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## **Design-Based Natural Disaster Education Practices for Primary School Teachers**

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### Abstract

The goal of this study was to uncover primary teachers' perspectives on the use of design-based activities in disaster education and to thoroughly examine the plans. The study is designed as a case study. The participants were chosen using the purposeful sampling method. The study included 24 primary school teachers (12 male and 12 female) from various regions of the country. The data collection tools were group-prepared lesson plans and follow-up focus group interviews, which aimed to reveal their experiences and opinions on the lesson plan design process. The data was analyzed using the content analysis method. The findings revealed that the use of design-based activities in primary school, the importance of disaster education in the primary school curriculum, and the importance of disaster education awareness at the primary school level were all highlighted. The primary school teachers' lesson plans were examined, and the themes of drawing attention, design, material, career connections, and assessment-evaluation emerged. The significance of using design-based activities in primary schools, as well as the pedagogical benefits of using design-based activities in disaster education, was emphasized. Despite their abstract nature, natural disasters can be made more understandable through design-based education, particularly for primary school students who are in the concrete operational stage and have limited experience.

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### Introduction

Recent scientific and technological advancements have made our lives easier, but they also pose a threat to the environmental, social, economic, and cultural areas. Climate change, drought, natural resource depletion, pollution, biodiversity loss, and hunger are among the most visible of these global issues (Fomby et al., 2009; Barlas, 2013). Humans are destroying nature as a result of the rapid urbanization that has resulted from the advancement of technology. According to Duran (2021), Akkuzu-Guven, and Uyulgan (2021), one of the causes of environmental problems is human beings. People have an impact on the environment, either directly or indirectly, and people must be educated in order to reduce environmental problems (Erdas-Kartal & Ada, 2022). On the other hand, the effects of natural disasters have recently increased as a result of climate change, as has the community's social life (Becken et al., 2014). Along with it, we face man-made and natural disasters like erosion, flooding, and drought.

Disasters are events that occur as a result of natural or man-made causes, causing people to suffer physical, economic, and social losses. These occurrences have the potential to have a significant impact on human life. Natural disasters have become more common around the world (Seddighi & Bahatmand, 2020), and there are 31 different types of natural disasters (Disaster and Emergency Management Presidency, 2020; Shaluf, 2007). These are geological disasters (e.g., earthquake, landslide, rockfall, and tsunami), climatic disasters (e.g., heat-cold wave, hail, flood, icing, air pollution, and excessive snow), biological disasters (e.g., erosion, forest fires, epidemics, insecticides) and social disasters (e.g., fires, wars, terrorist attacks). Natural disasters affected one out of every 39 people between 2004 and 2013 (UNISDR, 2015).

Disasters are divided into two types based on their causes. These are classified as both natural and man-made disasters. Human-caused disasters, as opposed to natural disasters caused by natural hazards, have an element of human intent, negligence, or error involving a failure of a man-made system (Central Washington University, n.d.). Natural disasters include earthquakes, floods, volcanoes, and hurricanes, whereas man-made disasters include war, pollution, nuclear explosions, and transportation accidents (Zibulewsky, 2001). Fires, for example, can fall into either category depending on how they start.

Natural disasters such as earthquakes, fires, tsunamis, floods, hurricanes, and drought have occurred on a global scale recently. In this context, people should be aware of natural disasters and be prepared to take precautions against them in order to reduce the dangers posed by them. A significant proportion of those who died in disasters were children, and it was stated that the number of people affected by disasters has increased due to weak structures and unplanned urbanization (Kousky, 2016; Limoncu & Atmaca, 2018). Natural disaster awareness and preparedness studies should be taught to children at a young age. Children's early experiences with common disasters will guide them throughout their lives. In this regard, it is critical to start teaching children about natural disasters at a young age. Possible problems that may be experienced as a result of natural disasters can be minimized by raising awareness and consciousness among students about natural disasters, so individuals of all ages are expected to have natural disaster literacy.

Disaster literacy is defined as the ability to read, understand and use knowledge for the purpose of mitigating the impact of disasters, preparing for disasters, making better decisions in terms of response and avoiding disasters, and following instructions (Brown et al., 2014). Many people in disaster-prone areas may be underinformed about how to protect themselves and take precautions. As a result, disaster literacy and education are critical for reducing disaster risk. Teachers and school administrators' natural disaster literacy was inadequate (Chung & Yen, 2016; Sözcü, 2019). On the other hand, teachers are not well-informed about natural disasters and thus cannot effectively instruct their students on natural disasters. According to Sözcü and Aydınözü (2019), while the curriculum includes achievements for natural disasters, it is insufficient for natural disaster literacy.

In response to changing conditions within the context of the needs of the twenty-first century, interdisciplinary problem-solving skills are required from an early age (Bybee, 2010), so innovative strategies, approaches, and methods have begun to be implemented in education. The design-based education approach, particularly the engineering design process, is one of the most important of these. The following is a description of the engineering design process:

*Engineering design is a systematic and thought-provoking process used by engineers to create, evaluate and define solutions for devices, systems, or processes whose form(s) and function(s) meet customer goals and meet user needs, under certain limitations. In other words, engineering design is a reflective process used to create plans or schematics for devices, systems, or processes that achieve given goals while adhering to certain limitations (Dym et al., 2009, p. 7).*

### **Design-based Disaster Education Project Implementation Process**

To reduce the devastation caused by natural disasters, teachers must first gain knowledge and awareness before passing on their knowledge and experiences to their students. According to Tuswadi (2014), teachers' knowledge and skills in disaster teaching are insufficient. The goal of this study is to determine primary school teachers' opinions on design-based natural disaster education and to examine the lesson plan designs they have prepared in this direction. It is the goal of design-based natural disaster education to ensure that participants use various disciplines together and to raise awareness about the professions and occupations associated with these disciplines. As a result, the participants help students become more aware of natural disasters. As a result, the project's objectives are as follows:

- To increase the knowledge and awareness of the teachers participating in the project about natural disasters,
- To equip the teachers participating in the project with competencies towards design-based teaching and interdisciplinary STEM approach, which are innovative teaching approaches in the teaching of natural disasters,
- To ensure that the teachers participating in the project develop activities for the teaching of natural disasters and implement them in their classrooms through interactive applications based on the guidance of the project team,
- To develop a design-based activity pool for natural disasters and to make it available to stakeholders by sharing the activity plans developed by the project team and participants within the scope of the project.

Following the training, teachers must implement design-based disaster practices in their classrooms. In accordance with the stated research objectives and questions, teachers were asked to prepare a lesson plan reflecting what they learned following the design-based disaster education practices. The purpose of requesting lesson plans from teachers is to see how much of what has been learned can be reflected in lesson plans.

## Purpose of the Study

Teachers have been determined to be ineffective in disaster education (Tuswadi, 2014), so examining how teachers currently perform disaster education is critical. Finally, the teachers' perspectives on the design-based disaster activities and their applicability are important. As a result, the following questions were addressed in this study:

- How do teachers collaboratively design their lesson plans after participating in a design-based disaster education professional development?
- What are teachers' views on current design-based disaster education practices in primary schools?

In accordance with the project's objectives and research questions, the implementation process is divided into three stages, namely the preliminary stage, activity implementation, and the process of developing lesson plans.

Table 1. Activities

Day	Activities	Explanation
Day 1	Activity 1: What is a disaster? Disaster awareness Activity 2: Ice-breaking action	On the first day of the project, participants were informed about common disasters in order to raise disaster awareness. Furthermore, instructions on what to do before, during, and after the disaster were provided. A drama activity was also held on the first day of the project so that the participants could get to know each other, warm up, and form a group.
Day 2	Activity 1: We produce natural solutions to drought Activity 2: Environmentally friendly alternative solutions to the problem of urbanization	In the first event of the day, participants studied the adaptations of various plants and animals to meet their water needs in low-rainfall areas, and based on these animals, they created designs that would store more water in the event of a drought. In the other activity, participants were asked to focus on the problems caused by uncontrolled urban population growth (unplanned urbanization, concretization of green areas, air and water pollution, etc.) and create designs that necessitate alternative solutions.
Day 3	Activity 1: We create a post-disaster living space Activity 2: Journey to the science center	The first activity of the day asked participants to build a home for the creatures affected by the fire. Following that, a trip to the Science Experiment Center and Sabancı Space House was organized, where the trainers asked the participants to design a bridge that could remain intact after disasters such as earthquakes and floods in order to raise disaster awareness. In addition, the disaster simulations in these locations exposed the participants to earthquake, tornado, and flood disasters.
Day 4	Activity 1: Durable towers Activity 2: Disasters experience with virtual reality goggles	The first event of the day was a discussion about how earthquake-resistant structures should be, and participants were asked to design durable towers based on the criteria provided. The participants created virtual reality goggles in the second activity of the day. They examined concrete examples of natural disasters in mobile applications and experienced virtual disasters using the goggles they designed.
Day 5	Activity 1: Flood? What's that? Where was it? Activity 2: Erosion Simulation	In the first activity of the day, participants were asked to design a settlement, taking care to include an area that would be least affected by the flood. The second activity of the day required participants to work in groups to create two different surfaces, one without vegetation and one with vegetation.
Day 6	Activity 1: User friendly masks Activity 2: Where to position ambulances?	With the first event of the day, it was requested that ambulances be placed in various parts of the city, using the modeling method, to respond to people who contract disease during the epidemic process as quickly as possible. In the other event, participants were challenged to create user-friendly masks while considering the positive and negative experiences they encountered during the Covid-19 pandemic.
Day 7	Activity 1: I have finalized my materials I am preparing an e-portfolio Activity 2: Presenting the lesson plans	The participants presented the lesson plans they designed in groups on the final day of the project and received feedback from the other groups and the project team.

## **Preliminary Stage**

During the preliminary phase, themes were developed for the activities to be carried out within the scope of the project, and appropriate activities were developed for each theme (drought, earthquake, erosion, fire, flood, and epidemic). The final version of the activities was given in accordance with the activities by interviewing the experts in their fields and who would best implement these activities.

## **Activity Implementation**

Field specialists delivered design-based disaster education for six days, two sessions per day. The first 30 minutes of training included information about the topic, the next 2 hours included creating designs in accordance with the given criteria, and the final 30 minutes were dedicated to the presentation of the prepared designs, for a total of 3 hours. The following is a day-by-day breakdown of what has been accomplished in the project. Table 1 shows details of the activities.

## **Process of Developing Lesson Plans**

At the end of each day, participants met in groups of four to prepare design-based lesson plans for each disaster case given within the project. Within the two-hour period given at the end of the day that focused on that specific type of disaster, these lesson plans were developed with the assistance of the project team (project team and experts who carried out the activity on the relevant subject).

## **Method**

The purpose of this study is to examine the lesson plans prepared by primary school teachers in disaster education using design-based approaches, as well as to present their opinions and perspectives on their experiences during this process. The research was targeted to uncover primary school teachers' perspectives on the use of design-based activities in disaster education and to thoroughly examine the plans they developed for this purpose. The study is structured as a case study, which is defined as an in-depth examination of one or more limited cases over time using multiple data sources (Creswell, 2007). A case study design was chosen for this study because it aimed to deal with the products, experiences, and perspectives of the participants in a specific time period in a thorough and holistic manner.

## **Participants**

The purposeful sampling method was used to select study participants. One of the criteria in this context was to select teachers who taught at the primary school level, and the other was to select teachers who had received design-based activity preparation training. According to the criteria established, 24 primary school teachers were chosen, 12 of whom were female and 12 of whom were male. The participation of teachers from various regions was ensured in order to increase diversity when selecting project participants. It was hoped that by doing so, the project's overall impact would be increased. Table 2 displays participant information.

## **Data Collection Tools**

The lesson plans developed by the participants in groups and the follow-up focus group interviews to reveal their experiences and opinions on these lesson plans were used to collect data within the scope of the research. These two data sources were combined to gain a holistic perspective in order to find answers to the research questions.

Lesson plans prepared by participants in groups of four within the scope of the project were obtained as the primary data source in the research. Given the project's focus and content, these plans were based on a natural disaster chosen by the participants and included design-based learning processes. While the participants were given freedom to decide the content of the lesson plans, a consensus was reached on the 5E model, which the teachers were familiar with due to their regular use of the format. As a result, while the participants' lesson plans were ensured to be consistent with one another, their applicability in the classroom was also increased.

Table 2. Information of participant

Nickname	Grade served	level	Age	Professional seniority	Education level
Daisy	1		26-30	5	Bachelor
Mike	4		31-35	8	Bachelor
Anna	1		26-30	4	Bachelor
Nicole	4		26-30	7	Bachelor
Iris	4		36-40	15	Bachelor
Kevin	2		41-45	21	Bachelor
Alice	2		36-40	13	Bachelor
Amy	2		26-30	2	Bachelor
Garry	2		36-40	13	Bachelor
Brian	1		46-50	23	Bachelor
Adam	1		31-35	15	Bachelor
Owen	Principal		31-35	9	Master
Lively	2		46-50	22	Bachelor
Nate	1		36-40	17	Bachelor
Julia	Multigrade (3-4)		36-40	16	Bachelor
Eve	2		41-45	21	Bachelor
Jack	1		31-35	9	Bachelor
Carol	2		41-45	20	Bachelor
Jordan	4		36-40	17	Bachelor
Harrison	3		31-35	11	Bachelor

The secondary data collection tool for the research was focus group interviews, in which the teachers worked collaboratively to prepare lesson plans and participated in groups throughout the process. As a result, in these interviews, which were conducted in groups of four, the participants were asked about their experiences and perspectives on the process of designing the lesson plan within the scope of the project. Given that the participants went through the process with the group they were in, it was thought that focus group interviews would provide more detailed information. Each focus group interview lasted approximately one hour. The researchers were in charge of the moderation and transcription of the focus group interviews.

### Data Analysis

The content analysis method (Miles & Huberman, 1994) was used in the analysis of the data obtained within the scope of the research. The NVivo qualitative data analysis program was used to inductively analyze the lesson plans and transcripts of the semi-structured interviews prepared by the participants. The findings were organized in accordance with the codes, categories, and themes derived from the data analysis. In the study, construct validity was tried to be established by using multiple data collection tools (focus group interview form, and course syllabus draft). Furthermore, an effort was made to ensure reliability by involving more than one researcher in data collection and analysis (Merriam & Tisdell, 2016). Finally, direct quotations from the data were used to ensure reliability, and participant confirmation was obtained to ensure validity (Creswell & Poth, 2018).

### Findings

Within the scope of the research, groups of teachers were asked to prepare the lesson plans and interviews were held regarding the process of preparing these lesson plans. In this context, data from interviews and lesson plans were analyzed separately and presented under headings corresponding to the themes that emerged.

### Lesson Plans

Teachers were asked to reflect on their training and prepare a disaster education lesson plan in groups of four. They were divided into groups for this purpose and designed a lesson plan based on the 5E model. The data obtained from these lesson plans are presented under the headings of "engage, explore, explain, elaborate, and evaluate".

General Information on Lesson Plans

Table 3 represents the course, grade level, and type of disaster targeted in the lesson plans.

Table 3. Course, grade level, type of disaster targeted in lesson plans

Group	Grade	Selected courses	Type of disaster
1. Group	2	Life Science, Visual arts	Epidemic
2. Group	3	Life Science, Literacy, Mathematics, Visual arts	Drought
3. Group	4	Social Studies, Literacy	Fire
4. Group	4	Social Studies, Literacy, Mathematics, Visual arts	Flood
5. Group	2	Life Science	Earthquake
6. Group	4	Social Studies, Mathematics	Erosion

Table 3 reveals that teachers do not prioritize first grade in their lesson plans. However, acquisitions in Life Science and Social Studies were prioritized. It was discovered that some groups (for example, 2 and 4) mostly targeted course outcomes, whereas the 5th group only targeted one course outcome.

5E Process

Table 4 displays lesson plan content prepared using the 5E model.

Table 4. Lesson plan contents prepared according to the 5E model

Group	Engage	Explore	Explain	Elaborate	Evaluate
1. Group	using a mask	Checking student preliminary information	Q&A-video	Experiment	Game
2. Group	Using news text	a Brainstorming	Asking students for a solution regarding the problem situation, creating a design	Discussing the designs created	Discussing the final version of the designs
3. Group	Using a scenario	a video playback	Sample case	Creating a design for the problem situation	Determination of the most appropriate fire response method
4. Group	Using images and story text	Discussion	Bringing an expert, Creating a design for the problem situation	Discussion on created designs	Display of designs
5. Group	Using a disaster kit	a Creating a simulation	Creating a video, drill, disaster kit	Coding work	station technique
6. Group	Creating and presenting a story	Watching videos	Experiment, graphing, video	Creating designs to prevent erosion	Process evaluation form

Drawing Attention

When Table 4 is examined, it can be seen that teachers use various materials to attract students' attention during the introduction portion of the lesson. The first group, for example, described the situation in the lesson plan as follows: *"The teacher enters the classroom wearing a crow-nose mask. He questions the class about why he is wearing the mask."* Furthermore, the fifth group attempted to pique the students' interest by bringing a disaster kit to class:

*"The teacher entered the classroom with a disaster and emergency bag (go-bag). He asked students to guess what its contents were. The bag was opened and examined. A game on the subject was opened on the smart board. The materials that should be in the bag were placed with the students."*

The third group attempted to draw attention through a scenario and preferred the drama method for the students, with the goal of allowing students to recognize human behaviors that lead to disasters.

*“A small fire broke out (planned for drama before the fire) when a butt, unconsciously thrown into the trash can in front of the school, ignited with pieces of paper in there.”*

Another method used by teachers in the introduction is the use of their own stories or news texts. The questions and answers with the students over a created text were used to create an introduction to disaster issues. Group 4's lesson plan, for example, stated the situation as follows:

*“Students were shown a photograph of houses and natural beauties built in places such as creeks. They were asked the question “Would you like to live here?” and the answers given by the students were heard. Afterward, the students were told the story of two siblings, who lived in a place like the one in the photo.”*

The second group intended to capture the students' attention by bringing a real-life news text about drought to the classroom.

*“Within the scope of the news titled “the villagers have returned to their traditions due to the drought”, the students were made to feel the problem without using the term “drought” and they were attracted to the visual.”*

Finally, the sixth group wrote a story about erosion and shared it with the students, asking them to answer questions about the text.

*“The reading passage “What Was the Reason” was distributed to the students. They were asked to answer questions about the text. The answers to the questions were discussed and brainstormed.”*

### *Design*

The fifth group devised an earthquake experiment. Thus, the goal was for the students to understand how the furniture in the house should be designed in the event of an earthquake. Students were asked to create solution-oriented designs for the experiment to be carried out in this direction.

*“In order to teach the precautions to be taken before the earthquake, artificial tremors were created in the model house, whose furniture was not fixed with the materials prepared in advance, by using the design-based education method. The damage caused by the earthquake was noticed and the students were asked to design solutions. It was ensured that the students understand that the items in the house should be fixed as a solution. The items in the model house were fixed and another artificial tremor was created. The damage caused by the tremor was examined. They were asked to make comparisons about tremors where the items were fixed and not fixed.”*

Finally, the fifth group intended to do coding activities with the students in order to provide disaster education. It is hoped that this course will provide students with the skills necessary to prepare a disaster emergency plan using coding.

*“Coding activity was performed. A family disaster emergency plan was prepared. After the disaster, the family knew the meeting place they had to go.”*

While attempting to attract attention through a scenario, the third group preferred the drama method for the students. It was aimed that this would help students understand the human behaviors that lead to disasters.

*“A small fire broke out (planned for drama before the fire) when the butt, unconsciously thrown into the trash can in front of the school, ignited with pieces of paper inside it.”*

Then, videos that can support the activity carried out in the introductory part were used.

*“After returning to the classroom, students were divided into groups. After the fire drama watched in the garden with the students, they were made to watch a video.”*



Following the viewing of the videos, the third group presented a problem situation to the students and instructed them to create a suitable design. The students were expected to create a design that would enable the evacuation of animals in the event of a forest fire, which is a current disaster, as the design criteria.

*“Ayşe, who resides in Datça, is looking for a solution to intervene by air, land, or water for the evacuation of animals in the district with the least damage from the forest fire she witnessed in July. How can Ayşe save animals in the fastest and most economical way?”*

After the houses of the students living near the flood were destroyed in the story written by the fourth group, the students in the class were asked to design a new house.

*“The students were divided into groups of three. They discussed among themselves the solutions they found to the problem. At this stage, it was stated to the students that they would design new houses for two siblings. First of all, they were asked to make a draft of their designs and to show the solutions they found on a sketch.”*

The second group challenged the students to create a settlement where water is saved in order to find a solution to the drought problem mentioned in the attention-grabbing section of the news.

*“The real situation was discussed with their solutions and the materials they designed. The drafts prepared by the students were discussed and the materials they would use during the design phase were given to the students.”*

In the sixth group design section, students were asked to create an erosion-resistant area. The plan was for the students to create a first example using the materials they were given, and then conduct experiments to see if this area functions efficiently.

*“Students were asked to design a product to prevent erosion by discussing in groups and to produce drawings of these designs. The following materials were given to the students. They were asked to prepare and present their designs as models. The designs were completed considering the given criteria and limitations.”*

### *Material*

While the groups were making their plans, they asked the students to design products. At this point, they gave the students some materials to work with in order to create products. When course syllabuses are examined for this purpose, it is discovered that teachers select materials for use in designs from materials used in their daily lives. For example, the second group stated that the designs would be made with the following materials: background cardboard, skewers, toothpicks, cardboard, colored papers, soil, and water. Similarly, the fourth group, which asked students to create designs to keep people living near the stream from being flooded, listed materials that the students could easily access. The fifth group chose materials that students could easily access after identifying the theme of an earthquake as a natural disaster in the course syllabus. Finally, the sixth group, which chose the theme of erosion disaster, decided on the materials that students should use during the design phase, which included soil, artificial grass, water, chenille, egg carton, blow dryer, and paper towel.

### *Career Connections*

Teachers planned to collaborate with other professional groups to learn the subject they had chosen. For example, the sixth group, which identified erosion as a theme, intended to contact a Disaster and Emergency Management Presidency (DEMP) official during the learning phase and request a presentation on the subject. Furthermore, they considered listening to their experiences by hosting a person who had witnessed the erosion event.

*“Career experts were invited to the school and information was obtained. A live history study (sharing the life and experiences of the person who has suffered erosion) was conducted.”*

The fifth group, which chose earthquake as a theme, intended to collaborate with "DEMP volunteers, geological engineers, architects, and environmental engineers" to explain various aspects of the earthquake to the students.

The fourth group planned to invite a flood expert to the class to educate the students about the flood theme in their lessons.

#### *Measurement-Evaluation*

The groups preferred to use different assessment strategies at this final stage of lesson plan preparation. For example, the second, third, and fourth groups aimed to reveal the change in the students' learning levels during the process by discussing the products prepared by the students. After the students presented their designs, Group 2 planned for the entire class to evaluate the advantages and disadvantages of the designs.

*“Students present their designs in groups in class. Advantages and disadvantages are evaluated.”*

During the evaluation phase, the first group aimed to teach students to follow the mask, distance, and hygiene rules during the pandemic through educational games.

Another preferred method of evaluation is the station technique. The fifth group, which preferred to use this technique, divided the students into groups and planned to assess earthquake awareness using stations such as painting, music, and poetry.

*“Using the station technique, students are divided into groups regarding earthquakes. Groups are made to work on painting, music, poetry, and letters.”*

Finally, Group 6 intended to use a "Process evaluation form" to assess students throughout the procedure.

#### **Themes Obtained Through the Interviews**

The themes of the use of design-based activities, disaster education in the curriculum, and the importance of providing disaster education were obtained from the data obtained from the interviews (See Figure 1).

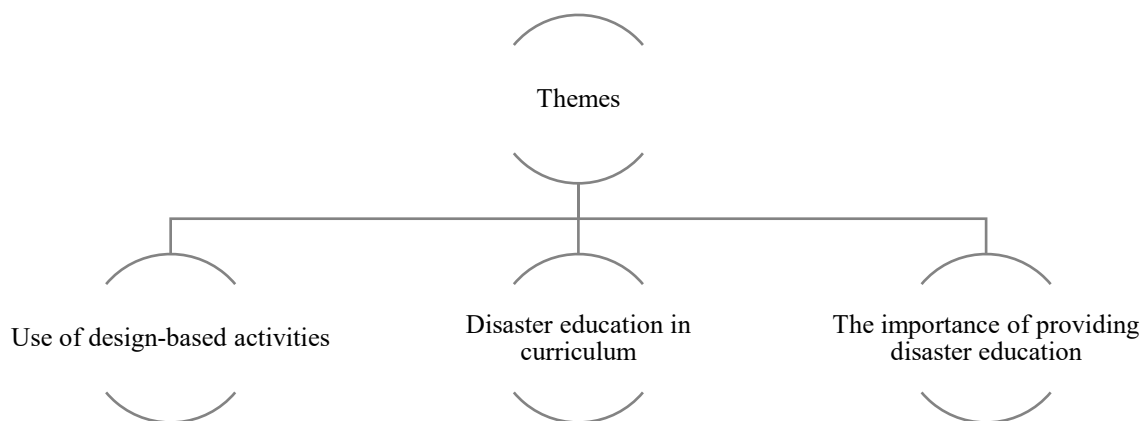


Figure 1. Themes obtained through the interviews

#### *Use of Design-Based Activities*

The potential of design-based activities was one of the highlights of the participant interviews. During the interview process, many participants mentioned the pedagogical benefits of design-based activities. The concretization of abstract concepts, which are difficult for primary school children to learn, through direct experience within the scope of design-based activities is at the forefront of these points.

*“I think that design-based learning is concretizing the abstract concepts at the primary school level and making them more tangible by supporting them with visual materials.”* Mike

Design-based activities, it has been claimed, give meaning to abstract subjects in younger age groups. Furthermore, it was emphasized that it is a fun learning process that will boost students' motivation and attitudes

in this age group. Nicole, for example, emphasized the fact that design-based teaching can be carried out using simple and easily accessible materials and described it as activities that can increase the motivation of children when they become bored in class.

*“Actually, we didn't use very different things here, we created beautiful designs using simple materials. This is what we do in class. We use materials and activities to gamify things that remain abstract or when children are suffocated by lecturing.”*

Amy stated that design-based teaching is a process that necessitates the execution of numerous complex actions. Furthermore, he emphasized that the design process is not just an internal process and that the design can be restructured cyclically as a result of sharing ideas and critical feedback.

*“I think it is work that requires a process. First, we design and share ideas, then we can move on to a new design by discussing the disadvantages-advantages. While creating a product with the process, we can say that the product is actually being restructured with the criticisms provided.”*

In addition to these, participants mentioned a variety of dimensions related to the process and outcome of design-based activities. For example, Anna described design-based activities as "the emergence of a product as a result of learning". Daisy defined it as "learning by doing and living". With the words "the child's creation of his/her own product with his/her original thought and being able to produce a solution in line with the problem," Iris stated that it is essential to produce a solution to a problem while creating an original product in design-based activities.

Participants emphasized certain points in order to improve the efficiency of design-based activities. For example, Adam emphasized the importance of selecting a problem situation from real life for use in design-based activities and stated that the problem situations chosen from real life do not have a single solution, allowing students' skills such as creativity to be developed.

*“In real life, there is a problem situation, and we take it. We want students to create solutions, and in design-based learning, there are no ready-made solutions. We solve it by making it more realistic. Is our solution practical or not? There were various scenarios ranging from "let's put the ambulance center here" to "let's do this" in the activities we held for a week. It also inspires creativity because it can happen in real life.”*

Eve emphasized that group work is one of the prerequisites for design-based activities to achieve learning objectives. She used to want her students in her class to do individual studies, but she saw the effectiveness of group work on learning during the project process.

*“I used to educate children individually. But here I saw that when you do something as a group, there better learning takes place.”*

Another issue that arose in the context of the effect of design-based activities on learning was the persistence of learning. With the following statements, Jack stated that the applicability of the activities for the teacher was increased by the introduction of concrete designs, and for the students, they resulted in permanent learning:

*“I think it increases persistent learning. When we do the projects concretely, I think it fits in a more applicable way.”* Jack

Similarly, Carol stated that the student internalized what she learned as follows: *“We internalize the problems we encounter; we will have experienced them rather than just seeing them.”* In addition to the benefits of design-based activities mentioned by participants, some drawbacks were also mentioned. Nicole, for example, argued that design-based activities take time, which is a disadvantage for teachers when using design-based activities. She cited crowded classes as one of the reasons for this:

*“Because the classroom is crowded, it is not possible to do it in 40 minutes in our classrooms. If we are planning a material production activity, we are certainly sacrificing 2-3 lecture hours.”* Nicole

Similarly, Julia stated that, while design-based activities have many benefits, they are time-consuming: *“We may experience situations where design-based teaching takes a little more time in small age groups and there are not enough class hours, but the benefits are too numerous.”*

*Disaster Education in the Curriculum*

The participants' perspectives and opinions on disaster-based training, which is another aspect of the project process, were solicited. Participants made statements about the role of disaster-related activities in the curriculum at this point. One of the participants, Garry, argued that disaster-related activities are sufficiently included in the primary school curriculum and that they can be handled in an interdisciplinary manner by associating different courses with their outcomes, as follows:

*“Certainly not enough. As we’ve seen, it can be related to both mathematics and science courses. We only see it as an achievement in social studies, and social studies outcomes in fourth grade are very intense. The majority of them are abstract ideas. However, as a result of this project, I realized that we never associate it with courses like painting and music.”*

Garry was not the only participant who emphasized the importance of implementing disaster education practices through interdisciplinary approaches. Jordan, like Garry, stated that curricula have limitations in integrating disaster issues and that the integration of different disciplines is one way to overcome these limitations. According to Jordan, this interdisciplinary approach can be realized not only through life studies, science, and mathematics but also through courses such as music and physical education:

*“I think we should integrate natural disasters into the curriculum; there should be a place for it not only in life studies and social studies but also in science. In mathematics, for example, it can be addition and subtraction. We can play games about rapid escaping in music, and physical education.”*

Harrison emphasized that by establishing a relationship between the courses in each semester, these subjects can be realized much more effectively as a result of the spiral structure of the curriculum. He emphasized that the spiral structure allows the interdisciplinary approach to be realized at higher levels.

*“The interdisciplinary structure needs to be at a high level. At the same time, the spiral structure must be active. It is necessary to maintain the relationship between courses in a spiral structure from one term to another, not from one year to another.”*

Amy, who criticized the lack of disaster subjects in the curriculum, emphasized that it is a contradiction that disasters occur so frequently in our country, yet they are included in the curriculum with so few learning outcomes.

*“It is constantly being said that we are a country of earthquakes, a country of natural disasters. But there are only two or three outcomes in the curricula related to this.”*

*The Importance of Providing Disaster Education*

In addition to the placement of disaster-based teaching approaches in the curriculum, participants evaluated their inclusion in classrooms. Participants argued that disaster-related topics should be taught, particularly in primary school, and emphasized the pedagogical benefits of this subject. For example, Owen stated that it is critical for children to become aware of disasters at a young age and that by doing so, great progress can be made in disaster preparation.

*“We believe it will be very useful, particularly in the preparation and before. An old dog cannot be taught new tricks. If the child learns about disaster education and prevention early on, he may not be able to prevent the disaster, but as an adult, he will raise his own child in this manner. It makes a significant contribution.”*

Furthermore, Adam stated that many disasters on a local and global scale are possible in the future, and emphasized the critical importance of disaster education, particularly for primary school children, in order to cope with these disasters. He also argued that primary school disaster education should focus on how to deal with these disasters.

*“According to projections for the next five years, a disaster such as a drought is on the way, and by raising awareness of this, we will have more water resources. It is critical to raise awareness. Unfortunately, it appears that natural disasters will become more common in the next 5-10 years. I*

*believe it is critical to provide education on how to deal with natural disasters, particularly at the primary school level."*

*"When you touch a child, his/her parents, grandmothers, and grandfathers become multipliers of this widespread effect, and an aunt and grandmother who never knew it learns something,"* Lively said of disaster education given to children her age in primary school to create social awareness. She emphasized the importance of primary schools in raising social disaster awareness.

Participants, on the other hand, criticized disaster-based teaching practices in schools. For example, Anna stated that the disaster activities they conducted in their schools were mostly on paper and could not be implemented by the students. Anna, who stated that disaster education practices in schools, in general, were limited, expressed her uncertainty about the effectiveness of these activities with the following statements:

*"Clearly, we haven't gotten very far in disasters until now. Based on the activities here, I believe we will be more focused on paper. When it comes to what to do in the event of an earthquake, we say this is done or that is done and leave it at that, or we conduct earthquake drills with all school students. I'm not sure how effective it is, but I doubt we'll get very far."*

Nicole shared a case on the effectiveness of disaster education in schools, describing how they were caught in an earthquake during class in her school building, and how neither she nor her students were able to put what they had learned into practice.

*"I realized this: yes, we teach only earthquakes for four years, but at the end of four years, we notice that there is not even a spiral. We practice earthquake drills in advance, but once we were caught in an earthquake at school. We have seen from experience that we did not give it. Neither as a result nor a practice. I would like to criticize this here, there is no such thing as disaster education of high quality in the curriculum. We were snagged during recess. We were in the teachers' room, and we rushed into the classrooms to collect the students. We were also stunned; the children ran from one location to another, and everyone dispersed somewhere. When we discovered the truth, it was extremely difficult. In fact, we were unable to teach it, we were unable to provide adequate information, and we observed that the children were unaware of it."*

Anna, who supports Nicole's experiences with similar criticisms, believes that the current disaster education given in schools is insufficient. She stated that the consequences of this deficiency could be severe:

*"We always practice earthquake drills in class. For example, Nicole was caught in the earthquake at school, but the student could be in the restroom, outside during a break, or in the corridors."*

Furthermore, it has been stated that only disaster-related education activities take place in schools, while other disasters are ignored. Daisy, for example, stated that natural disaster education practices generally progressed while earthquakes and other natural disasters remained in the background.

*"I noticed it as well, especially here. When it comes to natural disasters, we usually think of earthquakes. We always try to teach children about earthquakes, but we struggle with other natural disasters. They appear to be natural disasters, but I learned here that flooding is the most common."*

Harrison stated that the disaster examples in textbooks are limited to earthquakes and that other disasters are not adequately covered. He argued that the students' disaster awareness is limited as follows:

*"Instead, I believe it would be better if we examined the issue of natural disasters under a broader theme each year. Most of the examples in the books are given in relation to earthquakes. Children are more likely to be affected by earthquakes; they are unaware of avalanches and floods. We only cover earthquakes in general; the rest are up in the air."*

Kevin also argued that because the country is constantly subjected to various disasters, disaster-related training should be given on a regular basis to all grade levels:

*"Actually, disaster education should be given from the first grade, because our country is one that struggles with disasters. A regular disaster education should be given from the first grade to the last year of high school."*

There are criticisms of the existing content, in addition to the fact that the data obtained from the interviews do not provide enough content for disasters. Daisy, for example, stated that the examples given in disaster textbooks are above grade level: *"I taught fourth grade. It is given in greater detail because it pertains to social studies, but at a higher level, as opposed to storytelling."* The courses she taught about disasters before receiving design-based disaster education, on the other hand, were not very permanent due to the age of the children: *"We make them watch videos and show them pictures, but there are not many pupils who really experienced it because the children are very young, and the videos are so far."*

## Discussion and Conclusion

This study intended to ascertain primary school teachers' perspectives on design-based natural disaster education and to examine the design-based lesson plans they prepared. The use of design-based activities, the place of disaster education in the curriculum, and the importance of disaster education awareness emerged as a result of the interviews. Furthermore, the primary school teachers' lesson plans were scrutinized, and the topics of drawing attention, design, material, career connections, and assessment evaluation were thoroughly examined.

The importance of using design-based activities in primary schools was emphasized, as were the pedagogical benefits of using design-based activities in disaster education. The disaster remains a very abstract issue, particularly for primary school students who are in the concrete operational stage and have limited experience. It is possible to make natural disasters more understandable through design-based education. In addition, choosing the problem situation in disaster education from a real-life situation and highlighting the disasters that may occur frequently in the vicinity of the students will increase the interest and awareness of the students on these issues. Similarly, King and English (2016) stated that in order for learning to be more permanent, engineering experiences must be presented in the context of the real world by combining science, mathematics, and technology concepts. The study's findings also revealed that natural disasters provide a strong real-life context for design-based activities.

Furthermore, the limitations of disaster education can be overcome through an interdisciplinary approach that incorporates disaster education into the primary school curriculum and associates different classes with disaster education learning outcomes. According to Wood (1997), in an interdisciplinary teaching approach, children must use more than one source in order to gain a broader perspective. It is critical that children gain a broad perspective on disaster education and that this education be given in an interdisciplinary manner. Natural disasters are only directly addressed in the curriculum's Life Studies course in the second grade. Natural disasters, on the other hand, have no learning outcomes in the curriculum of courses such as science, mathematics, social studies, and literacy. Participants are seen to criticize the situation, and in their course syllabus designs, they attempt to overcome this barrier through "indirectly related gains" related to the subject.

Disaster education should begin at a young age, and students should be taught how to respond to disasters before, during, and after they occur so that they can transfer these skills to their lives as future engineers and scientists. According to studies, children who receive disaster education at a young age not only protect themselves properly during events but also warn those around them (Shaw, 2015; Amelia et al., 2020). Both the project dimension's objectives and findings highlight the students' outcomes of disaster education practices prepared for primary school students.

Because earthquakes are commonly associated with disasters and other types of disasters are overlooked, deficiencies in disaster education occur. Furthermore, the fact that curricula are not prepared in accordance with the level of the students is emphasized. Furthermore, disaster-related topics (such as epidemics, floods, and erosion) should be included in the curricula. Similarly, Çevik et al. (2022) stated that disasters such as epidemics are included in science programs to increase students' socioscientific perspective. It was also stated that earthquake drills for disaster education in schools, as well as fire extinguishing activities, were carried out in the schoolyard. Disaster education in schools is seen to be simple and ineffective in this regard. Indeed, studies have shown that such practices in schools are simple actions that are not appropriate for real-life situations due to the need to maintain school safety (Ramirez et al., 2009; Lund, 2013; Gong et al., 2021). Furthermore, during the research interviews, one of the teachers stated that they were caught in an earthquake at school and that they were surprised by the event and couldn't do anything about it.

The primary school teachers' lesson plans were examined, and the findings were organized around the themes of drawing attention, design, material, career connections, and measurement evaluation. According to Brittin (2005), teachers should create a learning environment in which students can learn effectively, and a good course

syllabus includes materials, effective teaching strategies, and appropriate timing for the student level. Teachers used a variety of methods to draw students' attention to disasters. According to Seddighi et al. (2022), teachers should use various educational equipment for natural disaster preparation, and the curriculum should be revised for better disaster education. All groups that took learner characteristics into account began the class with a drawing attention activity appropriate to the students' level. Several studies have concluded that it is critical to draw primary school students' attention to the classroom (Şahin, 1994; Bartan, 2018). The availability of the materials that teachers intend to present to students, in particular, will facilitate student participation in the process. If the materials used in design-based activities are expensive and difficult to obtain, it makes implementation in classrooms, particularly in primary schools, difficult. According to some studies, obtaining materials was difficult (Siew et al., 2015; Garcia-Carrillo et al., 2021). In their study, Siew, Amir, and Chong (2015) stated that obtaining materials was difficult.

Teachers who placed a high value on career connections emphasized careers related to the subject, with a particular emphasis on disaster-related work, when developing lesson plans. Students will be able to focus more consciously on their careers as a result of such activities that will guide them in choosing a profession. Developing career awareness at a young age will lead to a better career choice in the future. Concerning STEM career options in particular, emphasis was placed on the importance of early intervention in students' STEM-oriented career choices, as well as the importance of increasing students' awareness of STEM-oriented career options (Moore & Richards, 2012). To that end, educational approaches should be used, particularly from a young age, to steer children in the right direction in their career choices.

## Scientific Ethics Declaration

The authors declare that the scientific ethical and legal responsibility of this article published in the JESEH journal belongs to the authors.

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