing Global Climate Change Awareness Levels of Z Generation Individuals With Digital Games: The Case of Balikesir

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Abstract

The aim of this research is to increase awareness of “Global Climate Change” with digital games that will enable Z-generation individuals to focus as an alternative to traditional teaching methods. It was determined whether the "Global Climate Change" scale scores of the students varied according to variables such as gender, parental education level, parental occupation and income level.A pre-test/post-test experimental design with a control group was used in this study. The sample group consists of a total of 58 students, 29 in the control group and 29 in the experimental group, studying in the 9th grade in a project school in Balıkesir in the 2022-2023 academic year. In the study, the “Global Climate Change Awareness Scale” was used as a pre-test and post-test in the experimental and control group. The Cronbach Alpha reliability coefficient for the entire scale is .826. In the research, the solutions to the data obtained from the data collection tools were carried out by using the SPSS package program. In the analysis of the data, mean, standard deviation, ANOVA, and t-test were used and the level of significance was taken as $p<.01$. Firstly, Flippity, Kahoot, and Quizizz-based digital games including scale questions were prepared. While no significant difference was found between the experimental and control group in the pre-test analysis, it was found that there was a significant mean difference between the groups in favor of the experimental group in the post-test. Moreover, the opinions of the experimental group students were taken after the implemantation.

Keywords: Digital Game, Flippity, Generation Z, Global Climate Change, Kahoot, Quizizz

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INTRODUCTION

Global warming is defined as the increase in average temperature in the Earth's atmosphere, particularly in areas close to the Earth's surface, either due to human intervention or natural factors. Although it is thought that the global climate characteristics have not changed after the settled life of the societies, the findings collected from the old years until today are an indication that this is not the case. While the quality of global climates can differ without environmental and human influence, the effects of today's human-based actions contribute significantly to this differentiation (Aksay et al., 2005).

Climate scientists say that there is a problem with the balance of climates on a global scale. In addition, the Second Evaluation Report of the Intergovernmental Conference on Climate Change (IPCC), conducted in cooperation with the United Nations(UN) Environment Program and the World Meteorological Organization (WMO), concluded that the human impact is one of the main causes of the global climate change (IPCC, 1996; UN/FCCC, 1996). Studies showed that without taking necessary measures, the accumulation of greenhouse gases in our atmosphere will lead to disruptions and changes in climates, resulting in significant problems (Çakırlar, 2015).

The Industrial Revolution between the years 1775-1800 and as a result of the increase in the population since the middle of the 19th century, as a result of industrial systems and human activities, the excessive greenhouse effect of gases such as carbon dioxide, methane and nitrous oxide, especially in the near-earth part of the troposphere, caused the temperature to increase gradually in the atmosphere near the earth's surface. There have been human activities in the period from the first societies to the Industrial Revolution which deeply affected the world, but none of them reached such serious dimensions as to gradually change the global climates and reveal the phenomenon called global warming (Galip, 2006).

Global warming and climate change are primarily the supply of energy required in industry and transportation with fossil fuels, the destruction of forests and the abnormal increase in the temperature of the world with the mentioned human activities. The greenhouse effect, which occurs due to the increase of synthetic chemicals such as chlorofluorocarbons, as well as gases such as methane and carbon dioxide, is the most serious factor causing the increase in temperature (Atik and Doğan, 2019).

When the negative effects of global warming and climate change on the balance of our world are examined, it is of great importance to raise awareness and education about these problems (Demir et al., 2016). The basis of environmental problems such as global warming is the low level of knowledge, attitudes, awareness and value given to the environment by individuals. In order to build

and maintain healthy communication between people and the environment, it is essential to raise individuals with environmental awareness and a high level of awareness. This can only be met with an effective education (Atik and Doğan, 2019).

The generation that consciousness education should target is the Z generation. The new generation, known as the Z generation or the digital generation, was born in the digital age. Therefore, it is stated that it is different from other generations. This generation's mastery of digital knowledge and skills without the need for an extra educational process is subject to reactions. However, it is evident that digital devices and internet technologies constitute a significant part of their daily lives. For this reason, it is predicted that traditional education methods and platforms operating in the old generations will not be enough to attract the attention of the Z generation (Somyürek, 2014).

Individuals of the Z generation differentiate from other generations as individuals who follow technological developments closely, have a high level of commitment to the Internet, and communicate through different communication channels. Generation Z individuals, who are fast in speaking, thinking, learning, growing and consuming, see the time they are away from the internet and social media as a waste. Their ability to run multiple jobs simultaneously is also quite high (Çarıkçı and Göktaş,2015).

The way to attract the attention of Generation Z in education and training is through digital technologies. The fact that this generation is intertwined with technology in every aspect of its life has changed the concept of game compared to previous generations. The attention of the new generation is on digital games. One of the easiest and most accessible ways to have fun is through digital games. In addition, they are games in which life is experienced and develop strategic thinking skills, it is a tool that provides the social, spiritual and intellectual development of the individual and supports his routine behaviors and character. Digital game technologies are games that include formations that we can come across in our lives and that use the entertainment approach of traditional games as a tool. They rely on education and training as a foundation. It aims to guide players towards certain goals. It provides the opportunity to experience the skills needed in real life such as analysis, organization and planning in the virtual community. The virtual environment offers the opportunity to provide the same conditions (Bülbül, 2022).

The games that interact with the interface applications, created through the advanced and multiple stimuli of the technology, are called digital games. Educational digital games, on the other hand, are helpful tools for information and general topics to be taught during the lessons. They occur for purposes such as improving their ability to solve problems. The use of these games in education provides students with the opportunity to question, exchange information and develop their creativity

skills. Therefore, it is very necessary to use the games mentioned during the training (Öztürk and Çakır, 2022)

In short, in order for students to reach the desired level of consciousness, a tool should be presented, suitable for the Z generation, taking into account the environments in which the generation grew up and the technological tools surrounding them. Digital games are the most suitable tool for an effective education. Games that provide both material and interactive learning in Web 2.0-based education such as Kahoot, Quizizz, and Flippity more than fulfill the aforementioned "effective education" purpose. Kahoot platform provides students' knowledge levels and process assessments. It is also a game-based platform used for purposes such as taking a break from traditional classroom activities. The main purpose of Kahoot is to enhance students' learning processes, class unity, and dynamics by increasing concentration, enjoyable learning, and motivation (Wang and Tahir, 2020). With Kahoot, students exhibit higher success in the learning process than with traditional methods, with the effects of the feeling of competition. In addition, Quizizz is a digital test-heavy game that supports this. Quizizz contains many materials that can be applied in the classroom environment. It is multiplayer and students can control their response speed through the application (Basuki and Hidayati,2019). Unlike Kahoot, Quizizz puts questions directly in front of students, giving players an experience that progresses at their own pace. Both apps offer a fun and motivating experience by measuring the level of speed as well as knowledge.

Flippity is quite different from Kahoot and Quizizz apps. As a goal, Flippity allows teachers to prepare templates in the classroom, both on paper and through a single screen. It is also a Web 2.0 tool such as Kahoot and Quizizz that supports the development of the teaching and learning process. It contains materials that can support many teaching areas, from templates similar to digital games to templates of different types. Unlike Kahoot and Quizizz, it is not test-based. Students say and calculate answers and scores in the traditional way.

Creating awareness about global climate change among the individuals of Generation Z, who will be the adults of the future, is of great importance. Studies that assess people's awareness levels regarding global climate change, in other words, conducting situation analyses, can be found in the literature. However, there are very limited efforts to increase awareness levels among individuals. In this context, our study aims to increase the awareness of Generation Z individuals, who were born into technology and do not settle for traditional teaching methods, using digitally prepared Flippity, Kahoot, and Quizizz games that will capture their interest and ensure their focus. The fact that Kahoot and Quizizz games are not widely used outside of English and Computer Science classes and that Flippity has not been found to be used in Turkish educational resources highlights the original and innovative aspect of our study.

METHOD

In this section, information about the design of the research, the study group, data collection tools, data collection and data analysis are given.

Research Model

In the research, a pre-test/post-test experimental design with a control group was used. Experimental designs are used to determine cause-and-effect relationships, where the desired data are produced under the researcher's control (Büyüköztürk, 2010). This study was carried out in the 2022-2023 academic year. The experimental design is presented in Table 1:

Table 1. Pre-test/Post-test experimental design with a control group

Experimental Group (Class A)	Control Group (Class B)
Pre-test	Pre-test
Practice	x
Post-test	Post-test

Study Group

Information from 58 students in the study is illustrated in Table 2:

Table 2. Distribution of the sample group by gender

Groups	Female	Male	Total
Expt. group	16	13	29
Control group	14	15	29
Total	30	28	58

The sample group consists of a total of 58 students, 29 in the control group and 29 in the experimental group, studying in the 9th grade in a project school in Balıkesir in the 2022-2023 academic year (Table 2).

Data Collection Instruments

Global Climate Change Awareness Scale, a five-point Likert-type scale, consisting of 21 questions developed by Deniz, İnel, and Sezer (2020) (Annex 1), and a personal information form consisting of 20 questions were used as data collection tools. Global Climate Change Awareness Scale has four sub-dimensions: “Awareness of the Effects of Global Climate Change on Natural and Human Environment.”, "Awareness of Global Organizations and Agreements"; "Awareness of the Causes of Global Climate Change" and "Awareness of Energy Consumption of Global Climate Change". For each item on the scale, the students were asked to rate it on a Likert scale from (1) “I am not aware at all” to (5) “I am fully aware”. They found the reliability coefficient for the sub-

dimensions as "Awareness of the Effects of Global Climate Change on Natural and Human Environment"(NH) α: ,876; "Awareness of Global Organizations and Agreements" (GO) α: .814; "Awareness of the Causes of Global Climate Change"(COE) α: ,814;"Awareness of Energy Consumption of Global Climate Change"(EC) α: ,725. They found the Cronbach Alpha reliability coefficient for the whole scale as .826.

Moreover, semi-structured interviews were conducted with 11 students in the experimental group who volunteered to express their opinions about the application. These interviews provided a comfortable and easy environment for students to freely express themselves. The opinions of the students about digital games were given in the findings section.

Data Collection and Analysis

The purpose of the research was to determine whether there is a significant difference between the awareness levels of global climate change among Generation Z individuals and variables such as gender, parental educational status, parental occupation, family income level, membership in civil society organizations, level of curiosity about the environment, following environmental developments, level of alerting those who harm the environment, and opinions on teaching environmental courses in schools. ANOVA and *t*-test were performed to test for significant differences between the variables. The significance level was set at 0.05. The statistical analysis was performed using SPSS 24 software. In the qualitative findings section where student opinions were collected, the responses obtained from the interviews were coded as "Student 1, Student 2, ... Student 29" and presented verbatim.

FINDINGS

In order to determine the difference between the pre-test and post-test scores of the experimental group students on the global climate change awareness scale, a *t*-test was conducted and the findings are presented in Table 3.

Table 3. The Comparison of Pre-test and Post-test Scores in the Experimental Group

	N	**x̄**	**SD**	**t**	**df**	**p**
Expt. Group Pre-Test	29	3,26	.63	-9,15	28	.000*
Expt. Group Post-Test	29	4,35	.53			

p<0.05 *Significant Difference

According to the *t*-test results in Table 3, a statistically significant mean difference was found between the pre-test ($\bar{X}$ = 3.26, SD = 0.627) and post-test ($\bar{X}$ = 4.35, SD = 0.533) scores in the experimental group [t(28) = -9.15, p < 0.05].

The *t*-test was conducted to determine the difference between the global climate change awareness scale pre-test and post-test scores of the control group students, and the findings are presented in Table 4.

Table 4. Comparison of Control Group Pre-test and Post-test

	N	**x̄**	**SD**	**t**	**df**	**p**
Control Group Pre-Test	29	3,03	.99	1,13	28	.266
Control Group Post-Test	29	3,23	.63			

According to the *t*-test result presented in Table 4, there was no significant mean difference between the control group pre-test ($\bar{X}$ = 3.03, SD= 0.99) and post-test ($\bar{X}$ = 3.23, SD= 0.63) scores [t(28) = -1.13, p > 0.05].

The findings related to the comparison of the scores of the experimental and control group students from the sub-dimension and the total of the global climate change scale applied as pre-test and post-test are presented in Table 5.

Table 5. The comparison of scores obtained by the experimental and control group students on the sub-dimensions and total of the global climate change scale administered as pre-test and post-test

	Measure	**N**	**x̄**	**SD**	**t**	**df**	**P**
Natural and Human-Pre-test(NH_E)	Expt.	29	35.13	6.37	.432	56	.667
	Control	29	34.17	10.19	.432	47.02	.667
Global Organization-Pre-Test (GO_E)	Expt.	29	11.93	5.82	-1.182	56	.242
	Control	29	14.03	7.60	-1.182	52.42	.242
Causes of Emergence-Pre-Test (COE_E)	Expt.	29	7.55	3.70	.519	56	.606
	Control	29	7.03	3.87	.519	55.89	.606
Energy Consumption-Pre-Test(EC_E)	Expt.	29	13.93	1.88	1.566	56	.123
	Control	29	12.75	3.56	1.566	42.58	.125
Total of Pre-test (T_E)	Expt.	29	68.55	13.17	.120	56	.905
	Control	29	68.00	20.90	.120	47.21	.905
Natural and Human-Post-Test(NH_O)	Expt.	29	40.27	4.97	3.332	56	.002*
	Control	29	34.10	8.64	3.332	44.72	.002*

Global Organization-Post-Test (GO_O)	Expt.	29	24.34	5.23	9.352	56	.000*
	Control	29	11.06	5.57	9.352	55.77	.000*
Causes of Emergence-Post-Test (COE_O)	Expt.	29	12.89	2.76	8.982	56	.000*
	Control	29	6.00	3.07	8.982	55.41	.000*
Energy Consumption-Post-Test (EC_O)	Expt.	29	14.00	1.60	2.137	56	.037*
	Control	29	12.48	3.47	2.137	39.43	.039*
Total of Post-test (T_O)	Expt.	29	91.51	11.21	8.603	56	.000*
	Control	29	63.65	13.36	8.603	54.36	.000*

$p<0.05$ *Significant Difference

According to the *t*-test results in Table 5, no significant difference was found in the pre-test scores between the experimental and control groups. In the "Natural and Human Pre-Test (NH_E)" subscale, the experimental group had a mean score of 35.13 (SD=6.37), while the control group had a mean score of 34.17 (SD=10.19). In the "Global Organization-Pre-Test (GO_E)" subscale, the experimental group had a mean score of 11.93 (SD=5.82), while the control group had a mean score of 14.03 (SD=7.60). In the "Causes of Emergence-Pre-Test (COE_E)" subscale, the experimental group had a mean score of 7.55 (SD=3.70), while the control group had a mean score of 7.03 (SD=3.87). In the "Energy Consumption-Pre-Test (EC_E)" subscale, the experimental group had a mean score of 13.93 (SD=1.88), while the control group had a mean score of 12.75 (SD=3.56). In the "Total of Pre-test (T_E)" subscale, the experimental group had a mean score of 68.55 (SD=13.17), while the control group had a mean score of 68.00 (SD=20.90). $p>0.05$ indicates that there is no significant difference between the groups. On the other hand, according to the *t*-test results, significant differences were found in the post-test scores between the experimental and control groups in the subscales and the total score. In the "Natural and Human-Post-Test (NH_O)" subscale, the experimental group had a mean score of 40.27 (SD=4.97), while the control group had a mean score of 34.10 (SD=8.64). In the "Global Organization - Post-Test (GO_O)" subscale, the experimental group had a mean score of 24.34 (SD=5.23), while the control group had a mean score of 11.06 (SD=5.57). In the "Causes of Emergence-Post-Test (COE_O)" subscale, the experimental group had a mean score of 12.89 (SD=2.76), while the control group had a mean score of 6.00 (SD=3.07). In the "Energy Consumption- Post-Test (EC_O)" subscale, the experimental group had a mean score of 14.00 (SD=1.60), while the control group had a mean score of 12.48 (SD=3.47). In the "Total of Post-test (T_O)" subscale, the experimental group had a mean score of 91.51 (SD=11.21), while the control group had a mean score of 63.65 (SD=13.36). $p<0.05$ indicates that there is a significant difference in favor of the experimental group.

The data obtained from the statistics related to the pre-test and post-test comparison of the Global Climate Change Scale sub-dimensions according to the gender of the participants in our research are given in Table 6.

Table 6. Comparison of Sub-dimensions of the Global Climate Change Scale between Genders: Pre-test and Post-test

	Mesure	**N**	**x̄**	**SD**	**t**	**df**	**P**
Natural and Human-Pre-test(NH_E)	Female	30	35,30	7,71	0.59	56	.552
	Male	28	33,96	9,24			
Global Organization-Pre-Test (GO_E)	Female	30	13,40	6,67	0.48	56	.633
	Male	28	12,53	7,02			
Causes of Emergence-Pre-Test (COE_E)	Female	30	7,83	3,61	0.48	55,20	.262
	Male	28	6,71	3,91			
Total of Pre-test (T_E)	Female	30	69,86	15,93	0.72	56	.474
	Male	28	66,57	18,83			
Natural and Human-Post-Test(NH_O)	Female	30	36,70	7,97	-.50	56	.618
	Male	28	37,71	7,40			
Global Organization-Post-Test (GO_O)	Female	30	18,66	8,81	.088	56	.382
	Male	28	16,67	8,34			
Causes of Emergence-Post-Test (COE_O)	Female	30	10,50	4,69	1.87	56	.067
	Male	28	8,32	4,12			
Total of Post-test (T_O)	Female	30	78,80	19,96	0.51	56	.612
	Male	28	76,28	17,34			

According to the *t*-test results in Table 6, no significant difference was found between girls and boys in terms of the sub-dimensions of the scale and the total scores. Mean and standard deviation values for the sub-dimensions and the total scores of the scale are given respectively; girls ($\bar{X}$=35.30, SD=7.71) and boys ($\bar{X}$=33.96, SD=9.24) for the Natural and Human-Pre Test (NH_E) sub-dimension; girls ($\bar{X}$=13.40, SD=6.67) and boys ($\bar{X}$=12.53, SD=7.02)for the Global Organization-Pre Test (GO_E) sub-dimension; girls ($\bar{X}$=7.83, SD=3.61) and boys ($\bar{X}$=6.71, SD=3.91)for the Causes of Emergence-Pre Test (COE_E) sub-dimension; girls ($\bar{X}$=69.86, SD=15.93) and boys ($\bar{X}$=66.57, SD=18.83)for the Total of Pre-Test (T_E) score; girls ($\bar{X}$=36.70, SD=7.97) and boys ($\bar{X}$=37.71, SD=7.40)for the Natural and Human-Post Test (NH_O) sub-dimension; girls ($\bar{X}$=18.66, SD=8.81) and boys ($\bar{X}$=16.67, SD=8.34) for the Global Organization-Post Test (GO_O) sub-dimension; girls ($\bar{X}$=10.50, SD=4.69)

and boys ($\bar{X}$=8.32, SD=4.12)for the Causes of Emergence-Post Test (COE_O) sub-dimension; girls ($\bar{X}$=78.80, SD=19.96) and boys ($\bar{X}$=76.28, SD=17.34) for the Total of Post-Test (T_O) score.

ANOVA test was conducted to examine the status of Generation Z students in terms of the sub-dimensions of the global climate change awareness scale, specifically regarding "those who follow environmental developments from news, newspapers, or magazines" and the results are presented in Table 7.

Table 7. The status of "those who follow environmental developments from news, newspapers or magazines" in the experimental and control groups

	Source of Variance	**Sum of Squares**	**df**	**Average of Squares**	**F**	**p**	**Sig. Value**
Natural and Human-Post-Test(NH_O)	Expt.Group	762,70	2	381,35	8.14	.001*	1>2 3>2
	Control Group	2576,20	55	46,84			
	Total	3338,914	57				
Global Organization-Post-Test (GO_O)	Expt.Group	1169,83	2	584,91	10.64	.000*	3>2
	Control Group	3022,18	55	54,94			
	Total	4192,01	57				
Causes of Emergence-Post-Test (COE_O)	Expt.Group	398,55	2	199,28	14.23	.000*	3>2
	Control Group	769,78	55	13,99			
	Total	1168,34	57				
Total of Post-test (T_O)	Expt.Group	7108,26	2	15,93	15.43	.000*	1>2 3>2
	Control Group	12665,80	55	18,83			
	Total	19774,06	57				

According to the ANOVA and the homogeneity test in Table 7, since the p-value is less than 0.5, Dunnett's C multiple comparison tests were preferred. In the sub-dimension of Natural and Human-Post Test (NH_O), the response "Yes" was found to be significantly higher than the response "Sometimes," and the response "Sometimes" was also significantly higher than the response "No." In the sub-dimension of the Global Organization-Post Test (GO_O), the response "No" was found to be significantly higher than the response "Sometimes."In the sub-dimension of Causes of Emergence-Post Test (COE_O), the response "No" was found to be significantly higher than the response "Sometimes."In the sub-dimension of Total of Post Test (T_O), the response "Yes" was found to be significantly higher than the response "Sometimes," and both "Yes" and "No" responses were significantly higher than the response "Sometimes."

ANOVA test was conducted to examine the situations of Generation Z students in terms of the sub-dimensions of the global climate change awareness scale regarding the behavior of "fearlessly warning someone who is harming the environment," and results are presented in Table 8.

Table 8. The situations of the experimental and control groups regarding the behavior of "fearlessly warning someone who is harming the environment"

	Source of Variance	**Sum of Squares**	**df**	**Average of Squares**	**F**	**p**	**Sig. Value**
Global Organization-Post-Test (GO_O)	Expt.Group	514,52	2	257,26	3.81	.028*	1>2 3>2
	Control Group	3637,19	54	67,35			
	Total	4151,71	56				
Causes of Emergence-Post-Test (COE_O)	Expt.Group	290,99	2	145,49	8,95	.000*	1>2 3>2
	Control Group	877,04	54	16,24			
	Total	1168,03	5				
Total of Post-test (T_O)	Expt.Group	2492,22	2	1246,11	3,92	.026*	1>2
	Control Group	17149,28	54	317,57			
	Total	19641,50	56				

According to the ANOVA results presented in Table 8, Dunnett's C post hoc test was chosen due to the level being less than 0.05 in the homogeneity test. The ANOVA test revealed that in the Global Organizations-Post Test (GO_O) subscale, the frequency of "Yes" responses was higher than "Sometimes" and "No" responses. In the Causes of Emergence- Post Test (COE_O) subscale, the frequency of "Yes" responses was higher than "Sometimes" and "No" responses. Furthermore, in the Total of Post Test (T_O) subscale, the frequency of "Yes" responses was higher than "Sometimes" responses.

In the Z generation students, a *t*-test was conducted to compare the perceptions of "believing that environmental-related lessons should be taught in schools" in terms of the sub-dimensions of the global climate change awareness scale, and the divergent findings are presented in Table 9.

Table 9. The situations of Z generation students “who believe that environmental-related lessons should be taught in schools” in terms of the sub-dimensions of the global climate change awareness scale.

	Measure	**N**	**$\bar{x}$**	**SD**	**t**	**df**	**p**
Global Organization- Pre-Test (GO_E)	Yes	44	14,11	7,25	2.33	56	.023*
	No	14	9,42	3,29			

According to the *t*-test results in Table 9, there is a significant mean difference in the sub-dimension of Global Organization-Pre-Test between those who answered "Yes" ($\bar{X}$ = 14.11, SD = 7.25) and those who answered "no" ($\bar{X}$ = 9.42, SD = 3.29), [t(56) = 2.33, p < 0.05].

According to the *t*-test results for Table 9,there is no significant mean difference in the sub-dimension of Global Organization-Post-Test between those who answered “Yes” and those who answered “No”.

ANOVA test was conducted to examine the status of Z generation students in terms of the sub-dimensions of global climate change awareness scale based on the family income level, and the divergent findings are presented in Table 10.

Table 10. The status of Z generation students in the experimental and control groups, based on the family income level, in terms of the sub-dimensions of global climate change awareness scale

	Source of Variance	**Sum of Squares**	**df**	**Average of Squares**	**F**	**p**	**Sig. value**
Natural and Human- Pre-Test (NH_E)	Expt. Group	725.00	3	241.66	8.14	.001*	B>A
	Control Group	3281.21	53				
	Total	4006.21	56				

(A:10.001-15.000, B:15.000 and more, C: 0- 6000, D:6001-10.000)

According to the ANOVA test results in Table 10, since the p-value is less than 0.5 for the sub-dimension of Natural and Human Pre-Test, Dunnett's C multiple comparison test was preferred. Significant differences were found between the experimental and control groups in the sub-dimension of Natural and Human Pre-Test. As a result, it was determined that the level of awareness is higher in the group with a family income level of 15.000 and above compared to the group with a family income level of 10.001-15.000.

According to the ANOVA test results for Table 10,since the p-value is higher than 0.5 for the sub-dimension of Natural and Human Post-Test,there is no significant mean difference between the experimental and control groups.

ANOVA was conducted to examine the situation of Z generation students in the experimental and control groups depending on the "level of curiosity about the environment" in terms of the sub-dimensions of the global climate change awareness scale, and the different findings are presented in

Table 11. The status of Generation Z students in the experimental and control groups was examined in terms of the subdimensions of global climate change awareness scale based on their "curiosity level about the environment"

Source of Variance		Sum of Squares	df	Average of Squares	F	p	Sig. Value
Natural and Human-Pre-Test (NH_E)	Expt. Group	609.30	3	203.10	3.17	.031*	3>1 4>1
	Control Group	3451.80	54	63.92			
	Total	4061.10	57				
Energy Consumption Pre-Test (EC_E)	Expt.Group	98.33	3	32.78	4.69	.005*	2>1 3>1 4>1
	ControlGroup	376.76	54	6.97			
	Total	475.103	57				
Energy Consumption Post-Test (EC_O)	Expt.Group	62.43	3	20.81	2.96	.040*	1>2 3>1
	Control Group	380.18	54	7.04			
	Total	442.62	57				

(Not at all:1, Very Low:2, Mid Level:3, High Level:4)

According to the results of the ANOVA test presented in Table 11, a significant difference was found in the sub-dimension of "Natural and Human- Pre-Test" (NH_E) ($p<0.05$). It was observed that the response of the "Mid-Level" was higher than the "Not at all" response, and the "High Level" response was also higher than the "Not at all" response. In the subdimension of "Energy Consumption - Pre-Test" (EC_E), a significant difference was detected ($p<0.05$). It was observed that the "Not at all" response was lower than the "Very Low," "Mid-Level," and "High Level" responses. In the subdimension of "Energy Consumption - Post-Test" (EC_O), a significant difference was found ($p<0.05$). The "Not at all" response was higher than the "Very Low" response, and the "Mid-Level" response was higher than the "Not at all" response. No significant differences were found in the other sub-dimensions.

- The t-test was conducted to examine the differentiation status of high school students in experimental and control groups in terms of sub-dimensions of global climate change awareness scale according to membership in environmental organizations, and no significant difference was found.
- ANOVA was conducted to examine the differentiation status of high school students in the experimental and control groups in terms of the sub-dimensions of the global climate change awareness scale according to the educational status of the mothers, and no significant difference was found.
- ANOVA was conducted to examine the differentiation status of high school students in the experimental and control groups according to the educational status of the father in terms of the sub-dimensions of the global climate change awareness scale, and no significant difference was found.

- The opinions obtained through semi-structured interviews with 11 students from the experimental group at the end of the application are the followings :"It was beneficial, and I learned new information about global warming.","It was both entertaining and informative, and it raised awareness. I thank the organizers for their efforts.","The tests were well-prepared and memorable.","The activity was great. I learned new information about climate change.","The tests and surveys were well-prepared down to the smallest detail. The level of teaching was excellent.","These types of awareness-raising activities should be increased because they help us gain knowledge.","The activities were very beneficial. I learned many new things. By learning new information, I recalled the consequences caused by global warming. Thank you, it was excellent.","It was fun and enjoyable. I also learned new information and decided to be more environmentally conscious.","It was great and enjoyable. I learned a lot of information that I didn't know before, and it was quick and easy to learn.","It was a good program, and using Quizizz made it more engaging so that we didn't get bored.","The activity was great. Using applications like Kahoot made it easier.".

CONCLUSIONS AND DISCUSSION

Global warming and climate change are the most serious threats endangering life on our planet. Therefore, they have become one of the most prominent agenda items of our time (Sağlam et al., 2008). Concerns about global warming and climate change are increasing day by day. The increasing emission of greenhouse gases and thoughtless human activities are disrupting the balance of our planet. One of the most important steps to address this issue is to create awareness among individuals.

The time when awareness is formed in individuals is crucial. Education is important from a young age, just like in any other subject, including environmental issues. Time intervals formed by global economic and social activities are defined as generations. In other words, the concept of generation refers to all individuals who were born in recent years and have lived under the same conditions of the era (Kırık & Köyüstü, 2018). This also leads to them having similar learning styles. Games are one of the supporting tools for these learning styles.

Since the existence of humans, games have been a significant factor contributing to the formation of cultures. Digital games, on the other hand, are systems on computers with specific rules and objectives, involving intermediate units. They consist of defined rules and goals (Hazar et al., 2017).

As mentioned in this study, 9th graders, that is, individuals from Generation Z, were examined as experimental and control groups. Generation Z was born into technology compared to

previous generations. It is inevitable that technology, which has surrounded their lives since they were born, will also take its place in the field of education. In our study, after the Global Climate Change Scale was applied to the experimental and control groups as a pre-test, the experiment group was applied with digital-based games (Flippity, Kahoot and Quizizz) prepared for four weeks. At the end of the process, the same scale was applied to both groups as a post-test. Two-to-one interviews were conducted with the volunteers of the experimental group students. The data were entered into the SPSS program and analyzed. As a result of the findings;

- According to the *t*-test result, it was determined that there was a significant mean difference in the experimental group pre-test scores compared to the post-test scores. The reason for this is that the awareness of the Z generation students increased thanks to the games we applied. When the literature is examined, it has been determined in other studies (Somyürek, 2014; Kavalcı and Ünal, 2016) that the Z-generation is more suitable for digital-based learning methods compared to traditional methods in learning. This proves the consistency of our study with other similar studies.
- According to the *t*-test results, there was no significant difference in the control group between the pre-test and post-test scores. These findings indicate that there was no significant mean difference in the control group between the pre-test and post-test scores. This suggests that without the implementation of the intervention (the digital games used in the experimental group), no increase in awareness occurred in the control group during the study process.
- When comparing the pre-test results of the experimental and control groups, a significant difference was found in the sub-dimensions and the total score. This result indicates that the students in the experimental and control groups had similar levels of knowledge at the beginning of the study.
- When comparing the post-test results of the experimental and control groups, significant mean differences were found in favor of the experimental group. This result suggests that the digital game activities implemented in the experimental group increased their awareness of global climate change.
- No significant differences were found between the experimental and control groups based on gender.
- A significant difference was found in the *t*-test results of NH_O, GO_O, COE_O, and T_O, that is, post-tests, among those who “follow the developments regarding the environment from news, newspapers or magazines” of Generation Z.
- According to the results of the ANOVA test, a significant difference was found in the GO_O, COE_O and T_O, that is, post-tests, among the "warnings of someone who harms the environment" of the Z generation.

- A significant difference was found in the GO_E sub-dimension in the *t*-test results of those of the Z generation who think that "environment-related courses should be taught in schools".
- A significant difference was found in the pre-test only in the NH_E sub-dimension of the global climate change scale with the family income status of the Z generation.
- According to the "Environmental curiosity level" of the Z generation and the ANOVA test results of the experimental and control groups, a significant difference was found in the NH_E, EC_E, and EC_O sub-dimensions.
- No significant difference was found between global climate change scores and maternal education level ($p>.05$). Ağtaş Bektaş and Güneri (2019) also found in their study that the mother's education level did not make a difference in the awareness of the environment. This shows that the current study is compatible with the literature.
- A t-test was performed to determine the relationship between global climate change scores and the father's educational status, and no significant difference was found. Ağtaş Bektaş and Güneri (2019) did not detect a difference between the father's educational status and environmental awareness. This shows that our study is compatible with the literature.
- To examine the differentiation status of high school students according to membership in environmental organizations in terms of sub-dimensions of the global climate change awareness scale, a *t*-test was conducted and no significant difference was found. The reason for this is that all high school students participating in the survey are members of at least one environmental organization.
- No significant difference was found between the global climate change scores and the profession of parents. Kanbak (2015) also determined in his study on university students' environmental attitudes that the profession of mother and father had no effect on students' environmental attitudes. In this respect, our results are compatible with the literature.
- Positive feedback was received from the participants about Kahoot, Quizzz and Flippity games that we used during the application. As given in the findings section, the students said, "The event was good. Kahoot etc. The use of applications made the activity easier.","It's a good program, it's better to have it in the form of Quizizz so we don't get bored." expressed their opinion. Wang and Tahir (2020) found that digital games such as Kahoot increase students' motivation to learn while having fun. This is in line with the views of the students who participated in our study.

It is of great importance for the future of our world to raise awareness about global climate change among the Z generation individuals who will have a say in the future. Generation Z individuals have a different learning style apart from traditional methods. In this context, the aim of our work is to increase awareness of Global Climate Change with digital-based prepared Flippity, Kahoot and Quizizz games that will attract the attention and focus of Z generation individuals. In the

literature review, studies on determining the status of global climate change (Atik and Doğan, 2019; Şen and Özer, 2018; Ek et al., 2010; Akbulut and Kaya, 2020; Ay and Erik, 2020; Biçer and Vaizoğlu, 2015; Babaoğlan and Babaoğlan 2022; Kılıçoğlu and Akkaya Yılmaz, 2021; Durkaya and Durkaya, 2018; Gürer and Sakız, 2018; Ünlü et al., 2011).

RECOMMENDATIONS

In line with the results obtained in the study, our suggestions for students to improve their awareness of global warming and climate change in a positive way are as follows:

1- Awareness studies should be increased to increase the level of knowledge on global warming and climate change, and to show the negative effects of some behaviors encountered in life or become a habit on this situation.

2- Considering the technology age of the Z generation, which is the target audience, education and training materials suitable for this new generation should be used.

3- Courses that will increase sensitivity and awareness towards the environment should be applied in educational institutions.

4- The use of digital games and materials such as Kahoot, Quizizz, Flippity in teaching should be increased.

5- Students should be encouraged to join environmental organizations in order to develop their sensitivity towards the environment.

6- The first education of individuals begins in the family. The low or high sensitivity of future generations to climate change depends on the attitude that Generation Z will take towards the environment. With this in mind, such studies should be conducted at all grade levels.

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