

# Fifth grade elementary students' conceptions of earthquakes

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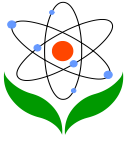
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## Abstract

This study intends to investigate the fifth grade students' conceptions of earthquakes. Twenty two grade 5 students (11-12 years old) from five different elementary schools in Istanbul voluntarily participated in the study. Data were collected from semi-structured interviews with each participant. Six interview questions were designed by researchers based on the literature (Ross & Shuell, 1993; Laçın-Şimşek, 2007) and the curriculum. Findings of the study indicated that



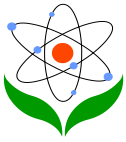
most of the students did not have any scientific conceptions, describing earthquakes mostly from social, psychological and religious aspects, and believed that earthquakes happen as a result of human action. Most students were not able to scientifically explain why earthquakes occur and what precautions they should take during the event.

**Keywords:** Students' Conceptions, Elementary Students, Earthquakes, Grade 5 (10-12 year old) children

## Introduction

Earthquakes are one of the most destructive natural disasters for many countries all over the world. Turkey is one of the most seismically active regions on earth due to the complex plate interaction between Arabia, Eurasia and Africa (Tan, Tapırdamaz, & Yörük, 2008). Ninety six percent of the country falls under the earthquakes zones while 99% of the population lives in hazardous earthquake areas (Türkoğlu, 2001, as cited in Öcal, 2005). The most active fault zone in Turkey, the North Anatolian Fault Zone, passes near Istanbul and other major urban cities (Taymaz, Tan, & Yolsal, 2012). Turkey has experienced several destructive earthquakes throughout history. Two major earthquakes happened in 1999 in Gölcük-İzmit and in Düzce and thousands of people lost their lives and homes (Taymaz et al. , 2012). The recent destructive earthquake with a moment magnitude (Mw) of 7.2 on October 23, 2011 occurred in Van, the region of Eastern Turkey and caused significant damage and losses, including of 644 lives (Erdik, Kamer, Demircioğlu, & Sesetyan, 2012). Although it is impossible to prevent earthquakes, the damage of earthquakes can be reduced by increasing people's knowledge and awareness about earthquakes (Aydın, 2010; Buluş-Kırıkkaya, Çakın, İmalı, & Bozkurt, 2011; Buluş-Kırıkkaya, Oğuz-Ünver, & Çakın, 2011; Lacin-Simsek, 2007; Nağacı, 2011; Öcal, 2005; 2007).

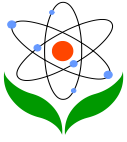
Towards this aim, some researchers have undertaken studies to investigate students' conceptions of earthquakes. One of the earliest studies focusing on students' conceptions of earthquakes was conducted with 91 elementary students by Ross and Shuell in 1993. In their study, two thirds of the students defined earthquakes as a shaking/trembling of the ground while most of students' responses addressed the results of earthquakes, such as property damage and deaths or injuries. Twenty percent of the students confused earthquakes with volcanoes. While most of the students did not respond with regard to what causes an earthquake, a few students



(6-13%) did state that faults are the cause of earthquakes. Tsai (2001) conducted interviews with 60 fifth and sixth graders in a total of four rounds after the major earthquake in Taiwan. The study revealed that although immediately after the earthquake students received scientific information about the causality of earthquakes from the public media and formal schooling, many students attributed the causes of earthquakes to supernatural forces and myths. Özdemir, Ertürk, Güner, & Koca (2002) conducted interviews with 89 elementary students in grades 1 through 5 in two different cities in Turkey in order to investigate their awareness and ideas about earthquakes. The study revealed that 26% of the students did not know what an earthquake was. Forty-four percent of the students defined earthquakes as ground shaking while 12% of them defined it as a natural disaster. Seven percent of the students defined earthquakes as damage to people and buildings. The findings of the study indicate that 56 % of the students are not aware of the causes of earthquakes. Buluş-Kırıkkaya, Çakın, İmalı, & Bozkurt (2011) collected data via open-ended questionnaires from 96 4th and 5th grade students and found that they defined an earthquake simply as a natural disaster and quake. In their study, most of the students did not know that they were living in an earthquake zone. Lacin-Şimşek (2007) also conducted interviews with 40 students from kindergarten through 8th grade in order to investigate what ideas they might have about earthquakes and methods of protection. The findings of the study reveal that none of the students could adequately or scientifically explain the causes of earthquakes.

Aydın (2010) investigated students' conceptions of earthquakes by asking two open-ended questions to 480 eighth grade students and organized them into six categories: (1) An earthquake is a natural disaster, (2) An earthquake is ground shaking, (3) An earthquake means collapsing buildings and deaths of people, (4) An earthquake is a natural disaster and its damage can be reduced if necessary precautions are taken in advance, (5) An earthquake is ground shaking as a result of movement of ground and plates, and (6) An earthquake is ground shaking caused by the release of energy depending on the movement of plates.

Rakkapao, Arayathanitkul, Pananont, and Chitaree did a further study with 171 high school students in Thailand in order to investigate their misconceptions regarding earthquakes. This study revealed most students alternative conceptions that all earthquakes create observable cracks on the Earth's surface. Students in the study also believed that when an earthquake occurs, the earth shakes at least once every 10 seconds for a period of at least 1 minute and all earthquakes damages



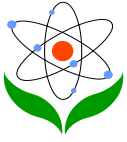
manmade structures. More than half of the students (51%) thought that the weather, such as rain, was the main source of earthquakes while 15% of them thought that volcanic eruption was the main cause of earthquakes. They also stated that earthquakes often take place near islands. Only 14% of the participants showed a scientific understanding that when an earthquake occurs, energy is released from inside the Earth and only 13% of the students correctly explained that an earthquake occurs as a result of the rupture and sudden movement of crust at plate boundaries.

Although there have been some studies investigating Turkish students' conceptions of earthquakes, some of the data collected was only through an open-ended questionnaire (Aydın, 2010; Buluş-Kırıkkaya et al., 2011) while others (Laçın-Şimşek, 2007; Özdemir et al., 2002) were conducted prior to the revision of Turkish national curriculum (MEB-TTKB, 2007). According to the national elementary curriculum in Turkey, students should learn the fundamental concepts of earthquakes by grade 5. Therefore, the purpose of the current study was to conduct an in-depth analysis of grade 5 students' conceptions of earthquakes from both scientific and social perspectives. The study investigated the following research questions:

1. What are the fifth grade (10-12 years old) students' conceptions of earthquakes?
2. What are their ideas about the cause of earthquakes?
3. What awareness do they have regarding precautions to be taken before earthquakes? (at school, at homes, and outside the home)
4. What do they know about precautions to be taken during an earthquake?(at school, at homes, and outside the home)
5. What are their ideas about the consequences of earthquakes?

## Method

A qualitative research methodology was adopted in this study. Data were collected from semi-structured interviews and the interview questions were designed by researchers based on the Turkish elementary curriculum (Milli Eğitim



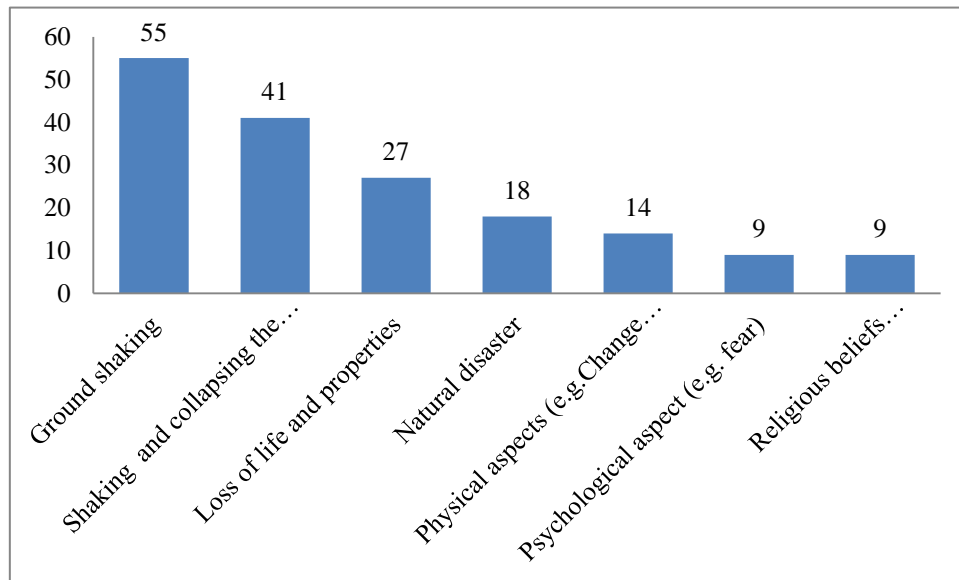
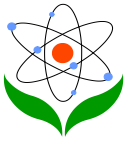
Bakanlığı-Talim Terbiye Kurulu Başkanlığı [MEB-TTKB], 2007) and the literature (Ross & Shuell, 1993; Laçin-Şimşek, 2007). Interview questions were revised and edited according to two other scholars' opinions. Finally, at least six main questions were determined and posed to each student. Each interview took approximately 20-30 minutes depending on participants' responses. Interviews were tape-recorded and then transcribed.

Twenty two grade 5 students (12 female, 10 male) from five different elementary schools in a metropolitan city voluntarily participated in the study. Students were selected based on such criteria such as willingness to participate in the study and being representative of a sample of average fifth grade students in terms of their socioeconomic backgrounds, achievement, and gender. Seven of the students were 10 years-old, ten of them were 11 years-old, and five of them were 12 years-old. By the time this study was conducted, students had already learned about earthquakes in social studies and life sciences classes. Thirteen of the participants had never experienced an earthquake while nine of them had experienced a minor earthquake. A pseudonymous name was given to each participant in order to maintain confidentiality. For this study we used conductive data analysis, which can be defined as working from the data of specific cases to a more general conclusion (Schwandt, 1997). Researchers carefully read interview transcripts and analyzed codes and categories from students' responses to generate general themes. Codes and categories which came from students' responses were independently analyzed and counted by researchers in order to increase internal reliability. Minor conflicts in interpretation among the investigators were negotiated.

## Findings

### *1. What are the 5th grade (11 year-old) students' conceptions of earthquakes?*

Students' responses to the question of what they understand about earthquakes are presented in Graph 1, showing that they had quite a variety of conceptions about earthquakes. The most common response was that in involved ground shaking. Slightly more than half of the participants (55%) said that ground shaking came to their minds when they first thought about earthquakes. It was not surprising since ground shaking is a major characteristic of earthquakes.

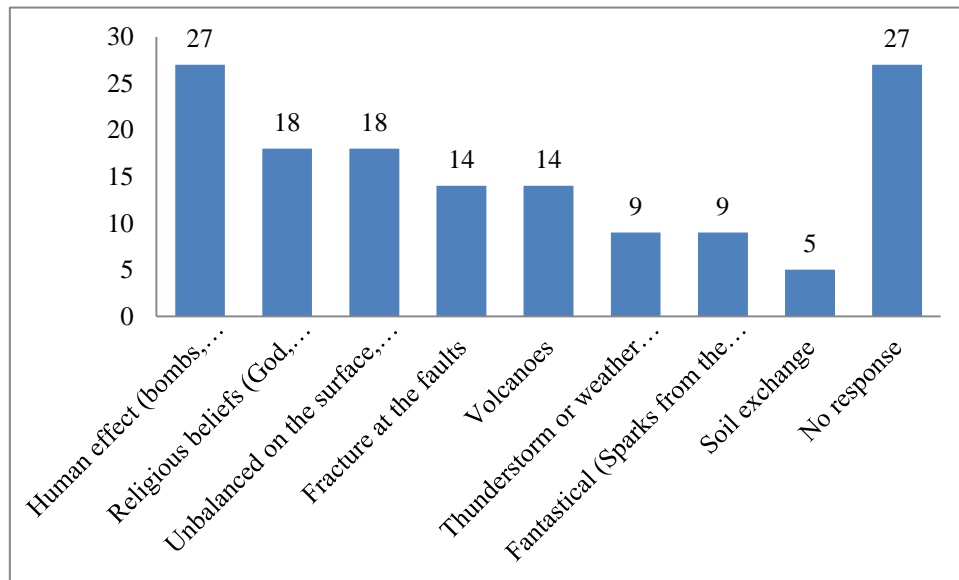
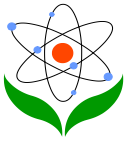


**Graph 1.** The Percentage of Students' Conceptions of Earthquakes

Collapsing/shaking buildings (41%) and loss of life and property (27%) were the other most common associations stated by the participants. In other words, more than two thirds of the participants (68%) defined an earthquake in terms of its negative consequences rather than scientific definition. Four students (18%) indicated that earthquakes are natural disasters. Three students (14%) tried to explain earthquakes in terms of physical aspects although they lacked scientific understanding. One of these students confused earthquakes with landslides and the other with volcanoes. Two other students said that they felt fear when they heard about earthquakes while another two students related earthquakes to God's action or doomsday.

## *2. What are the fifth grade students' conceptions about the causality of earthquakes?*

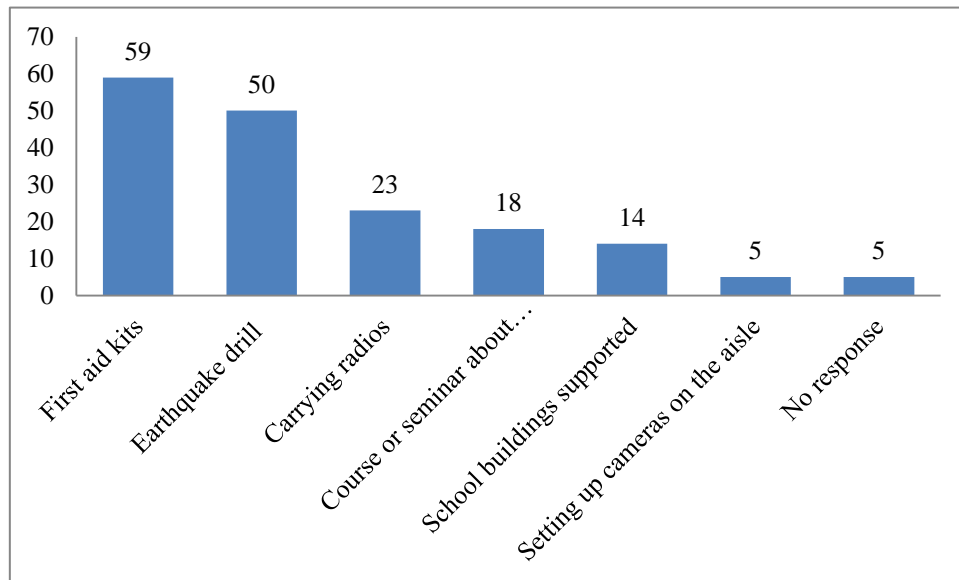
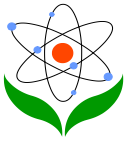
Graph 2 shows student responses to the question of why earthquakes happen. The most interesting and common response, given by 6 students (27%), was that earthquakes resulted from human action. Causes cited included bombs, pollution, or old and ill-structured buildings. For example, Emir said, "because people put bombs into the ground" while Nur said "because people do not care about the environment, they pollute it".



**Graph 2.** The Percentage of Students' Conceptions Why Earthquakes Happen

Moreover, four of the students (18%) explained the cause of earthquakes in terms of their religious beliefs such as God's doing or the approaching doomsday. Four of the students (18%) explained them in terms of physical defects, including an imbalance on the earth's surface, or a pressure in the soil at the core. Three of the students (14%) explained that earthquakes occur as a result of fractures at the faults. Two of these students (9%) also related earthquakes to volcanoes. Two of the students (9%) said thunderstorms or other weather conditions cause earthquakes. One of the students confused earthquakes with landslides. Two of the students gave fantastical responses while six of the students did not give any response.

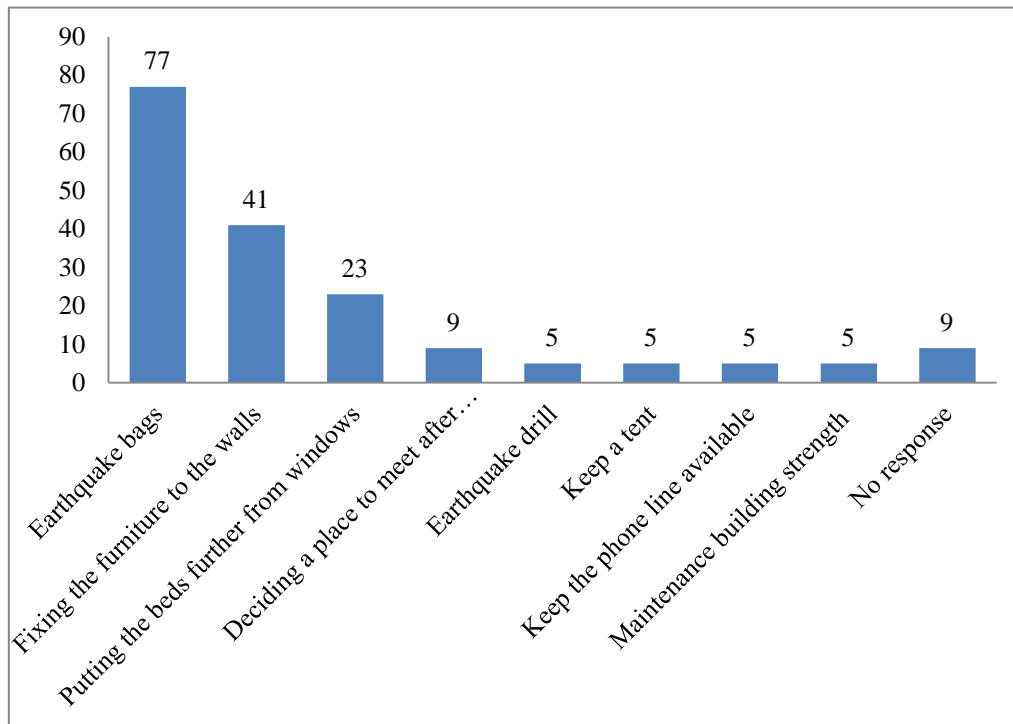
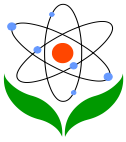
*3. What do they know about precautions that should be taken before earthquakes?*



**Graph 3.**The Percentage of Students' Responses about Precautions before Earthquakes at Schools

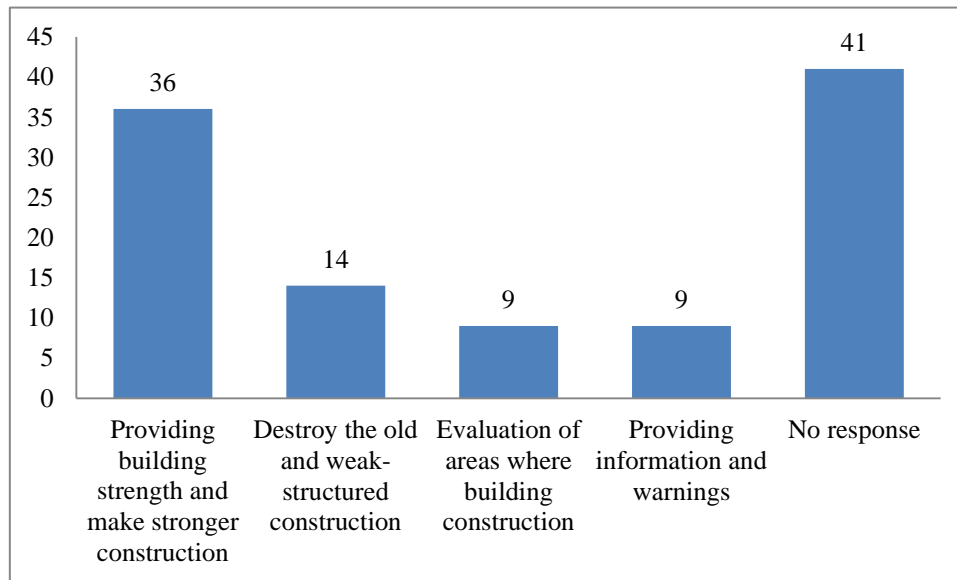
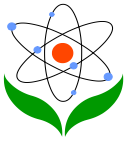
Graph 3 indicates student responses to this question in relation to school precautions. Most of the students indicated that they should have first aid kits at schools in case of earthquake damage. Eleven of the students (50%) expressed the importance of earthquake drills at schools since they had previously experienced them. Five of the students (23%) said that carrying radios could be useful in order to get updated information about earthquakes. Four students (18%) suggested that courses and seminars be given in order to prepare people for earthquakes. Three students (14%) highlighted that school buildings should be supported and earthquake proofed. One student suggested putting cameras on the aisles in the school in order to watch students during earthquakes. Two students did not give any response to the question.





**Graph 4.** The Percentage of Students' Responses about Precautions before Earthquakes at Homes

Graph 4 shows that student responses to the question what kinds of precautions should be taken at homes. These responses differed from their previous responses about precautions taken at school. The most common response was the provision of earthquake bags. Earthquake bags are often suggested by experts in media and include necessary items such as blankets, drinking water, flash lights, whistles, food, and a radio for people victims of earthquakes. Earthquake bags should always be on hand at homes in the event of an earthquake. Seventeen of the students (77%) expressed that this precaution be taken. Nine of the students (41%) indicated that people should fix their furniture or shelves to the walls. Five of the students (23%) said that beds should be further away from windows. Only two students said that family members should decide on a place to meet each other after an earthquake. Although half of the students indicated that earthquake drills should be performed at schools, only one of them said that people should have earthquake drills at home, too. One student suggested that people have a tent on hand. The same student also suggested that people have their buildings checked in terms of earthquake resistance.

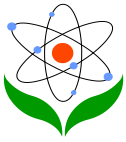


**Graph 5.** The Percentage of Students' Responses about Precautions before Earthquakes at the Outside

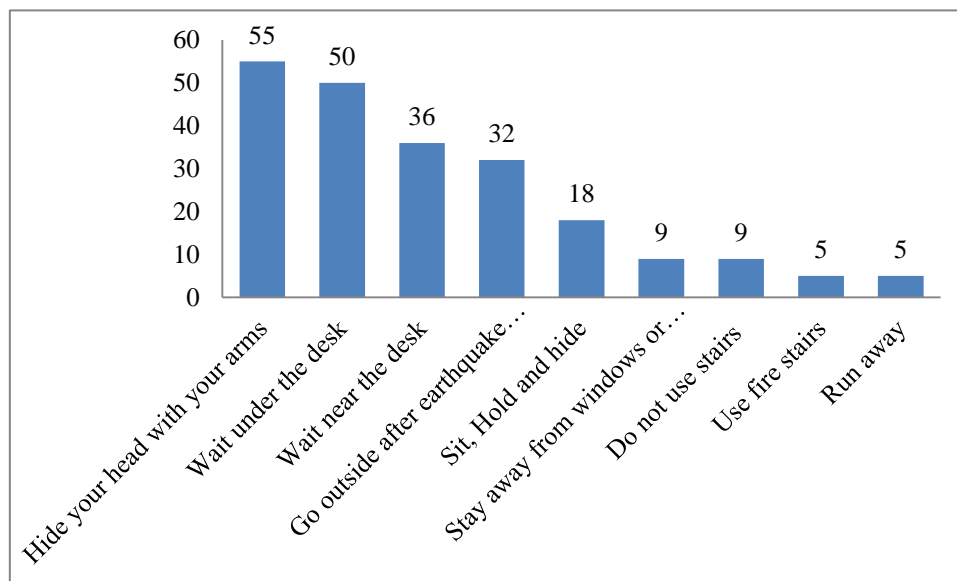
Graph 5 indicates that student responses regarding precautions to be taken outside. When students were asked what people and local governments should do before earthquakes, most of the students (41%) did not provide any response. Eight of the students (36%) said that people should check the strength of their buildings and make stronger constructions. Three students (14%) indicated that people should destroy old and weak-structured buildings. Two students (9%) said that people should test the construction areas prior to building in order to identify whether it is a safe place. Two other students (9%) said that people should be educated about earthquakes.

#### *4. What do the students know about precautions to be taken during an earthquake?*

Students were asked what people should do during earthquakes at schools and their responses are listed in Graph 6. The most common response was that people should cover their heads with their arms. Students seemed to be confused about whether they should wait under or near the desks. Eleven of the students (50%) said that they should wait under the desks while eight of the students (36%) said that they should wait near the desks. Seven of the students (32%) were aware of the fact that they should not try to go outside in the midst of an earthquake and wait until it stops. Four students (18%) recommended the sit-hold-and cover position, meaning that students should sit where the place is safe, hold tightly to the heavy furniture or table legs, and cover their heads. Some of the videos or TV programs developed in

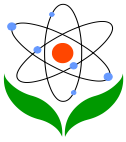


order to prepare students for earthquakes demonstrate this position and four of the students probably saw and remembered this position from videos or television. Only two of the students were aware that they should stay away from windows or shelves and two other students said that they should use stairs during an earthquake. One student said that they could use fire stairs and another student said that he could immediately run away.

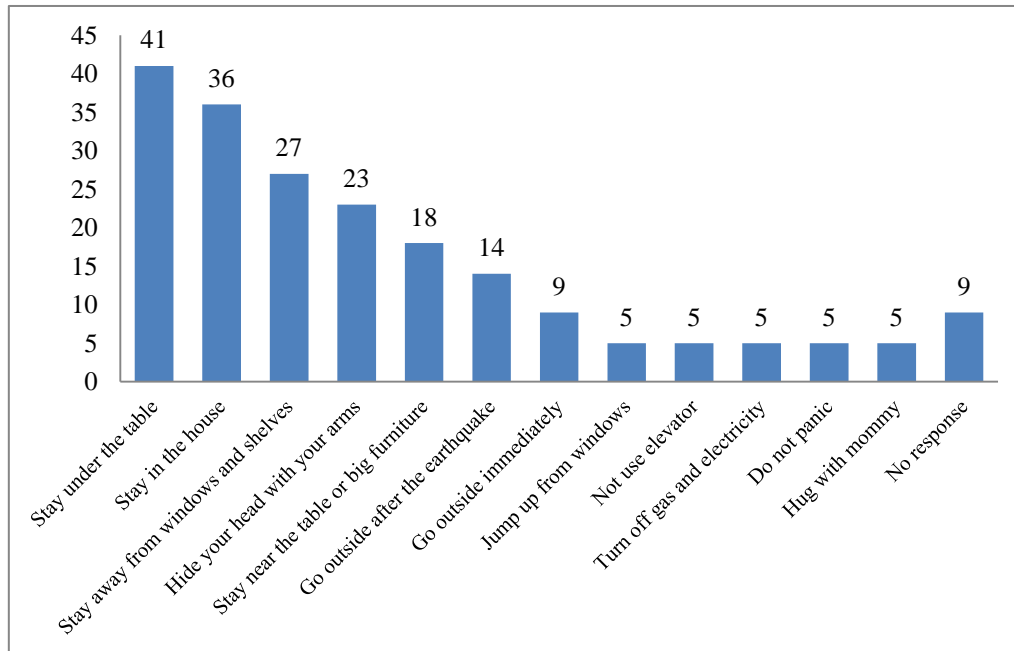


**Graph 6.** The Percentage of Students' Responses about Precautions during Earthquakes at Schools

When students were asked what people should do while at home during earthquakes, their responses varied (see Graph 7). The most common response was that people should stay under the table. Eight of the students (36%) indicated that people should stay indoors during earthquakes. Six of the students (27%) also indicated that people should stay away from windows and shelves. Only five students (23%) said that people should cover their heads with their arms although it was the most common response with regard to schools. Four students (18%) said that people should stay near the table or large furniture whereas eight students gave the same response (wait next to the desks) as in the previous question. Three students (14%) responded that people should go outside after the earthquake while seven students gave the same response as in the previous question. Two students said that people should go outside immediately while one of them said that they could jump out from the windows and the other one said that people should not be

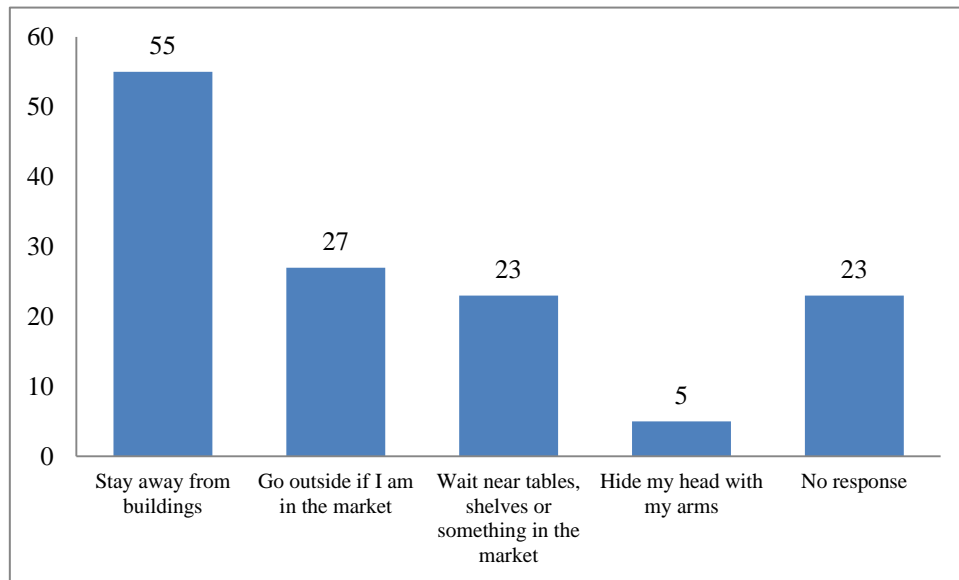
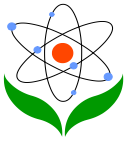


panic. Only one student said that people should turn off the gas and electricity and another student said that nobody should use elevators. Two students did not provide any response to the question.



**Graph 7.** The Percentage of Students' Responses about Precautions during Earthquakes at Homes

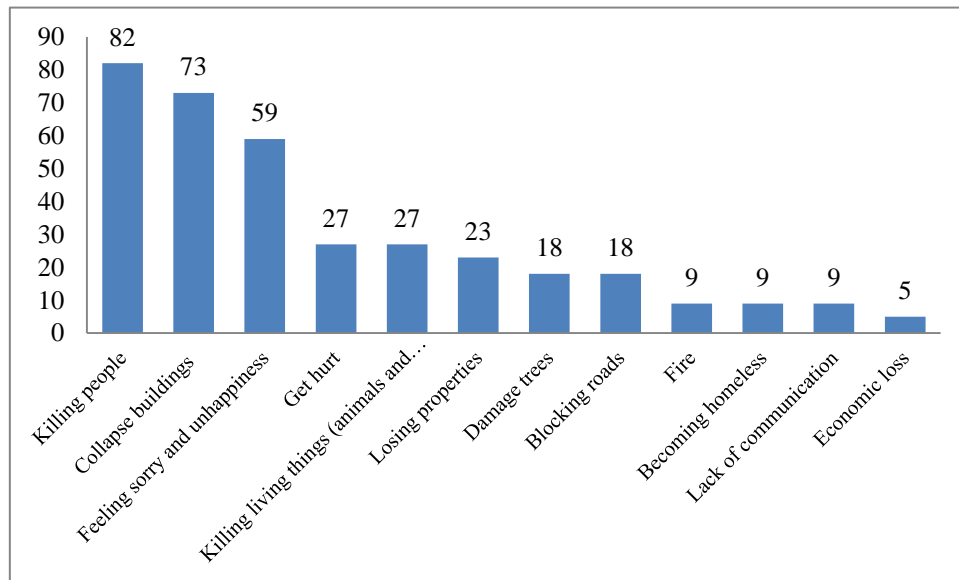
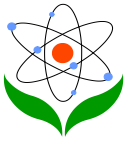
As the final part of the question, students were asked what people should do during earthquakes if they were out of their homes. Graph 8 shows student responses. Twelve of the students (55%) indicated that people should stay away from the buildings. Six of them (27%) said that they should go outside while five students (23%) said that they should wait near the shelves or tables if they were in the market. One student said that people should cover their heads. Five of the students did not provide any response.



**Graph 8.** The Percentage of Students' Responses about Precautions during Earthquakes at the Outside

*5. What are the students' conceptions regarding the consequences of earthquakes?*

Students' ideas about consequences of earthquakes are listed in Graph 9. The most common response equated earthquakes with the killing of people and the collapse of buildings. Thirteen of the students (59%) indicated the psychological effects of earthquakes such as feeling sorrow and unhappiness. Six students (27%) named suffering and injuries while other six students stated the killing of other living things such as animals and plants. Four of them (18%) specifically added that earthquakes damage trees. Property loss, road blockage, fires, and becoming homeless were other responses given by students.

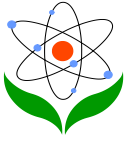


**Graph 9.** The Percentage of Students' Responses about Consequences of Earthquakes

## Discussions

The findings of the study offer important insights related to the literature about students' conceptions of earthquakes. One of the main findings of the current study indicates that a majority of the participants associate earthquakes with negative consequences such as shaking and collapsing buildings and loss of life and property rather than with scientific explanations of earthquakes. Similarly, in Ross & Shuell's study, most students defined earthquakes by their negative consequences such as property damage and killing/hurting people. However, in Özdemir, Ertürk, Güner, & Koca's (2002) study, only a small percentage of the students associated earthquakes with damage to people and buildings. The reason for this discrepancy may be due to the media as the main resource for students' knowledge of earthquakes. Students mostly learn about earthquakes from TV (Lacin-Simsek, 2007) especially the news related to the negative consequences of earthquakes. Earthquakes have been discussed more frequently on TV since 2002; therefore, students in this study may associate earthquakes with negative consequences more than those in the earlier study in 2002.

Another main finding of the current study was that almost one third of the students thought that earthquakes occur as a result of human action such as bombing,

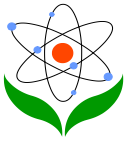


pollution or old construction. This surprising finding was noteworthy since it was not mentioned in the previous studies.

A significant finding was students' lack of knowledge as to the cause of earthquakes. In the current study, almost one third of the students did not give any response to this question. Similarly, in Buluş-Kırıkkaya, Çakın, İmalı, & Bozkurt's (2011) study, one fourth of the students stated that they did not know how earthquakes occur. In his article, Demirkaya (2008) stated that almost one fourth of the students did not give any response regarding the causes of earthquakes.

The finding of the current study reveals that more than half of the students define earthquakes as ground shaking. This finding is consistent with Ross and Shuell's study and Özdemir, Ertürk, Güner, & Koca's (2002) study. In Ross and Shuell's (1993) study, two thirds of the students defined earthquakes as the shaking of the ground while in Özdemir et al.'s study, nearly half of the students defined it as ground shaking. Furthermore, it revealed that only three students tried to explain earthquakes as scientific phenomena by their physical aspects while only one had a scientific conception of earthquakes. In addition, students confused earthquakes with volcanoes, thunderstorms and landslides, which was consistent with other studies. Laçın-Şimşek (2007) found that students confused earthquakes with other natural disasters such as landslides, flood, and heavy rains. Rakkapao, Arayathanitkul, Pananont, & Chitaree (2012) found that more than half of the high school students in their study thought that the weather was the main cause of earthquakes. Ross & Shuell (1993) found that students thought that volcanoes were the cause of earthquakes.

In the current study, nearly one fifth of the students defined earthquakes as natural disasters. Similarly, Buluş-Kırıkkaya, Çakın, İmalı, & Bozkurt (2011) found that one third of the students defined earthquakes as a natural disaster rather than as a natural geologic process. This finding was not surprising since earthquakes are taught in life sciences and social studies classes as part of disaster prevention. Since elementary science curriculum in grade 4 and 5 does not include earthquakes, the topic is not adequately taught in elementary science classrooms (MEB-TTKB, 2007). Even science curriculum in grade 6-8 does not sufficiently cover the topic. Earthquakes are intended to be taught in grade 8 and consist of eight percent of the whole content in the curriculum (Buluş-Kırıkkaya, Oğuz-Ünver, & Çakın, 2011). Consequently, as indicated in the current study, students defined earthquakes either from a psychological perspective (e.g. fear, sorrow) or from religious beliefs (the



doomsday, punishment from the God). This finding was consistent with other studies (Ross & Shuell, 1993; Laçin-Şimşek, 2007).

As shown in the current study, students seemed to have more knowledge about the precautions to be taken before earthquakes in different places including schools and homes. Students seemed to understand the importance of first aid kits and earthquake bags. Half of the students were aware of the importance of earthquake drills as precautions taken in schools although earthquake drills were not stated as precautions at home. The likely reason is that students had experienced earthquake drills at school but not in their homes. Students did not know about precautions to be taken outside the home as much as they did for schools and homes.

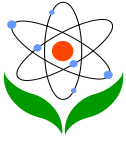
As indicated in the current study, most students think that they should stay under tables or desks during earthquakes while some students think that they should stay near tables or big furniture. Since some of media, TV and earthquake CDs included both ideas, these may be source of students' responses. While people previously had been instructed to stay under tables during earthquakes, according to updated resources, people are instructed to form a life triangle by sitting, holding fixed furniture and hiding near immobile furniture. However, relatively few students know about the updated information.

The current study indicates that students seem to be aware of the potential psychological, social, and economic consequences of earthquakes. This finding is not surprising since students are frequently exposed to only this type of information.

## Conclusions

In light of the findings of the current study, there may be several key implications for educators and curriculum planners. First of all, it is clear that students do not have enough scientific knowledge about earthquakes. Therefore, earthquakes should be included in the elementary science curriculum and taught in science classes at this level according to students' ages and prior knowledge. Second, educators could help elementary teachers create constructivist based science classrooms for teaching the subject. Educators could provide teaching materials and resources for elementary teachers to help them teach the material in their classes. Third, students should be taught about earthquakes by integrating science and



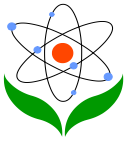


social studies classes. Therefore, students can be taught both the scientific and social aspects.

The current study may instigate new questions for researchers to investigate in the future. The current study focused only on grade 5 students with a small sample size. Researchers could compare conceptions of students living in different geographical regions, including those which have experienced earthquakes recently and those that have not. Researchers may also investigate students' conceptions by comparing grade 5, grade 8 and grade 12 students in order to see if there is any change across grade level. Further research can be conducted with pre-service and in-service teachers in order to investigate their conceptions of earthquakes and efficacy in teaching earthquakes.

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## Appendix

### Interview Questions

1. What do you understand about the term earthquake?
2. Why do you think earthquakes happen?
3. Could you tell us about how earthquakes happen?
4. What should people do before earthquakes?
  - a. At schools
  - b. At homes
  - c. Outside (street, market)
5. What should people do during earthquakes?
  - a. At schools
  - b. At homes
  - c. Outside (street, market)
6. What do you think about the possible consequences of earthquakes? In other words, what are the effects of earthquakes?