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Determining the Cognitive Structures of Geography Teacher Candidates on "Earthquake"

Baştürk Kaya[1] & Caner Aladağ[2]

[1] Department of Biology, Ahmet Keleşoğlu Faculty of Education, Necmettin Erbakan University, Turkey

[2] Department of Geography, Ahmet Keleşoğlu Faculty of Education, Necmettin Erbakan University, Turkey

Corresponding author: Caner Aladağ, Department of Geography, Ahmet Keleşoğlu Faculty of Education, Necmettin Erbakan University, Turkey. E-mail: caner5101@gmail.com

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Abstract

The objective of this study is to determine the cognitive structures of the students of geography teaching department by identifying their conceptual frameworks about the concept of earthquake. A case study design from qualitative research approaches was used in this research. Sample group of the study constitutes 155 students from the Department of Geography Teaching who took the course of natural disasters. Free Word Association Test was used to collect the data. The data were evaluated according to the content analysis, categories were formed according to the results of this evaluation and frequencies and percentages of the response words in each category were calculated. A total of 9 categories were created according to their semantic associations. Some of them are; "concepts about earthquake, damages of the earthquake, a category of defining earthquake, types and causes of earthquakes, landforms caused by earthquakes and other effects" and they form the dominant categories. The frequencies and percentages of some categories are low such as; "The things that earthquake makes feel, regions where earthquakes happened before or there is a possibility to happen, people, institutions and organizations about earthquakes, helping to the victims of the earthquakes, factors affecting the safety of life and property in the earthquake". In addition, this study revealed that students have some alternative concepts about earthquake.

Keywords: geography, earthquake, word association test, cognitive structure, perception

1. Introduction

Geography is a science which brings people some features such as thinking versatility and creatively, foreseeing, using the information in their daily lives, caring the social, cultural and economic issues happening in their environment. The development of these achievements and other behaviours desired from individuals are only possible with participation to a good learning process (Akbulut, 2004). In general with a geography education it is aimed to develop individuals' such scientific process skills as scientific thinking, problem solving. It is no doubt that one of the most important aims of geography education is to provide students a meaningful learning which is far from learning by heart for abstract and complex concepts and for this to prepare required learning environments (Sever et al., 2009). Natural disasters are also in the important issues in which geography science is interested. Natural disasters are defined as natural events that affect people negatively. The concept of earthquake is one of the most frequently encountered concepts of natural disasters.

To define generally, natural disasters are natural events which completely occur with natural formation with no human effects, commonly happen suddenly or in such a short time that safety measures cannot be taken, frequently create serious economic and social damages besides loss of lives (Özgen et al., 2011). Natural disaster can be defined as all kinds of disasters that cannot be prevented by human such as flood, storm, earthquake and hail. Natural disasters occur in a short time. They cause loss of lives and properties and they cannot be prevented by humans after they start (Özey, 2012).

Earthquakes are natural geological events which are caused by the movements of very big rocks suddenly and fast. The things that caused by the earthquake such as severe shaking, destruction, breaking and rupture of Earth's crust occur as a result of faults (Lutgens et al., 2013). Earthquakes are non-human origin and are from the major natural disasters which can cause loss of lives and property. By taking measures, people can only reduce

the loss of lives and property caused by this natural phenomenon.

Earthquake is a natural disaster. The most effective measure to be taken against earthquake and other natural disasters is individuals' knowing what to do to save themselves (Fetihi & Gülay, 2011). Education emerges as an important factor for a society to reduce the damages of disasters (Kırıkkaya et al., 2011). Schools are the places where earthquake education can be given in a most accurate way. If a right and awareness-raising education is given at schools, the damages of the earthquake can be reduced. It is possible to save from the earthquake's damages or reduce the future damages through an effective earthquake training or in other words disaster management. Natural disaster training must start with pre-school education and must continue throughout the education life with specific training programs (Aydın, 2010).

The subject of earthquake should be given at schools practically as well as theoretically to form the earthquake information and awareness. The methods to provide the conceptual learning need to be put into practice in curriculums. Thus, both sensitivity for earthquake will be formed and meaningful learning about earthquakes will be provided in their minds. For this, constructivist learning approach will provide conceptual understanding and conceptual change.

Although many different learning theories have different emphasis, especially the impact of constructivist approach in recent years has revived the use of different methods and strategies in determining the conceptual understanding and conceptual change (Vance et al., 1995). In recent years with the effect of constructivist approach to learning environments traditional methods has been replaced by some alternative methods in diagnosing students' cognitive structures and in determining conceptual change process and their misconceptions (Ercan et al., 2010). In addition to this, some strategies have been developed to provide and measure the conceptual framework and conceptual change.

This strategy has been listed by Bahar (2003) as follows; word association, structured grid, branched tree, concept maps, conceptual change texts, analogy, forecasting-observation and explanation. These give opportunities to students to express their opinions individually and with class. Thus they provide teachers to see the scientific concepts and thoughts that students bring to class.

Word association is a technique used to reveal the students' cognitive structures and bonds between the concepts in these structures; namely the information network; and also used to determine whether the relationships between concepts in long-term memory are sufficient or meaningful or not (Bahar & Özatlı, 2003). In this method, student answers with certain words that came to his mind first in a certain period of time about key concepts given on any subjects. In addition it is assumed that sequential response which student gives for any key-concepts from his long-term memory reveals the bonds between the concepts in cognitive structures and shows the semantic proximity. The closer two concepts are in semantic memory to each other in terms of distance according to the effect of semantic proximity and semantic distance, the more closely related they are and during the recall, because the mental research will be quicker, answers related to both concepts will be faster (Bahar, Johnstone, & Sutcliffe, 1999). Word association is one of the oldest techniques used to reveal the students' cognitive structures and bonds between the concepts in these structures; namely the information network; and also used to determine whether the relationships between concepts in long-term memory are sufficient or not (Özatlı & Bahar, 2010). In addition, word association tests are also used as a means of identification and the elimination of alternative concepts.

To configure the information that students learned before in their minds, they need to eliminate conditions that create conflicts and establish a relationship between their new and prior information. Therefore, it is important to determine the students' prior information and eliminate their misconceptions in teaching the concepts (Güneş et al., 2010). Misconception is defined as students' own interpretations and meanings in their minds which are not scientifically true, gained with experience and observation and resistant to change (Bahar, 2003). According to Semenderoğlu and Aydın (2014), constructivist curriculum implementation provides benefits for such many aspects as; determination of misconceptions, improving the processes of conceptual understanding, realization of permanent learning, the development of attitudes towards the courses and this approach will increase the quality of teaching.

2. Objective of the Research

In this study, the conceptual framework of geography students about "earthquake" was investigated by using the word association test. In other words, this study was conducted to determine how geography students configure the concept of earthquake in their minds and to reveal its scientific validity. Thus, the determined alternative concepts and misconceptions in this subject will be given in the part of suggestions to be done.

3. Method

Qualitative research model and case study design from qualitative research approaches was used in the study. According to İslamoğlu (2009), qualitative research makes possible to see an event from the perspective, eyes and senses of individuals. The aim of the case study is to reveal the results related to a specific case. The main feature of the qualitative case study is to investigate one or more cases deeply. It is possible to say that case study is a research method which uses the questions of how and why as base and gives opportunity to the researcher to investigate a phenomenon or event deeply which he cannot control (Yıldırım & Şimşek, 2011).

3.1 Working Group

Working group consists of 4th and 5th grade students in the Geography Department of Ahmet Keleşoğlu Faculty of Education, in Necmettin Erbakan University in 2014-2015 academic year. While selecting the sample, students' taking the course of natural disasters was taken into account. A total of 155 students participated in the test; 71 of them are girls and 84 of them are boys. The average age of students ranged from 21–23 and the number of the boys are a little more than the girls. But in this study, the age and gender differences weren't taken into account.

3.2 Data Collection Instrument

Word Association Test (WAT) was used as a data collection instrument in this study. The concept of "earthquake" was chosen to form the WAT. In addition, two instructors from the department of geography were consulted for their opinions while selecting this concept. The concept of "earthquake" was written ten times on a page and they were all under the other. A sample page layout is given below.

Earthquake----------

Earthquake ----------

Earthquake ----------

.

.

Related sentence:----------

The aim in writing a key word under the other 10 times is to provide students' returning to key concept again after they write each word. If key concepts aren't written under the other, it is possible that students can think their own response words as the key concept and write them as answers instead of the key concept itself. Bahar and Özatlı (2003), reveal the reason of writing a key concept under the other ten times is to prevent the risk of chain-responses. Because, student will write the words that brought to his mind by a concept which he wrote as a response instead of key-concept unless he/she returns to the key-concept in writing the concept every time. And this will give harm to the objective of the test.

Word association test consists of two stages as in the format. These stages were explained below.

Earthquake.....Seizma.....

Earthquake.....Fault.....

Earthquake..... Toktonism.....

Earthquake .....Richter.....

Earthquake .....Hypocenter.....

Earthquake.....Epicentre.....

Earthquake.....Volcanism.....

Earthquake.....Epicentre.....

Earthquake..... Graben.....

Earthquake.....Horst.....

1st Sentence.....It occurs at the places where fault lines are.....

2nd Sentence..... Volcanic activities can trigger the earthquakes.....

3rd Sentence..... Earthquake can occur as a result of the plate movement.....

4th Sentence..... Earthquake may occur due to the differences of pressure of continental and oceanic crust.....

Figure 1. A sample answer Sheet of the participant

First, students were informed about WAT and 30 second-time was given for the concept of "earthquake". When the studies in literature are examined, it is seen that approximately 30 second-time is given for each concept in word association test (Bahar et al., 1999; Bahar & Özatlı, 2003). Students wrote the responses which key-concept evokes in sequence in this time. Word association test is a data collection technique which is used to analyze the conceptual structure of an individual or a group of people about a specific subject (Bahar et al., 1999). While applying the test, students' writing meaningful sentences between the key concept and evoked word was taken into account and in the data analysis phase, each evoked word and written sentence was examined one by one. Because the response word that was associated with the key concept may be an associated product which does not have a meaningful relationship with key concept in only recalling level (Bahar et al., 2006). Only a single keyword was used in this research. Thus, it was studied on analyzing the cognitive structures of students about the key concept of "earthquake" and determining the possible misconceptions.

3.3 Data Analysis

Content analysis method was used to evaluate the data collected through free word association test. Main purpose of content analysis is to reach the concepts and relations that can explain the data. Data which is summarized and interpreted in descriptive analysis is subjected to a deeper process in content analysis and concepts and themes which cannot be detected with a descriptive analysis can be discovered as a result of this analysis. With this aim, it is necessary to conceptualize the collected data, then to arrange the data logically according to the emerging concepts and to detect the themes which explain the data. Content analysis is to integrate the similar data and to interpret and to arrange it as readers can understand (Yıldırım & Şimşek, 2011). Themes in qualitative research (also called as categories) are extensive knowledge units consisting of several codes which brought together to create a common idea (Cresswell, 2013). At the first stage, it is necessary to find the themes which can explain the data at a general level based on the codes revealed and group the codes under specific categories. For this, first of all codes are brought together and common aspects are tried to be detected by examining. In a sense this is a thematic coding process. For thematic coding, it is necessary to detect the similarities and differences of emerged codes and according to this, also necessary to determine the related codes and themes that can be brought together (Paker, 2011). Creating the codes or categories constitute the basis of qualitative data analysis. Researchers create detailed descriptions, develop themes and dimensions and provide a comment in the light of their views or different viewpoints in the literature here (Cresswell, 2013). The results of the word association test are grouped from the highest to the lowest based on only the frequencies of students' right connections regardless of their words.

In the analysis of WAT, each key word given by students is detected one by one. Response words are combined and categorized according to topic titles. A frequency table is prepared by calculating how many times different words in each category are repeated. Data obtained through free word association test are analyzed by using the number of words, the number of the responses and semantic relations technique (Atasoy, 2004). Words are categorized using the criteria of semantic relations and frequencies of words in each category are calculated. Many studies show that this type of data analysis provides secure results (Daskolia et al. 2006). Words answered with same meaning are classified under most repeated words. Many words which are seen as unrelated and don't have relationships with other words or repeated only once are not taken into the evaluation (Daskolia, et al., 2006; Kostova & Radoynovska, 2010; Kurt, 2013a, Kurt, 2013b).

Based on this information, the data obtained were analyzed by using the number of most frequent repetition and semantic relations technique. A frequency table was created showing how many times key words or concepts about the key concept of "Earthquake" were repeated. In order to evaluate the results of the test, all of the answers given to the concepts are examined in detail. A frequency table were also created showing which key words or concepts were repeated for which key concepts and how many times they were repeated. While ordering the response words given by students, it wasn't needed to write new expressed words after about 75^{th}–80^{th} answers. And this feature shows that the cognitive level of the students isn't so far away from each others.

3.4 A Study for Validity and Reliability

According to Yıldırım and Şimşek (2011), expert review was conducted to ensure the validity of the research. In order to confirm whether concepts obtained from the research data and the codes given under categories represent the conceptual categories, two researchers' codes and categories related to codes were compared. The reliability of the data analysis conducted in this manner were calculated by using the formula of [Consensus/(Consensus + Dissensus) x 100] (Miles & Huberman, 1994). Average reliability between coders was found to be 94%.

4. Findings and Interpretation

The findings obtained with the word association test under this title were coded and arranged into categories. Response words given for the key word of earthquake were classified and categories were created by bringing the similar ones together. Totally 9 categories were created by using the findings which belong to the cognitive structures of Geography students who participated in the research about the concept of earthquake. These categories and words answered in each category were presented with tables. The words which were repeated just once or weren't meaningful or related to the subject weren't combined with other words. 52 words (4.5%) from this type weren't included to the categories. These words were not given in the tables in terms of quality of research but these words were mentioned in the text. A total of 1255 response words were obtained and the distribution of 1203 of them was given according to categories in the table. Frequency and percentage (%) values were shown in tables by listing the words answered in each category.

An insignificant portion of the 52 words that was not included in the categories was considered as misconceptions. And some of them were not put into classification since they were repeated just once. These words are *disorder(4), soup kitchen for public (1), savagery (3), unawareness (1), life safety (1), despair (1), scream (2), wavelength (2), degrees of earthquake (1), seismic line (1), period after earthquake (2), earthquake aid (1), grade (3), huge waves (1), noise (1), disease (1), help! (1), humanity (2), chaos (2), escape (2), container (1), barking (1), lava (1), table (1), unhappiness (1), population loss (1), room (1), occurrence time (1), fatal (1), police (1), oscillation (1), static (1), chill (1), volcano (1), earth structure (2), surface earthquake (2), hardship (1).*

Table 1. A category of the concepts related to the earthquake (earthquake parameters)

Concepts	Frequency
Fault	78
Fault fracture	73
Earthquake focus	36
Fault line	36
Earthquake intensity	28
Epicentre	24
Seismology (earthquake science)	24
Seismic wave	22
Richter scale	15
Thrust faults	15
Aftershock	7
Destructive earthquake	6
Strike slip fault	5
Normal fault	5
Slickenside	5
Seismic zone	4
S wave	4
Earthquake duration	4
Earthquake frequency	3
P wave	3
Earthquake moment	3
Earthquake depth	2
Seismic activities	2
Diagonal slip fault	2
Diving-sinking	2
Total of category	398 (33.0%)
Total response words	1203 (100%)

When analyzing the data it is seen that the response words that were given for the concept of "earthquake" were intensified under the category of "*earthquake parameters*". The frequency of this category is 398 and percent value is 33. Constituting the highest rate, this category consists of such statements as; *fault, fault fracture, fault*

line, strike slip, normal fault. When looked at these statements, students' matching the concept of earthquake with fault intensively can be evaluated as undeniable result when taking their department into account. They also point that the most influential type of earthquakes are the earthquakes which are related to fault lines although they know what volcanic and collapse earthquakes are and this situation should be evaluated as the result of their education. And when also looked at the words they wrote, the frequency values of some words appears to be substantial proportion such as; *earthquake focus, earthquake intensity, seismology (earthquake science), earthquake wave.* But some words such as; *earthquake duration, earthquake frequency, earthquake moment* and *earthquake depth* are used less and have less intensity. It will be a right approach to say according to students' response words in this category that students have enough academic knowledge.

Table 2. Concepts related to earthquake defining category

Concepts	Frequency
Shake	57
It is danger	39
Disaster	22
Natural disaster	19
Seizma	10
Earth crust movements	5
Earthquake	4
Vibration	4
The release of energy	3
Total of category	163 (13.5%)
Total response words	1203 (100%)

Second category includes the response words written under "*earthquake defining category"*. Frequency of students' response words is 163 and the percentage is 13.5. Students tried to make sense of earthquakes with different expressions in this category. Some concepts are dominant such as; *shake, it is danger, disaster, natural disaster and seizma*". And the frequency of some words expressed by students is lower such as; *vibration, earthquake* and *the release of the energy.* Expressing the statement of "seizma" with a very low percentage can be evaluated negatively for geography teacher candidates. But students could conceptualize the concept of earthquake both at academic level and with the features of earthquake. The meanings which students create in their minds in this way show that they can make a correct association with the concept of earthquake.

Table 3. Concepts related to the category of types and causes of earthquakes

Concepts	Frequency
Volcanic earthquake	24
Tectonic earthquakes	23
Collapse earthquakes	16
Continental drift	10
Magma movements	9
Young land	6
Geologic structure	5
Epeirogenesis (the formation of continents)	3
Submarine earthquakes	3
Orogeny	3
Total of category	102 (8.4%)
Total response words	1203 (100%)

Third category includes the response words related to the category of "*types and causes of earthquakes"*. The frequency of this category is 102 and the percentage is 8.4%. Students have showed that they have the information at the academic level by using such expressions as; *volcanic earthquake, collapse earthquakes, continental drift, magma movements, young land, geologic structure, epeirogenesis (the formation of continents), submarine earthquakes* and *orogeny.* It is seen that participants have configured the subject of earthquake in their

cognitive structures correctly. This situation shows that geography students have comprehended the structural features of the concept of earthquake and configured them in their minds correctly. The thing that can be described negatively is that students mentioned about the type of tectonic earthquake less than the earthquakes created by volcanism. However, students are told about in their lessons that the effects of volcanic and collapse earthquakes are smaller than the effects of tectonic earthquakes.

Table 4. Concepts about the landforms caused by the earthquake and other effects

Concepts	Frequency
Tsunami	32
Hot water sources	19
Graben	13
Horst	12
Dent	8
Spa	6
New geomorphological formations	5
Collapse plains	4
Total of category	99 (8.2%)
Total response words	1203 (100%)

Fourth category includes words related to *"landforms caused by the earthquake and other effects"*. The frequency of this category is 99 and percentage is % 8,2. Participants produced such words as; "*tsunami, hot water sources, graben, horst, collapse plains and dent"*. These words show that students have enough information about earthquake and their cognitive structures are meaningful and valid. It will be a right approach to connect the reason of tsunami's being written much to the events happened after the earthquake in Japan short time ago. However, it would be expected from the geography teacher candidates to write such expressions much as; horst-graben and collapse plains.

Table 5. Concepts about the damages of the earthquakes

Concepts	Frequency
Loss of lives	66
Wreckage and debris	62
Damage and cracks in buildings	26
Financial damages and loss of property	16
Demolished houses and becoming homeless	13
Being injured	5
Migration	3
Earthquake victims	3
Economic losses	3
A ruined city	3
Total of category	200 (16.6%)
Total response words	1203 (100%

Fifth category includes the subject of *"the harms of the earthquakes"*. The frequency of the response words is 200 and the percentage is 16.6%. Participants' associations about this category happened with such expressions as; *"loss of lives, wreckage, debris, damages is buildings, loss of property, financial damages, economic losses and earthquake victims"*. Students' categorizing the concept of earthquake as physical damages created by earthquake is based on the destructive effects left by the earthquake visually in the minds. With these words, participants configured the concept of earthquake as a destructive disaster in their minds. And this shows that earthquake left a scary trace in students' minds. The thoughts of the students are mainly based on the information gained from the media. As a general, students produced correct thoughts simply and demonstrated the consequences of the earthquake.

Table 6. Concepts about the things that an earthquake makes feel

Concepts	Frequency
Sadness	20
Fear	15
Pain	12
Panic	9
Crying	7
Waiting	6
Misery	5
Hopelessness	4
Hunger	4
Separation	3
Children's being orphaned	3
Tear	3
Poverty	3
Total of category	94 (7.8%)
Total response words	1203 (100%)

In the sixth category, participants expressed about the *"the things that an earthquake makes feel"*. The frequency of the response words is 94 and percentage is 7,8. The words which participants associate with key word refer to psychological atmosphere happening mostly during and after the earthquake. When looked at the concepts that this atmosphere created in students' minds, it is seen that this is mentioned with such expressions as; *"pain, sadness, fear, panic, crying"*. These associations that students did with the concept of earthquake reflect that they were impressed by the people who lived the earthquake, by the news about the earthquake in media and by what they heard from the environment.

Table 7. Concepts about the regions where earthquakes happened before or there is a possibility to happen

Concepts	Frequency
Japan	14
Adapazarı	10
Van	9
Marmara	5
KAF- DAF-GAF (Northern. Eastern Anatolia, South- Eastern Anatolia fault lines)	5
Earthquake of Simav	4
Indonesia	3
İstanbul	3
Totoal of Category	53 (4.4%)
Tatol response words	1203 (100%)

Seventh category is "*the regions where earthquakes happened before or there is a possibility to happen"*. In this category, students mentioned about the seismic zones in the world and the regions in our country where earthquakes happened or have risk to happen. These words are; *"Japan, Adapazarı, Van, Marmara, Indonesia, Istanbul, the earthquake of Simav"*. The frequency of these words is 53 and percentage is 4.4%. It is noteworthy here that Japan is the most frequently stated word and this conflicts with the teaching principles of "from near to far" and "from known to unknown". It will be a right approach to associate this situation with students' knowing

the line in Pacific Ocean named as “Ring of Fire”.

Table 8. Concepts about people, institutions and organizations related to earthquakes

Concepts	Frequency
Tent	14
Kandilli observatory	13
Ahmet Mete Işıkara	10
AKUT (Search and Rescue Association)	10
Kızılay (Turkish Red Crescent)	9
Helping	7
Blood donation	4
Civil defence	3
First aid	3
Total of category	73 (6.0%)
Total response words	1203 (100%)

Eighth category was determined as *“people, institutions and organizations about earthquakes”*. The frequency of the response words in this category is 73 and the percentage is at the level of 6.0%. This category includes organizations that help when the earthquakes happen, institutions providing information about earthquake predictions and earth movements and scientists over identified with earthquakes. The most noteworthy statement here is Ahmet Mete Işıkara (Earthquake grandfather). Ahmet mete Işıkara is identified with the name earthquake grandfather and has a permanent place in people’s memory in our country. However, at the time of the research he was dead and there have been other scientists doing this job. It is possible to conclude that media has a very important place in affecting students’ or people’s memories. It can also be observed that students know about what to do firstly for the earthquake victims at time of earthquake and aids for health.

Table 9. Concepts about factors affecting the safety of life and property in the earthquake

Concepts	Frequency
Measures should be taken	6
Earthquake information	4
Earthquake drill	3
Contractors	3
Illegal building	3
Unwariness	2
Total of category	21 (1.7%)
Total response words	1203 (100%)

This category was determined as *“factors affecting the safety of life and property in the earthquake”*. Characteristics that students pointed out more are about how to reduce the effects of the earthquake. The conclusions that can be deduced from the statements of students are; building control’s being done well, materials’ being good quality in the construction and keeping the rationing control of contractors tightly.

Table 10. Sample sentences that was written by students about the key concept of "earthquake"

Sample sentences containing scientific information	Sample sentences containing non-scientific or superficial information	Sample sentences containing misconception
- As a result of fault's breaking, there happen shakes - There are a lot of hot water supplies in fractured lands - Horsts and grabens are formed by the breaking of the fault lines. - Earthquake is a natural phenomenon that precautions should be taken - Earthquake turns into destruction due to improper construction - The place where the earthquake occurs shows the depth - Earthquake is the strong shake occurring in the earth's crust - Earthquakes occur as a result of tectonic movements -Earthquake spreads in the form of seismic waves - Earthquakes occur along the fault lines very frequently - Undersea earthquakes cause tsunamis - The focal point where an earthquake occurred underground is called as earthquake focus. - After a severe earthquake, aftershocks occur. - Earthquakes occur as a result of continental drift - Earthquake is a natural disaster - Volcanic eruptions can create earthquakes - Earthquakes can create new geomorphological shapes - Earthquakes are more common in young land - There happen less earthquakes in massive places - Earthquakes are ground shakings - Observatories determine the location of the earthquake, and measure the intensity - Earthquake plays an important role in shaping the earth - The degree of the most violent earthquake is 12. - Seismic waves indicates the size of the	- We are very unconscious about the earthquake. - Unwariness will cause great losses in the earthquake - Great losses of lives and properties occur in the earthquakes happened in Turkey - People can get injured by jumping from the window because of fear - Earthquakes cause financial and emotional damages - Earthquake requires to be calm - Rotten buildings kill, not earthquakes - AKUT(Search and Rescue Association) and Kızılay (Red Crescent) are the organizations that help when earthquakes occur - Destruction in flimsy buildings would be more - Earthquake means death - People should be conscious at the time of an earthquake - People should help each other in earthquakes - Tent cities should be established for earthquake victims - People affect the residential areas - People need to be educated about the earthquake - Strong buildings should be done to the places on the earthquake lines - Earthquake gives harm to the economy - Turkey is an earthquake country - It causes damage in nature - Children live great fear - People's psychology is damaged - Great sorrow is experienced after the earthquake. - People escape and can't decide what to do - Earthquake affects human life	- We can reduce the impact of earthquakes by acting consciously - Earthquakes are natural events which we live together - Volcanism is common in the places where earthquake zones are intense - If the earthquake waves occur at the bottom of the oceans, then tsunami occurs - Fractured fault lines begins with a shake from the centre - It will shake during an earthquake - Short-term and less violent earthquakes are called as aftershocks - Tsunami occurs as a result of the earthquakes in big waters - It is a reflection of the tectonic movements to the earth - Collapses occur in the earthquake regions - It is a static movement of the Earth's crust - Earthquake causes diseases - Earthquake is the energy released during the stabilization of the continents - It is the release of energy in the ground - Meanders may occur in graben areas - The accumulated energy as a result of volcanism may cause shakes - Seizma movements can give direction to the continents - Earthquakes occur in young geological era -It is seen in the lands which reached the equilibrium profile - Earthquakes spread to the surface from the earth structure - The intensity of the earthquake is measured with epicentres - Earthquakes cause the fracture of the earth - Earthquake occurs as a result of the

earthquake - Earthquake occurs as a result of the movements of the plates - Earthquake occurs in places where the fault lines exist - The other name of the earthquake is seizma. - Earthquakes have varieties such as; diagonal, normal and vertical strike-slip faults		movements of the faults on one another Earthquake is an earth movement formed by the irregularity of layers - The size of an earthquake is measured by seismic movements - Earthquakes are measured and classified with the Richter scale

Some sample sentences are given in table 10 about students' explanations related to the concept of earthquake. When looked at the content of the sentences stated in table 10, it is seen that students have written sentences about each category but they have also written sentences about the concept of earthquake that are not scientific or containing superficial information. And it is also understood from their sentences that they have some misconceptions about the concept of earthquake. In addition, some samples are presented in table 10about incomplete and incorrect information related to the descriptions that geography students wrote for the concept of earthquake.

5. Result, Discussion and Suggestions

In this research thoughts of geography students on the concept of earthquake and how they conceptualize the word of earthquake has been tried to explain. The cognitive structures of geography teacher candidates about the concept of earthquake have also been evaluated under the scope of geography science. The words expressed in free word association test were coded under 9 categories. The frequencies of some categories such as *"concepts about earthquake, damages of the earthquake, category of defining the earthquake, types and causes of the earthquakes, landforms caused by earthquakes and other effects"* include over 100 response words and they are dominant categories. Students write almost all the concepts that are related to earthquake in these categories. They could adapt the important concepts about the earthquake to their informational frameworks.

The frequencies and percentages of the response words in the categories such as "the things that an earthquake makes feel, the places where earthquakes happened before or there is a possibility to happen, people, institutions and organizations related to earthquakes, helping to the victims of the earthquakes, factors affecting the safety of life and property in the earthquake" are lower. It is seen that the words of these categories are less associated with the key concept of earthquake and most of them do not require academic information. It is accepted that students infer about these subjects from the information gained through the media and environment aurally and visually. It means words containing non-scientific information for students are located mainly in these categories. When the response words of the students analyzed, it is seen that the words which have emerged as a misconception have a very low percentage. These words have been given in the text together with the words repeated once.

When the sample sentences about the key concept of "earthquake" are analyzed, it is seen that more sentences are containing scientific information. These sentences are given in table 10. This situation shows that students learned the concept of earthquake with its scientific definition and configure it in their minds correctly. Some statements such as "*earthquake is a natural phenomenon that precautions should be taken, earthquake is a natural disaster"* are used by students frequently. Students explained what the earthquake and its affects are by using such statements as; "*there happen shakes on earth as a result of fault's breaking, earthquake turns into a disaster as a result of unplanned construction, earthquake means death".*

Aksoy (2013) conducted a survey to 194 high school 9th grade students in the district of Erciş of Van with the aim of determining their metaphors related to the concept of "earthquake". In the findings of the research, 72 metaphors were evaluated in 6 different conceptual categories. The results reveal that 5.04% of the 9th grade students perceive the concept of "earthquake" as doomsday, 4.32% perceive it as fear, 3.60% perceive it as monster and cradle, 2.88% perceive it as death and disaster. In the category of unwanted emotions and events which includes the most metaphors, most of the participants likened the earthquake to *doomsday, fear, death and psychological shock.* Because Aksoy's research is based on the analogy through metaphor, there are similarities between the findings of this study and the subject of emphasizing the negative effects of the earthquakes.

In the study of Aydın and Çokun (2010), which was conducted with 7th grade secondary school students, 22.6% of the students define the earthquake as "the collapse of the buildings and the death of people", 19.7% define it as "a shake related to the earth and fault lines", 19.5% define it as "a natural disaster", 13.8% define it as "the shake of the earth", 11.6% define it as "natural disaster with increasing effects a result of people's conscious or unconscious behaviour", 10.7% define it as "a disaster whose effects can be diminished by taking the necessary precautions".

These results reveal the fact that students from all levels of education have similar thoughts about earthquake. It can be said that in the shaping of students' thoughts, information gained from environment, school or media is more effective than the scientific information. But when compared with the findings obtained from this study, it is seen that geography teacher candidates comprehended the concept of earthquake at a higher level and it is appropriate to say that this conclusion is normal.

Some sentences such as; "earthquakes cause financial and emotional damages, earthquakes affect the human life, children live great fear, people's psychology is damaged" are similar to the studies conducted before. Some similar results are also seen in the study of Şimşek (2007), which was conducted to reveal the thoughts of the children about earthquake. While 37 of 40 students attended the research described the earthquake as a bad thing, only 3 of them tried to describe it with good reasons. Some of these 37 students described the earthquake as a bad natural event and natural disaster and they put forward the following reasons; earthquake causes the death of people, their being wounded, collapse of the buildings and the loss of lives and properties, everybody is afraid, human labour is disappearing.

Some sentences containing scientific information such as "earthquakes occur as a result of tectonic movements, earthquakes occur as a result of plate movements, earthquakes can occur as a result of volcanic eruptions" are the correct sentences about the formation of the earthquakes.

Earthquakes are classified as tectonic, volcanic and collapse earthquakes according to their formations. The most effective of them is tectonic earthquakes. Tectonic earthquakes can be effective and destructive in wide areas (Aksoy & Sözen, 2014).

It is seen that a relationship is founded with the statement *"there are a lot of hot water supplies in fractured lands"* as there is a parallelism among the distribution of fault sources named as hot water sources.

Some statements constituting the majority are; "there happen shakes on earth as a result of fault's breaking, horsts and grabens are formed by the breaking of the fault lines, earthquake is the strong shake occurring in the earth's crust, earthquakes occur as a result of tectonic movements, earthquakes occur along the fault lines very frequently, after a severe earthquake, aftershocks occur, earthquakes can create new geomorphological shapes, earthquakes are more common in young land, earthquake occurs as a result of the movements of the plates. This situation reveals that there are not many contradictions in students' meaningful learning. Opinions of the students show that they configure the concept of earthquake in their minds and reveal the relationships among concepts correctly. The relationships among the concepts should be comprehended very well in order for a successful learning to take place.

In addition to this, there are sample sentences containing non-scientific or superficial information. Students tried to explain the concept with simple and non-scientific expressions without thinking it thoroughly. And it is also seen that students configure the concepts related to earthquake correctly but they are in conflict while forming their sentences about these concepts. It means that their incorrect and incomplete information was revealed more in their sentences about the earthquake. They have failed in making sense and building relationship.

This result shows that students have personalized their conceptual structures about the concept of earthquake and they do not have cognitive structures at academic level about some subjects. It is seen that students are mostly in conflict about the seismic intensity and magnitude and they have misconceptions. Their sentences such as; *"the size of an earthquake is measured by seismic movements, earthquakes are measured and classified with the Richter scale"* show that their information has not been formed sufficiently and they have contradictions in their minds in terms of meanings among concepts.

Earthquakes are measured and recorded by "seismograph". Instant magnitude of an earthquake is expressed with "Richter" scale. The intensity of the earthquake is measured by the "Mercalli" intensity scale.

The magnitude of an earthquake is defined as logarithm of the amplitude of the seismic waves on the seismogram in a certain period of time. The magnitude of an earthquake is the measure of the energy released in the earthquake source but the intensity is the measure of the impacts of the earthquake on buildings and people (İşçi, 2008).

In his study, Cin (2010) revealed that students have 7 different mistakes about natural disaster types (earthquake, flood, avalanche, lightening and hail). It is stated that there are also some misconceptions such as; "the intensity of the earthquake is measured with Richter scale", and "1 unit increase in the magnitude of the earthquake on the Richter scale leads to an increase in energy at the same rate". One of the biggest misconceptions about the earthquake is confusing "the intensity of the earthquake" and "the magnitude of the earthquake". Some unauthorized people's making statements in the media after the earthquakes in Turkey has a big impact in gaining these information (Öcal, 2007).

Students wrote some correct sentences such as; "submarine earthquakes cause the tsunami" but they also wrote some sentences such as; "if earthquake waves occur at the bottom of the oceans, then tsunami occurs", "Tsunami occurs as a result of the earthquakes in big waters". These are contradictory sentences expressing the formation of the tsunami. When looked at these statements, it is seen that some students have alternative concepts.

Tsunami–a Japanese word (harbour wave)–emerges due to the earthquakes in places close to the shore or sea bottom, landslide that occurs in the bottom of the ocean or volcanic activities (Özey, 2012).

Briefly, it is seen that such incomplete and incorrect information emerges in all levels of education similarly. It may be said about learning such concepts that out-of-school stimulants are effective. Such concepts that perceived by the senses from the outside world are difficult to be taught correctly. So, the methods offered by the constructivist learning approach must be used to configure such concepts about geography correctly and to provide the conceptual understanding. Thus, students will both learn the concepts about earthquake with a scientific language and will become conscious about the earthquake security.

It is clear that it is necessary for the individuals and families of the countries living with the reality of earthquake to give education at schools about disasters as well as their being conscious. Earthquake's being perceived as a natural event and cannot be predicted before it occurs is forcing us to take further measures. It is possible to define this situation as awareness shortly (Öztürk, 2013). Awareness-raising and informing activities related to the earthquake should start from pre-school period. The pre-school period covers the years which learning is the fastest and the most permanent. So, to develop the awareness of the children about earthquake will create a significant impact in the short and long term in terms of individual and society (Fetihi & Gülay, 2011).

As mentioned before, although earthquake is a geologic event in terms of its formation, it is related to lots of branches of social sciences in terms of its results. It is an incomplete approach just to give the geologic dimension of the earthquake with earthquake education. Earthquake education must bring students some behaviour models (Öcal, 2005).

Earthquake is a concept which students sometimes live or sometimes hear from environment or media. So, their configuring the concepts in their minds with non-scientific thoughts gained from different backgrounds is always contradicting with scientific concepts which they learn in their school lives. Because scientific and non-scientific concepts are always configuring in students' minds, it prevents them to configure the concepts in their minds correctly. This information that is not conceptualized correctly prevents students to produce correct thoughts. Students live the difficulty of explaining scientific information with scientific expressions.

So, while teachers are teaching the concepts, they should determine the alternative concepts of students and then should find the appropriate process, method and strategy to eliminate them. To teach the information without teaching the concepts correctly makes the permanence and availability difficult. In most of the geography courses and especially while teaching the subject of earthquake, animations, simulations, diagrams, shapes and models should be used frequently. Concepts can only be conceptualized in students' minds correctly when they are embodied with these materials. In addition, students' conceptual levels should be determined with alternative evaluation methods carried out at the beginning and end of the subject. According to this, subjects should be handled in the courses with appropriate methods.

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