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THE EFFECT OF GEOGRAPHICAL INFORMATION SYSTEMS (GIS) SUPPORTED GEOGRAPHY EDUCATION ON DISASTER RISK AWARENESS

(Research article)

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Abstract

In this study, the effect of Geographical Information Systems (GIS) supported geography education on disaster risk reduction (DRR) was investigated. Disaster risk maps of Fethiye district of Muğla province were generated in ArcGIS 10.8 program and used as educational material in Geography course. It was aimed for the students to recognize the disasters that pose a risk in their environment and to gain awareness against the risks that may arise in a possible disaster by associating why these disasters pose a risk with geographical factors. In order to realize this aim, training was carried out for five weeks with 193 students studying in Fethiye district in the 2023-2024 academic year. The research was carried out in the pretest-posttest control group model. Disaster Risk Awareness Scale developed by the researcher was used to collect the data. The data were analyzed with t-test in SPSS 21 program. The results of the analysis showed that there was a statistically significant increase in the awareness of individuals who received GIS-supported geography education about disaster risks. This study reveals the effectiveness of GIS-based geography education materials in reducing disaster risks. It is recommended that DRR education should be crucially integrated into the secondary curricula.

Keywords: Geography education, GIS, Disaster risk awareness, DRR

1. Introduction

Today, with the increase in the damages caused by disasters, the importance of reducing disaster risks has also increased. Although there are many definitions of the concept of risk, according to the Disaster and Emergency Presidency (AFAD, 2024), risk is the probability of an event causing loss of life and property. In other words, risk is the probability of realization of loss of life, property and economic loss caused by an event under certain conditions. The Intergovernmental Panel on Climate Change (IPCC, 2022) defined disaster risk as follows: "It is the negativity that has the possibility of causing changes in the normal functioning of society in a certain period of time and that requires urgent intervention in meeting human needs due to the economic and environmental impacts it creates". Based on these definitions, it is possible to say that disaster risk studies play an important role in effectively combating disasters.

Raising individuals who are aware of disaster risks can only be achieved through education. Disaster Risk Reduction (DRR) education helps students question the causes of disasters, understand their effects and develop their skills to reduce the damages that may occur (Selby & Kagawa, 2012). Recent documents and explanations from UN agencies such as the UNISDR (United Nations Office for Disaster Risk Reduction) and the UNESCO (United Nations Educational, Scientific and Cultural Organization) have emphasized the role of education in ensuring sustainable development and in building resilience (UNESCO, 2016; UNISDR, 2015). In order to create a prepared and conscious society against disasters, it is necessary and important to provide students with knowledge and skills related to DRR in schools (Muscchio et al., 2016).

The key to managing disasters effectively and successfully is the education to be provided in schools. Schools are the places where the formation process of disasters, their effects on the environment and human beings, and the things to be done in order to be protected from disasters can be learned in the most accurate and fundamental way. Therefore, the education to be given in schools should be sustainable and systematic at a level to cover all dimensions of disasters.

It is thought that educated individuals can be effective in being prepared for disaster risks and preventing problems that threaten the lives of many people, including their own lives (Tsai et al., 2020). Hence, generating disaster risk maps and integrating them into education is important for geography education where visual learning is most widely used (Song et al. 2022). In this way, an awareness can be created in the students to minimize the damages caused by disasters. Türker and Sözcü (2021) also state that high literacy levels of individuals about natural disasters are of great importance in reducing disaster risk and having disaster response skills.

Disaster education can be characterized as awareness-raising activities to reduce the social, economic and psychological effects of disasters and to create a culture of coping with these events (Forester et al. 2017). Thanks to disaster education, cognitive awareness of individuals increases and a prediction is formed in individuals about which measures can reduce disaster risks (Faupel & Styles, 1993). Disaster trainings are thought to play an important role in preparing individuals for disaster risks. Disaster maps used in trainings also play a vital function in supplying important information such as escape routes and the locations of service areas (Yoshikawa, 2011).

Minimizing the negative consequences of disasters is possible with an effective disaster risk education program. DRR training includes activities aiming to prevent new disasters, reduce existing risks and manage the risks that may arise. Selby and Kagawa (2012) stated that DRR education requires students to perform a series of behaviors expected from them to prevent disasters and reduce their effects when they encounter a disaster. Mangione et al. (2013) stated that DRR education is effective in providing individuals with the knowledge, skills and awareness to prevent the factors that pose risks and reduce damages. In addition, integration of geography into disaster education is important as it helps people understand the relationship between geographical factors and disaster risk. It is also possible to see that DRR education is integrated into course curriculums in many countries (Astuti et al., 2021; Kekic & Milenkovic, 2015; Ohnishi & Mitsuhashi, 2013; Tong et al., 2012; Zhu & Zhang, 2017).

The geological, geomorphological and climatic diversity of Türkiye causes the disasters experienced to vary. Different types of disasters lead to different risks. This makes risk studies compulsory for each disaster type. Studying each disaster separately is of great importance in risk reduction and effective disaster management. Although there are studies on disaster education in the literature, it has been observed that there are significant inadequacies in raising awareness about disaster risks.

When the Geography Course Curriculum (CDÖP) is examined, it is seen that the units and achievements related to disasters are given according to the grade level from the 9th to the 12th grade level, however, the achievements related to natural disasters are not equally distributed according to the grade level: the highest achievement rate is at the 9th grade level, and the lowest achievement rate is at the 12th grade level. The fact that the rate of outcomes directly related to disaster and disaster risk reduction is only 3% among a total of 130 outcomes in the

CDÖP shows that there is a significant deficiency in terms of disaster education in the curriculum. In addition, among the 15 objectives of the CDÖP, only one objective directly related to disaster education stands out; "To evaluate natural disasters and environmental problems and develop practices for ways of protection and prevention" (CDÖP, 2018, p. 12). All these results reveal that the subject of disasters should be given more importance in geography education. Reorganizing the CDÖP by taking disaster risk education into consideration will provide important opportunities to prepare students against disasters.

In this study, it was investigated whether GIS supported geography education is effective in reducing disaster risks. For this purpose, disaster risk maps of Fethiye district of Muğla province were used as teaching materials in the "Environment and Society" unit of the 10th grade Geography course and answers to the research problem were sought. In this way, it was tried to enable students to recognize the disasters that may occur in their environment and to realize the risks that may arise from them. The reason for using GIS in disaster management is that it helps to reduce the damages that may arise from disasters, to protect human life and natural resources and to control possible destruction.

This study also addresses the necessity of education in schools in reducing disaster risks and the importance of geography education in minimizing the damages that may arise from disasters, and addresses the integrated disaster risk approach with education. The study gains importance in three aspects: proving that GIS is an effective tool in geography education, developing students' awareness of disaster risks and providing guidance to teachers on how to reduce disaster risks.

The answers to the following sub-problems were investigated based on the problem statement of this study: What is the effect of the use of disaster risk maps developed with GIS in geography education on students' disaster risk awareness?

1. Does GIS-supported geography education increase students' awareness of disaster risks?

2. Does the awareness of students who receive GIS-supported geography education about disaster risks differ from those who receive traditional geography education?

3. Does the awareness of students who receive GIS-supported geography education about disaster risks vary according to whether they have experienced a disaster before?

4. Do the awareness of students who receive GIS-supported geography education about disaster risks vary according to their previous participation in disaster education?

2. Method

2.1. Research Design

The research was conducted in an experimental design, one of the quantitative research methods. Frankel et al. 2006 emphasize that experimental research is the most valid and reliable way to observe the effects of a variable and to determine cause and effect. Campbell and Stanley (1963) divide experimental designs into four categories: with control group, without control group, control group assigned by chance and time series models. In this study, pretest-posttest control group model was used. In this model, one of the two groups formed by random assignment is used as the experimental group and the other as the control group. In both groups, measurements are made before and after the experiment and the differences between the averages between the pretest scores and posttest scores are tested (Büyüköztürk et al. 2019). The schematic representation of the model is given in Table 1.

Table 1. *Pretest-posttest control group model schematic representation*

Group	Pretest	Application	Posttest
Experimental	O_1	X	O_3
Control	O2		O4

2.2. Study Group

The study group of the research consists of 200 students in the Fethiye district of Muğla province, who were selected by simple random sampling method, studying at the 10th grade level in the 2023-2024 academic year. Among the students participating in the study, 4 students from the experimental group and 3 students from the control group were dropped from the sample because they did not participate in the posttest. The remaining 193 students constitute the study group of the research. The general status of the study group is shown in Table 2.

Table 2. *Distribution of students in the study group*

Group	Girl	Male	Total
Experimantal	57	39	96
Control	57	40	97
Total	114	79	193

In the selection of the students participating in the study, the simple random sampling method was selected from the "random" unbiased sampling methods adopted by Fraenkel et al. (2006), in which each unit in the universe has an equal probability of being selected. In this sampling method, each unit in the universe has an equal probability of being selected for the sample (Büyüköztürk et al. 2019).

2.3. Study Area

Fethiye district of Muğla province was selected as the study area (Figure 1). The fact that Fethiye district is in the 1st degree earthquake zone, urban settlement is located in areas that are not suitable for construction and tourism activities are intensively carried out in these areas that are not suitable for construction reveals the importance of the selection of the district in disaster preparedness studies. For this reason, it is of great importance to raise the awareness of the inhabitants of the region against disaster risks in order to minimize the damages that may arise in a possible disaster that may occur in the region.

Located on the Fethiye-Burdur fault zone, one of the most active tectonic lines of Türkiye, the study area has experienced many earthquakes from past to present (Figure 2). The most recent destructive earthquake in the district occurred in 1957 and caused serious damage in and around the center of Fethiye. It is thought that the earthquakes that occurred in the region caused great damage and loss of life because geological and geomorphological factors were not taken into account and settlements were built in unsuitable areas. Factors such as the location of active fault lines, groundwater level, slope, distance to fault lines and lithology should be taken into consideration in the selection of settlements in earthquake-prone areas.

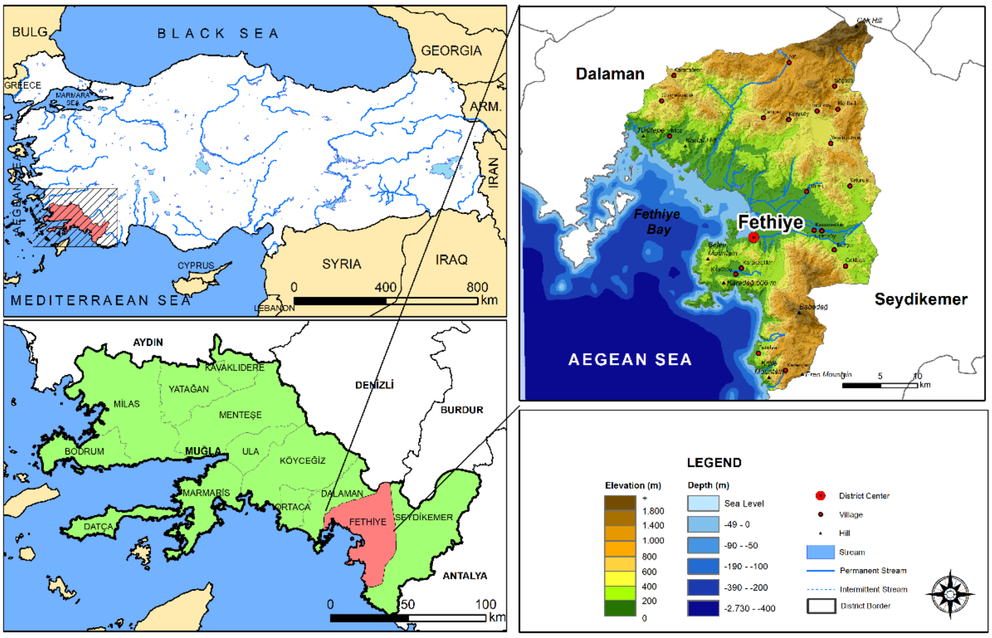

Figure 1. Location map of the study area

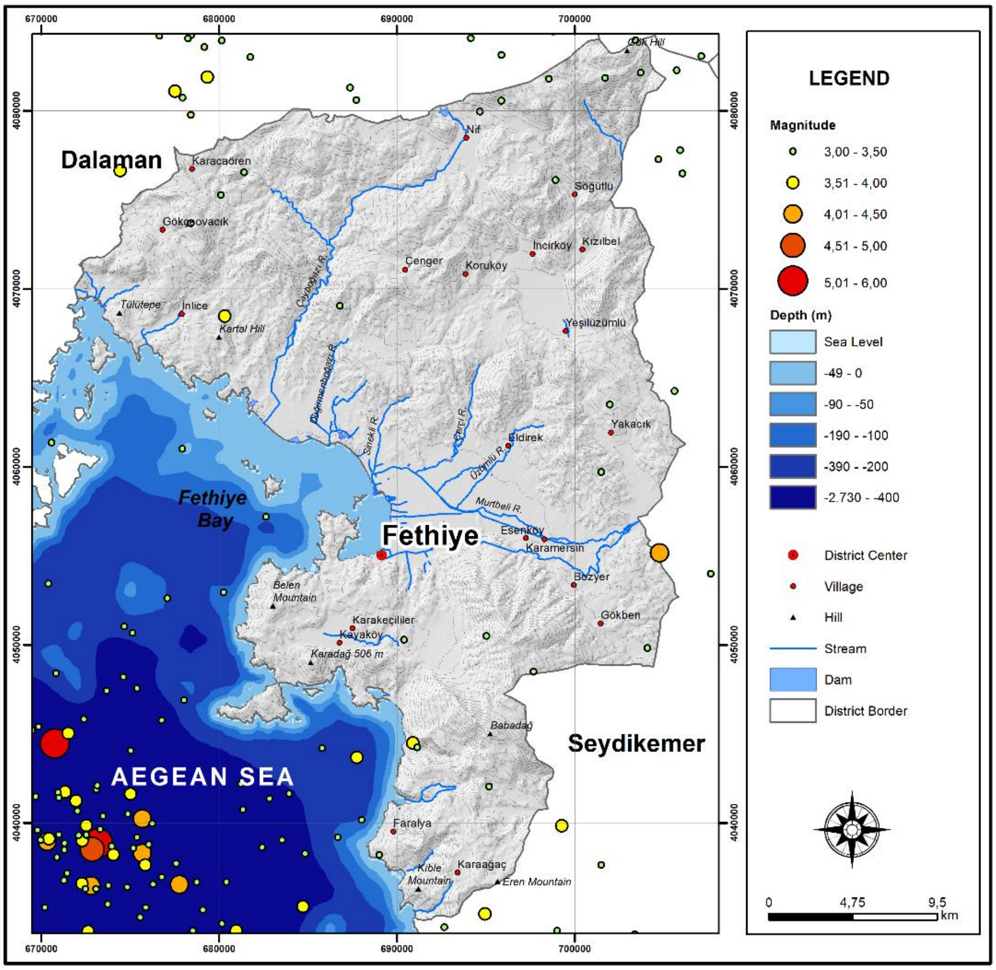

Figure 2. Earthquakes in and around Fethiye district (1900-2023), (created by the researcher using AFAD data)

In this study, proximity to fault lines, groundwater level, lithology, land use, slope criteria were used to generate the earthquake risk map of the study area in GIS. The earthquake risk map of the district was obtained by overlapping the relevant layers according to their weights with the Analytical Hierarchy Process (AHP) method (Figure 3). The earthquake risk map produced for the study area shows the areas that will be most affected in a possible earthquake.

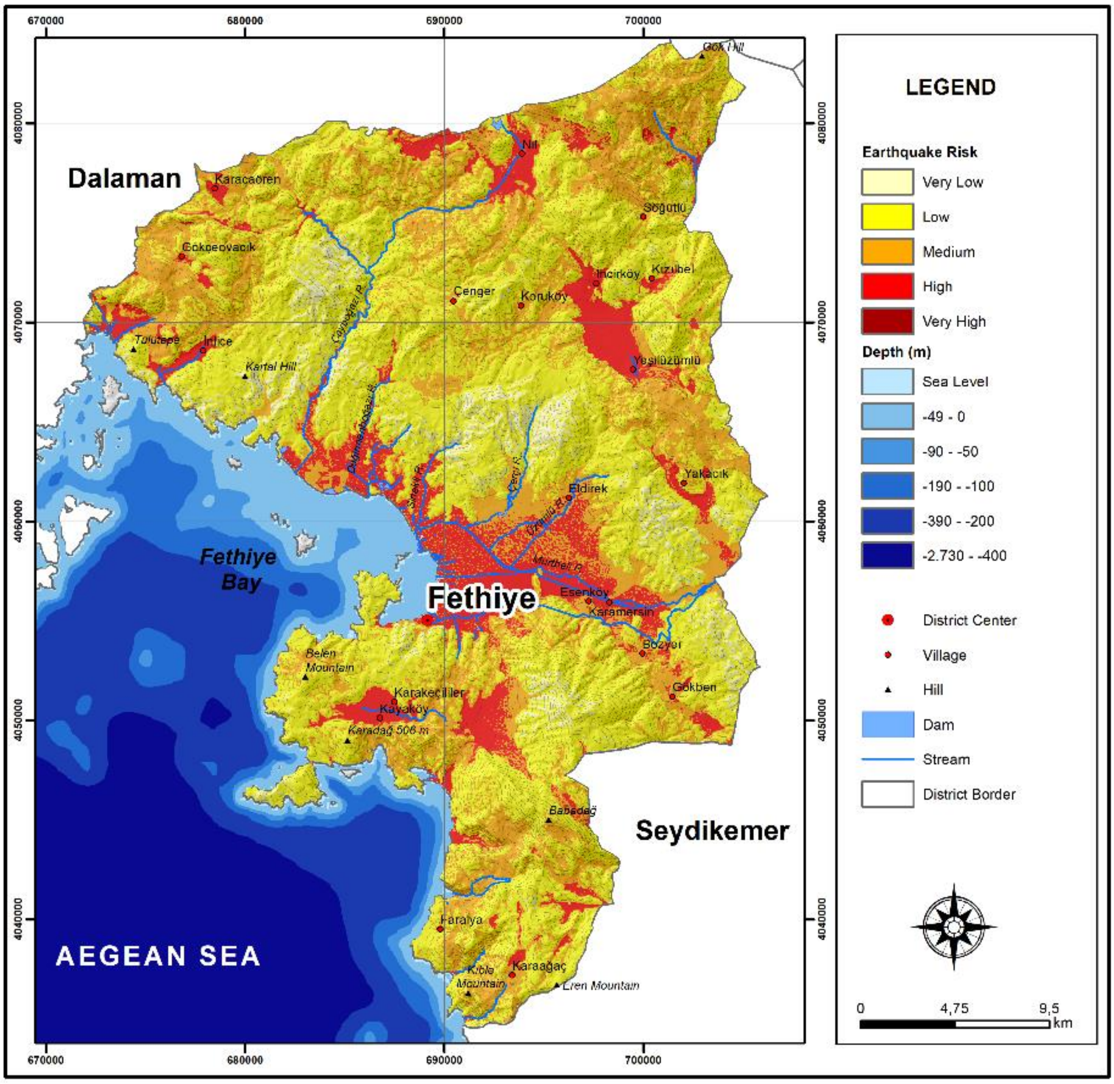

Figure 3. Fethiye district earthquake risk map, (created by the researcher using AFAD's coloring scale)

Floods are among the disasters that cause the most loss of life and property in our country after earthquakes. Analyzing the flood disasters in Fethiye is vital for the urban settlement. Especially in recent years, due to the effects of global climate change, it has become compulsory to take necessary precautions by making prediction studies for flood disasters. In this study, in order to generate flood risk maps in GIS, the criteria of slope, precipitation, soil, drainage density, distance to the stream were analyzed and the flood risk map of the district was obtained by overlapping the relevant layers with the AHP method (Figure 4).

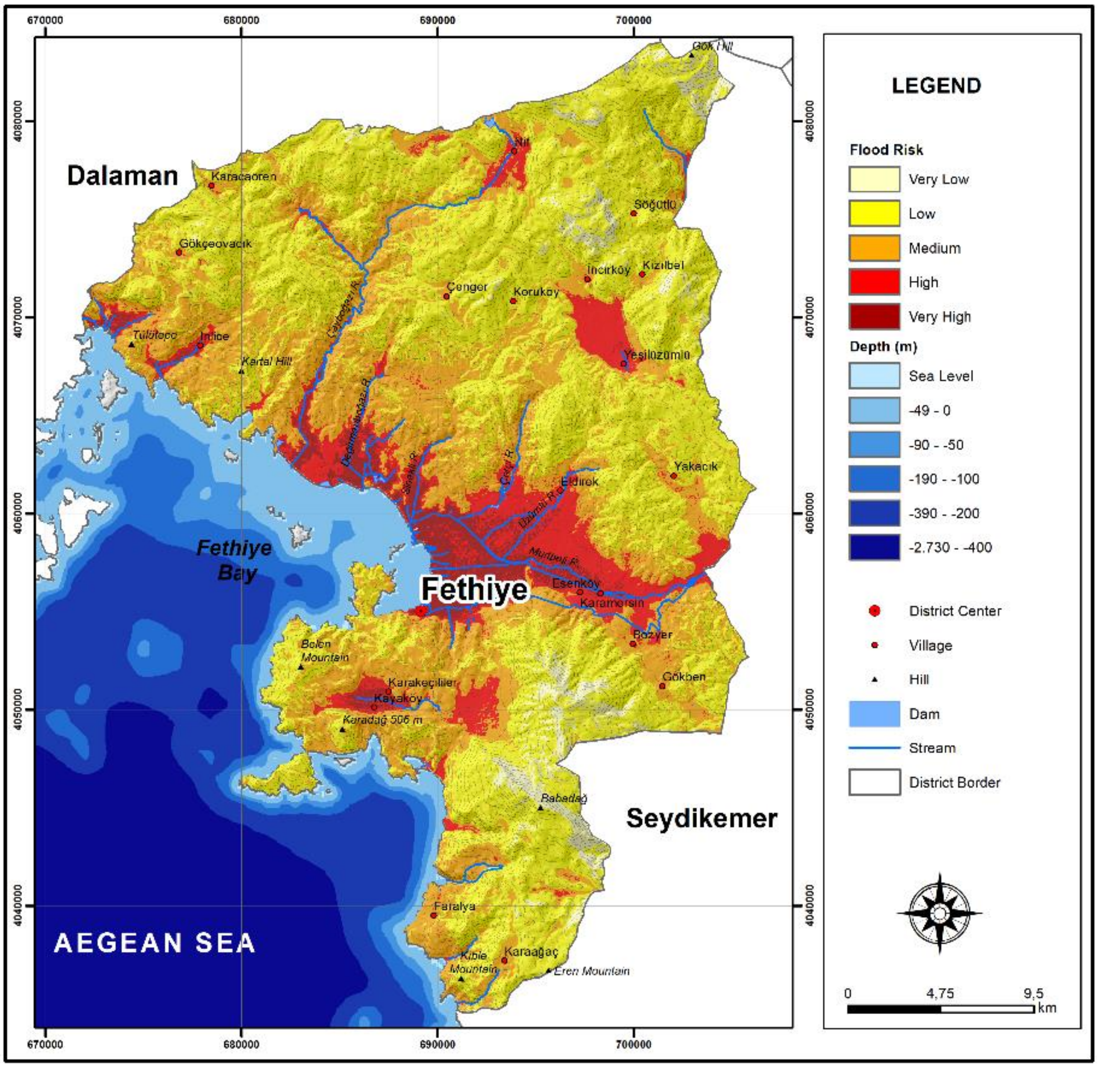

Figure 4. Fethiye district flood risk map, (created by the researcher using AFAD's coloring scale)

2.4. Data Collection

In the study, the 5-point Likert-type Disaster Risk Awareness Scale (DRAS) developed by the researcher and the activity forms applied to the experimental group were used to measure the disaster risk awareness of the students. While developing the Disaster Risk Awareness Scale, the researcher reviewed the relevant studies in the literature. As a result of the review, relevant topics were determined and draft items were prepared by the researcher and presented to the opinions of field experts. The 35-item draft scale form, which was finalized after the expert opinions, was tested with a pilot study. Data were collected from a total of 400 participants, 240 women and 160 men, for the pilot study of the draft scale form. The collected data were subjected to the Kaiser Meyer Olkin (KMO) and Barlett sphericity test, Exploratory Factor Analysis (EFA), Confirmatory Factor Analysis (CFA) and Cronbach's Alpha coefficient analyses in SPSS 21 and AMOS 28 programs for validity and reliability analyses, respectively. After the pilot study, 9 items were removed from the scale form.

The ethics committee approval required for the conduct of the research was obtained from Rectorate of Gazi University Ethics Commission. In line with the approval, an application was made to Muğla Provincial Directorate of National Education for the schools to be implemented in the study. With the legal permission dated 26.10.2023 and numbered 785220, the research data were collected from 10th grade students in Fethiye Anatolian High School, Şehit Süleyman Yasir Ağır Multiprogrammed High School and Ömer Özyer Anatolian High School in a total of 5 weeks in the 2023-2024 academic year, on dates deemed appropriate by the school principals so as not to disrupt the education. After the Disaster Risk Awareness Scale was applied as a pretest by the researcher to the students in the schools included in the study group; the experimental group was taught with maps prepared by the researcher with GIS in the 10th grade "Environment and Society" unit, while the control group was taught with the traditional method through the textbook. Two weeks later, a posttest was implemented to measure the learning levels of the experimental and control group students. In addition, activity forms 1 and 2 were applied to the experimental group students to measure the retention of learning at the end of the application (Gürhan, 2024). Due to the commitment given by the researcher to the Provincial Directorate of National Education, visual evidence of the data collection process of the study could not be presented herein.

2.5. Data Analysis

Skewness and kurtosis coefficients were examined to test whether the data exhibited a normal distribution. Skewness and kurtosis coefficients between +2.00 and -2.00 are considered sufficient for normal distribution (George & Mallery, 2019). According to analysis, it is seen that the data are normally distributed. In the study, t-test, one of the parametric tests, was used to analyze the data. Descriptive findings of the study group are presented in Table 3.

Table 3. *Descriptive findings of the study group*

Variable	Group	Experimental		Control		Total	
		n	%	n	%	n	%
Have you experienced any disasters before?	Yes	59	61,5	52	53,6	111	57,5
	No	37	38,5	45	46,4	82	42,5
If yes, which disaster did you experience?	Earthquake	55	93,2	46	88,5	101	91,0
	Fire	3	5,1	4	7,7	7	6,3
	Flood	1	1,7	1	1,9	2	1,8
	Landslide	0	0,0	1	1,9	1	0,9
	Other	0	0,0	0	0,0	0	0,0
Do you think disaster education is necessary?	Yes	94	97,9	94	96,9	188	97,4
	No	2	2,1	3	3,1	5	2,6
Would you like to receive education on disasters?	Yes	75	78,1	73	75,3	148	76,7
	No	21	21,9	24	24,7	45	23,3
Have you received education from any institution/organization on disasters?	Yes	17	17,7	20	20,6	37	19,2
	No	79	82,3	77	79,4	156	80,8
Total		96	100	97	100	193	100

The findings regarding the sources from which the participants obtained information about disasters are shown in Table 4.

Table 4. *Source of information about disasters*

From which sources do you get information about disasters?	Experimental		Control		Total	
	n	%	n	%	n	%
Family, Relative	55	57,3	51	52,6	106	54,9
Book	38	39,6	34	35,1	72	37,3
Internet	83	86,5	87	89,7	170	88,1
Magazines, newspapers, radio and television	53	55,2	53	54,6	106	54,9
School	65	67,7	66	68,0	131	67,9
Other	0	0	2	2,1	2	1,0
Total	294		293		587	

*Participants have the option to give more than one answer.

2.5.1. Findings related to the first sub-problem

The first sub-problem was expressed as "Does GIS-supported geography education increase students' awareness of disaster risks?". Regarding the first sub-problem, the findings obtained according to the results of the dependent groups t-test conducted on the experimental group are given in Table 5.

As seen in Table 5, the mean pretest score of the experimental group students who received GIS-supported geography education was 49.09±6.39 and the mean posttest score was 56.35±9.32. The awareness of the students who received GIS-supported geography education about disaster risks increased by 7.26 points from pretest to posttest and this increase was statistically significant ($t(95) = 6.467; p<0.05$).

There was also a statistically significant increase in the sub-dimensions of "preparation for disasters", "the role of geography education", "establishing a relationship between space and disaster" and "use of technology" ($t(95)=3,273$, $p<0,05$; $t(95)=6,950$, $p<0,05$; $t(95)=5,455$, $p<0,05$; $t(95)=4,997$, $p<0,05$, respectively). These results show that the application was successful in terms of raising awareness about disaster risks in students receiving GIS-supported geography education.

Table 5. *t-test results of disaster risk awareness of the experimental group*

Experimental Group	n	$\bar{x}$	s	Difference	t	Sd	p
Disaster Risk Awareness	96	56,35	9,32	7,26	6,467	95	**0,000***
(Posttest - Pretest)	96	49,09	6,39				
Disaster Preparedness	96	4,43	1,61	0,62	3,273	95	**0,001***
(Posttest - Pretest)	96	3,80	1,10				
Information	96	16,14	3,79	0,63	1,264	95	0,209
(Posttest - Pretest)	96	15,51	3,60				
The Role of Geography Education	96	7,56	3,26	2,68	6,950	95	**0,000***
(Posttest - Pretest)	96	4,89	1,78				
State Responsibility	96	6,65	2,38	0,40	1,228	95	0,222
(Posttest - Pretest)	96	6,25	1,94				
Establishing the Relationship between Space and Disaster (Posttest - Pretest)	96	9,09	1,94	1,27	5,455	95	**0,000***
	96	7,82	1,35				
Education	96	7,10	1,84	0,45	1,941	95	0,055
(Posttest - Pretest)	96	6,66	1,28				
Technology Use	96	5,39	2,08	1,22	4,997	95	**0,000***
(Posttest - Pretest)	96	4,17	1,23				

*p<0,05.

2.5.2. Findings related to the second sub-problem

The second sub-problem was expressed as "Do the awareness of the students who receive GIS-supported geography education about disaster risks differ from those who receive education with the traditional method?". Regarding the second sub-problem, the averages of the scores obtained by the students in the experimental and control groups from the pretest and posttest were obtained according to the results of the dependent groups t-test and the findings are given in Table 6.

As seen in Table 6, the mean disaster risk awareness score of the experimental group students who received GIS-supported education increased by 7.26 points from the pretest ($\bar{x}$=49.09, s=6.39) to the posttest ($\bar{x}$=56.35, s=9.32) and this increase was statistically significant ($p<0.05$). While the mean pretest score of the control group students who were trained with the traditional method was $\bar{x}$=53.49, s=10.40, the mean posttest score was $\bar{x}$=54.65, s=10.38 and this increase was not statistically significant ($p>0.05$).

Table 6. *t-test results of disaster risk awareness of experimental and control groups*

Score	Group	n	$\bar{x}$	s	Difference	t	Sd	p
Disaster Risk Awareness (Posttest - Pretest)	Experimental	96	56,35	9,32	7,26	6,467	95	**0,000***
		96	49,09	6,39				
Disaster Risk Awareness (Posttest - Pretest)	Control	97	54,65	10,38	1,15	0,715	96	0,476
		97	53,49	10,40				

Notes: N=number of people, $\bar{x}$=mean, s= standard deviation, p= significance value

2.5.3. Findings related to the third sub-problem

The third sub-problem was expressed as "Does the awareness of students receiving GIS-supported geography education about disaster risks vary according to whether they have experienced a disaster before?". The results of the independent groups t-test conducted to answer the research problem are shown in Table 7.

Table 7. *t-test results regarding the disaster experience of the experimental group*

Posttest Scores	Experiencing a disaster	n	$\bar{x}$	s	Difference	S. Error	t	Sd	p
Disaster Risk Awareness	Yes	59	49,08	6,52	-0,02	1,35	-0,017	94	0,986
	No	37	49,11	6,26					
Preparedness for Disasters	Yes	59	3,73	1,05	-0,19	0,23	-0,822	94	0,413
	No	37	3,92	1,19					
Information	Yes	59	15,69	3,64	0,48	0,76	0,632	94	0,529
	No	37	15,22	3,57					
Role of Geography Education	Yes	59	4,92	1,70	0,08	0,38	0,206	94	0,837
	No	37	4,84	1,92					
State Responsibility	Yes	59	6,14	1,77	-0,30	0,41	-0,729	94	0,468
	No	37	6,43	2,19					
Establishing the Place-Disaster Relationship	Yes	59	7,71	1,47	-0,29	0,28	-1,015	94	0,312
	No	37	8,00	1,13					
Education	Yes	59	6,75	1,21	0,23	0,27	0,864	94	0,390
	No	37	6,51	1,39					
Technology Use	Yes	59	4,15	1,24	-0,04	0,26	-0,142	94	0,888
	No	37	4,19	1,22					

As seen in Table 7, the disaster risk awareness average score of those who had a disaster experience was ($\bar{x}$=49.08, s=6.52), while the disaster risk awareness average score of students who had no disaster experience was ($\bar{x}$=49.11, s=6.26). Accordingly, the disaster risk awareness of the students who received GIS-supported geography education did not show a significant difference according to their disaster experience status (t(94)=-0.017, p>0.05).

2.5.4. Findings related to the fourth sub-problem

The fourth sub-problem was expressed as "Does the awareness of students receiving GIS-supported geography education about disaster risks vary according to their previous participation in disaster education?" The results of the independent groups t-test related to the fourth sub-problem are shown in Table 8.

Table 8. *t-test results regarding the participation of the experimental group in disaster education*

Posttest Scores	Receiving Disaster Education	n	$\bar{x}$	s	Difference	S. Error	t	Sd	p
Disaster Risk Awareness	Yes	17	45,82	5,38	-3,97	1,67	-2,384	94	**0,019**
	No	79	49,80	6,40					
Preparedness for Disasters	Yes	17	3,59	1,18	-0,26	0,29	-0,881	94	0,380
	No	79	3,85	1,09					
Information	Yes	17	13,41	3,02	-2,55	0,93	-2,738	94	**0,007**
	No	79	15,96	3,57					
Role of Geography Education	Yes	17	4,82	1,85	-0,08	0,48	-0,157	94	0,876
	Nor	79	4,90	1,78					
State Responsibility	Yes	17	5,82	1,81	-0,52	0,52	-1,001	94	0,319
	No	79	6,34	1,96					
Establishing the Space-Disaster Relationship	Yes	17	7,47	1,66	-0,43	0,36	-1,186	94	0,239
	No	79	7,90	1,28					
Education	Yes	17	6,76	0,83	0,13	0,25	0,521	37,216	0,606
	No	79	6,63	1,36					
Technology Use	Yes	17	3,94	1,03	-0,27	0,33	-0,833	94	0,407
	No	79	4,22	1,27					

When Table 8 is examined, the mean posttest score of the experimental group students who received GIS-supported education was ($\bar{x}$=45.82, s=5.38), while the mean posttest score of those who had not participated in disaster education before was ($\bar{x}$=49.80, s=6.40). Among the students who received GIS-supported geography education, the level of awareness about disaster risks reached by those who stated that they had not received disaster education before was significantly different from those who stated that they had received disaster education before ($t(94)=-2{,}384, p<0.05$).

In addition, there is a statistically significant difference in the "information" sub-dimension among those who have not participated in disaster education compared to those who have participated in disaster education ($p<0.05$). These results show that there is a significant increase in the disaster information and awareness levels of the students who have not received disaster education before.

3. Results, Discussion and Conclusion

Minimizing the negative consequences of disasters is possible with an effective disaster risk education. The aim of disaster risk education is to minimize disaster risks and increase knowledge and awareness of individuals on how to manage different types of natural and human disasters. Although many tools are used to create disaster awareness, their adaptation to technology is necessary and important for the rapid and effective execution of disaster management.

The results obtained according to the findings obtained regarding the sub-problems determined in this research, which tries to reveal the role of GIS-supported geography education in reducing disaster risks, are as follows:

According to the first finding obtained from the research, it was concluded that GIS-supported geography education was effective in raising awareness about disaster risks among students. Similarly, Song et al. (2022) tested the effectiveness of disaster risk maps prepared in GIS in DRR education and stated that GIS-based materials are effective teaching tools.

In regard to the result obtained from the second finding of the study, there was a significant increase in the awareness levels of students who received GIS-supported education compared to those who received education with the traditional method. The results of Durna's (2009), Özgen & Çakıcıoğlu's (2009) and Yağbasan & Yılmaz Baysal's (2021) studies also support the positive change in the awareness levels of students receiving GIS-supported education.

However, another result of the study is that students' disaster risk awareness did not show a significant difference according to their disaster experience status. The results of Hoffman and Mutturak's (2017) study show that students can be prepared for disaster risks even without disaster experience. Bubeck et al. (2012) also suggested that experiencing a disaster does not have a relationship in increasing risk awareness. Although these results support the findings of this study, many studies suggest that there is a positive and significant relationship between disaster experience and risk perception (Kung & Chen, 2012; Micelli et al., 2008; Terpstra, 2011). The reason for this situation is considered by Wachinger et al. (2013) as direct or indirect exposure or experience to hazard. Investigating the effect of disaster experience on risk perception and awareness by researchers using different methods and approaches may contribute to the elimination of contradictory results.

An important result obtained from the study is that there was a significant difference in the level of risk awareness and disaster knowledge among the students who received GIS-supported training, compared to those who had not participated in disaster training before. The results of Tercan's (2023) study revealed that the factor of receiving training on disasters was not effective on disaster risk perception. These results coincide with the results of the findings obtained in this study. Although Mızrak (2018) stated that individuals who receive disaster education have more preparedness behaviors against disasters, this study revealed that students who have not received disaster education before may have a significant increase in their disaster knowledge levels and awareness of disaster risks after GIS-supported trainings. It is clear that the disaster risk awareness to be gained through geography education will improve the individual in understanding natural and human-induced problems and finding solutions.

In this study, which aims to raise awareness about disaster risks with GIS-supported education in geography education, the following recommendations were proposed considering the research results:

- The use of active teaching methods adapted to technology in geography education should be expanded.

- It is necessary and important to revise the Geography Course Curriculum as soon as possible to include DRR according to international standards.

- Today, it is known that the use of spatial technologies in education is becoming more widespread day by day. The obstacles to the use of GIS should be identified, deficiencies should be eliminated and necessary strategies should be implemented by decision makers.

- In the structuring of disaster-resilient cities, it is important for decision makers to direct DRR activities and to realize correct and effective planning.

- It is vital for governments to invest in DRR measures such as early warning systems or evacuation centers.

- It is clear that disaster awareness and preparedness activities have a positive effect on increasing resilience against disasters. In this context, training activities should be planned to reduce the vulnerability of individuals.

- Risk assessment studies should be emphasized in order to identify and control the impact areas of natural disasters in settlements and the risks that these disasters may create.

- It is crucial to take into account the integrated disaster management system in the planning of sustainable urban settlements and to conduct analyses to determine the impact areas of disasters and the risks they will create.

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5. Conflict of interest

The author declares that there is no conflict of interest.

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