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Evaluation of the Cognitive Structures of the Middle School Students about the Concept of "Water Pollution" by Using Free Word Association Test

Haluk Bingol

Department of Chemistry Education, Faculty of A. K. Education, Necmettin Erbakan University Meram Yeni Yol, 42099 Konya/Turkey

Tel: +90 332 3238220-5497 E-mail: halukbingol@gmail.com

Abstract

It is necessary to focus on environmental education at every stage of education in order to raise the awareness of the students about the environment and make the information permanent. Before setting priorities for educational policy and taking precautions, necessary studies relating the determining the views of the students should be performed. Herein, the objective of our study which is about water pollution, an important issue in environmental problems, is to determine the current conceptual situations of the 8th grade middle school students about the key concept of "water pollution" and to determine the misconceptions about this subject if they have. The data of the research were collected by using free word association test from 60 students (34 of them are girls and 26 of them are boys) studying at Saraçoğlu Habibe Yılmaz Middle School in Karatay-Konya/Turkey. A case study pattern from the qualitative research methods was used in the study. While analyzing the data by using the content analysis approach, frequencies and percentages of categorized answer words were calculated. The words obtained are grouped into 5 categories as; "Factors causing water pollution", "The effects of water pollution on living things", "Possible effects of water pollution", "Concepts related to water" and “Natural sources where water pollution takes place”. It is seen that the information of the students about the factors causing the water pollution and the answer words they wrote about the water pollution are sufficient but some expected words (such as; “prevention of environmental pollution” etc.) could not be remembered by students and they have some information gaps on this subject. In addition, sample sentences that students wrote about the key concept of "water pollution" were examined. Although the sentences containing scientific information are relatively common, it has also been identified that there are some sentences with no scientific qualities or with misconceptions.

Keywords: Environmental problem, Water pollution, Free Word Association Test, Cognitive structure.

1. Introduction

Since multidimensional and comprehensive environmental problems require interdisciplinary research, environmental problems are of interest to many sciences. In our modern age, environmental problems, which are among the problems that humanity needs to solve initially, have an increasing importance (Breunig et al., 2014; Yildiz et al., 2005). In many studies carried out before, solutions that depend on policy, economy and current technology have been sought to solve the environmental problems. The most important factor for these solutions to be successful is the harmony between human and nature. Providing a harmony that can cope with environmental problems and training individuals in order to be able to sustain permanent solutions is one of the most important steps in this subject (Dixon and Ward 2015, Uzun and Sağlam, 2005). This can only be achieved by educated individuals or societies that have developed cognitive structures about the environment (Sterling 2010; Colakoglu, 2010).

Permanent conservation and sustainability of environmental resources can be achieved through effective studies on environmental education. Environmental education can be expressed as the efforts of people to recognize and protect the environment surrounding their lives (Breunig et al., 2014). Gaining environmental sensitivity and making positive behavioural changes in all segments of the society are among the basic qualities of environmental education (Eroğlu 2009). The main purpose of environmental education on society is individual's seeing the environment as a whole, raising a sensitive and conscious structure in related issues. So, the objectives

of environmental education include individual, social and global targets (Atasoy and Ertürk 2008). Environmental education starts in the family, and then, continues to develop with formal education and printing media tools (Gökçe et al., 2007; Özdemir, 2007). Studies conducted to measure the effect of environmental education on human behaviours have shown that environmentally educated students are environmentally sensitive. So, in order to increase the number of conscious and sensitive individuals in the society, it is also necessary for educational institutions to give importance to environmental education. The ability of younger generations to fulfil their thoughts, behaviours and responsibilities towards the environment depends on their achievement in the educational process (Blatt 2015, Mert 2006). Therefore, environmental education which aims to improve the positive attitude and behaviour towards the environment and increase the environmental sensitivity of the people is a process which should last from the pre-school period to the lifetime (Akçay 2006). Especially, it has been seen that the most appropriate education period should be the middle school period in order for environmental education to be the most lasting and most effective (Ada 2003; Ünal and Dımışkı 1999). So, basic education has a big task in order to make people aware of the environment. Issues related to environmental issues need to be taken into consideration at the point of raising awareness about environmental education (Kaya and Akış 2015). Since the environment is expressed as the whole of all the physical or chemical factors that affect the lives of the living beings and it directly affects the vital activities of the living beings, every individual living on the earth must be directly conscious of the present problems of the environment (Birdsall 2014; Kuzu, 2008). In the light of the related sources about environmental problems; *air pollution, soil pollution, water pollution, noise pollution and global warming* are the main issues. Water pollution has been described as "*the deterioration of the water environments in such a way that some substances mixed in various ways can change the quality of it and affect the lives of human beings and other living things negatively*" (Yıldız et al. 2005). Especially the wastes formed by the rapid growth of the industry and left to the nature cause *water pollution* (Kurgun et al., 2002). Potable water sources are limited and it is extremely important to think of these sources as an absolute necessity for the survival of the living beings (Yavaş and Erman 2000; Eguabor 1998). Therefore, the identification of cognitive structures of individuals on these environmental problems, including *water pollution*, plays an important strategic role in the roadmap for environmental education (Laniak et al., 2013).

As in many other areas, there are also many methods in environment education, in determining the cognitive structure of individuals about subjects and concepts, analyzing the information network and determining the long-term persistence of relations between these concepts. The word association tests (WAT), which are widely used in these methods, include answers of students containing their thoughts about the key concepts with a certain subject given to them in a certain period (Kaya and Akış, 2015; Özatlı and Bahar, 2010). It has been stated that these sequential answers given from the long-span memory reveal the connections between the concepts in the cognitive structure in a reliable way (Kaya and Akış 2015).

1.1.1. The Objective of the Study

This study was carried out to learn the information levels of 8th grade students of Saraçoğlu Habibe Yilmaz Middle School in Konya about water pollution by using the free word association test (WAT) and to reveal wrong, incomplete and incorrect concepts and knowledge if they have. In addition, the deficiencies about the environmental problems in middle school curriculum have been put forward and suggestions have been made for what needs to be done for improvement.

2. Method

A qualitative research model was used in this study because it helps students to convey their opinions and perceptions more easily. Qualitative research forms theories based on research and understanding of the social phenomena in the environment to which they are attached (Yıldırım and Şimşek 2011). In addition to this, qualitative research reveals the viewpoints and feelings of the individuals related to any events (İslamoğlu 2009). A case study pattern from the qualitative research methods was used in the study. According to Yıldırım and Şimşek (2011), the case study is a method that is used in the detailed examination of an event with the questions such as "how" and "why".

2.1. Study Group

Our research was conducted with 8th grade students (34 girls and 26 boys) who were educated in Saraçoğlu Habibe Yilmaz Middle School in Karatay, Konya in the spring semester of 2015-2016 academic year. For the collection of comprehensive and qualified data on the subject, volunteerism was taken into consideration in the selection of these students who had taken Science and Technology course.

2.2. Data Collection Instrument

In order to construct the test, "*water pollution*" was chosen as a key concept, and a word association test was prepared by writing this concept for 10 times as one under the other. The reason of writing a key concept under the other for ten times is to prevent the risk of chain-responses (Bahar & Özatlı 2003). Firstly, the students were informed about the WAT and a similar data collection tool was obtained in the related literature for the concept of "*water pollution*" (Bahar & Özatlı, 2003, Kaya & Akış, 2015). The layout presented below is an example page-layout, and the concept of "*water pollution*" was asked as a stimulating word for completing the word association test to the middle school students to whom the test was applied. The WAT in this form comes in two stages; one is writing answer words about the key concept and the other is writing sentences about the key concept.

Water Pollution:…….

Water Pollution:…….

.

Sentence:…….

A sample data collection test of this WAT and the results are presented in Figure 1. As it is seen here, it is ensured that students have responded as much as possible to the key words.

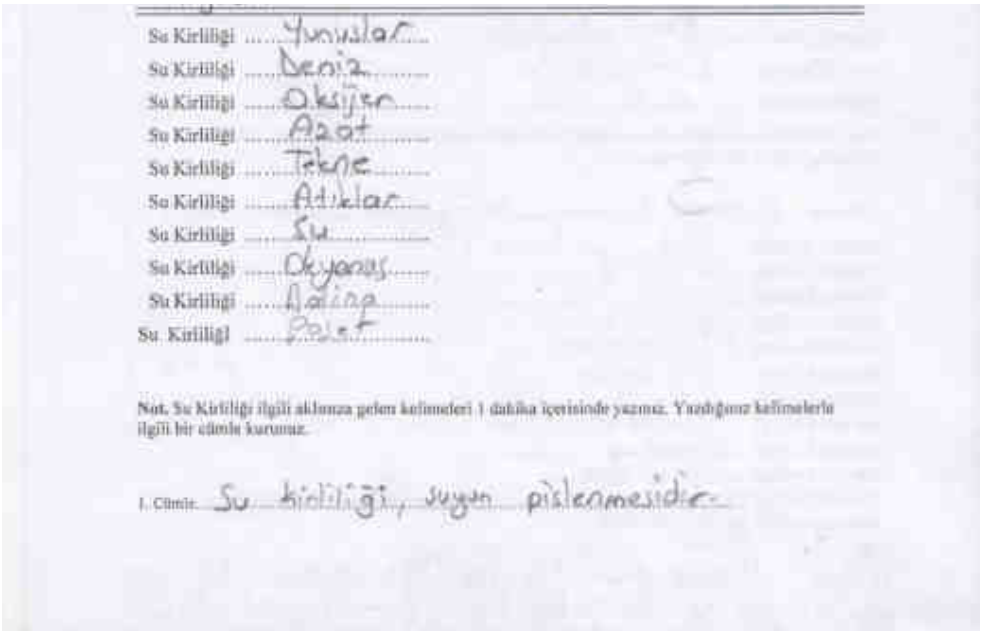


Figure 1. A Sample Answer Paper Belonging to the Participants of Word Association Test (WAT)

During the application of the test, students were asked to write a sentence containing the key concept and these sentences were collected and analyzed during the analysis of the data. In this technique, students are asked to write the concepts that come to his mind first when he/she encounters the key word in a certain period of time. It is assumed that this answer, given from the long-term memory of the student, reveals the connections between the concepts that students have and demonstrates the semantic closeness in the cognitive structure (Bahar, Johnstone and Sutcliffe, 1999). Since these sentences established by the students are more integrated and complex than the answers containing a single word, they have been evaluated by taking into account not only the scientific qualities but also the misconceptions that are emerging.

2.3. Data Analysis

Content analysis approach was used for data analysis. With the help of this content analysis, it is possible to reach the concepts that can explain the collected data and the relations between these concepts (Yıldırım and Şimşek 2011). The data that were processed relatively deeper by content analysis were first summarized and interpreted by descriptive analysis. With the help of in-depth content analysis, some themes and concepts can also emerge that could not be realized before. Through this analysis, which is necessary in determining the themes explaining the data, it is possible to conceptualize and organize the data in a logical structure. This can lead to a clearer understanding of the consequences (Kaya and Akış 2015). So, in the analysis phase of the WAT, students' answer words given for each given keyword are identified and then those with similar qualities are combined. Frequency tables are prepared by taking the number of repetitions of answer words into consideration that are categorized according to specific topic titles. The data obtained as a result are analyzed by considering the semantic relation technique as well as the number of words and answers (Atasoy, 2004). The total frequencies of these words which are categorized using the semantic relationship technique are calculated and then evaluated. Answer words with the same meaning are combined under the most frequently repeated word. In addition, any words that are not related to one another and are repeated once are excluded from evaluation. It is also expressed in the related sources that this data analysis method provides safer results (Daskolia et al., 2006, Kurt, 2013).

In this study, word association test was used as a data collection instrument. Answer papers used in the questionnaire were numbered and put in order. The answer words in each paper were coded, similar ones were put together and categories were created. Answers which were repeated for 2 times or above were included in the categories. Since the words in the categories were combined according to their common characteristics, each category was given an appropriate name. Words that repeated just once were given in a sentence under an appropriate category. Answer words that not included in the categories and contain misconceptions were also given in the text. The data in each category were first subjected to descriptive analysis and frequency tables were created to show how many times words or concepts were repeated for the key concept.

In order to ensure the validity of the study, expert opinions were taken into consideration while making examinations. At this stage, the researcher who firstly verbally transmitted all the processes to the expert, evaluated the data and the results together with the expert again. Obtained codes and related categories were compared and necessary confirmation studies were made. The reliability of the data analysis was determined using the following formula: [Reliability = Number of Agreements / (Number of Agreements + Number of Disagreements) * 100] (Miles and Huberman). As a result, the average reliability value between the coders was calculated as 88%.

3. Findings

The data obtained by the free word association test that applied to the students were evaluated and organized in categories. In addition to separating the answers given to the key words presented to the students into the common categories, misconceptions were also identified. Then, a model was developed to reveal the conceptual frames of middle school students in the direction of their answers given for the key concept of *water pollution*. Using free word association test, 5 categories were formed by using the findings of cognitive structures of middle school students participating in the research related to the concept of *water pollution*. These categories and the answer words in each category were given in tabular form. A total of 105 answer words were obtained and 75 of them (71.4%) were categorized and presented in tabular form. If these words were repeated once and were not related to the subject, they were not included in the categories, they were given separately in the text. The 30 words from these words have 31 frequencies and were not included in the categories. A total of 105 answer words were obtained and their total frequency was determined as 301. The frequencies of the answer words included in the categories were calculated as 270.

Table 1. Answer words and frequencies belonging to factors causing water pollution

Category 1	Concepts in the category and their frequencies		Total frequency of the category
Factors causing water pollution	*Factory Wastes (21)* *Rubbish (20)* *Waste materials (19)* *Sewage (12)* *Oil (10)* *Dirt (5)* *Plastic (5)* *Plastic bottle (5)* *Glass bottle (4)* *Oil well (3)* *Ship (3)*	*Chemical wastes (3)* *Industry (2)* *Oil Gas (2)* *Gasoline (2)* *Industrial wastes (2)* *Bottle wastes (2)* *Pesticides (2)* *Nylon bag (2)* *Wastes thrown by people (2)* *Poisonous liquids (2)*	128

Our first category named "factors causing water pollution" consists of 24 words and its frequency is 131. The total number of answer words that were repeated for 2 times or more is 21 and total frequency was calculated as 128 (Table 1). The most repeated words in this category are; *Factory Wastes (21), Rubbish (20), Waste Materials (19), Sewerage (12) and Oil (10).* With these answers, it is seen that the students have correct inferences about the causes of water pollution. These words that they produce are valid and expected words at the academic level. When this situation is taken into consideration, it can be said that the cognitive structures of students about the formation of *water pollution* are sufficient. This category is a dominant category and the answer words when considering students' level are largely up-to-snuff. Some of the words with relatively high frequencies in this category are Dirt (5), Plastic (5), Plastic Bottle (5) and Glass Bottle (4). The words that repeated once and not included in this table are; Gasoline of vessels (1), Nuclear wastes (1), Wastes thrown into the water (1).

Table 2. Answer words and frequencies belonging to the effects of water pollution on living things

Category 2	Concepts in the category and their frequencies		Total frequency of the category
The effects of water pollution on living things	*The death of fish (14)* *Aquatic creatures (9)* *Whale (6)* *Dolphin (6)* *It affects aquatic creatures negatively (6)* *Dead fish (4)*	*It affects fish negatively (4)* *Shark (4)* *Deaths (3)* *It affects plants negatively(3)* *Life without plants (2)*	61

Our second category having a high frequency is "The effects of water pollution on living things" (Table 2). In this category there are 11 answer words and in addition to this there are some 6 more answer words that repeated once and not included in this category: "*Sea creatures", "Sea pollution", "Ink fish", "Water turtle", "Water snake"* and *"It affects octopuses"*. This category has 17 words and the total frequency of this category was determined as 67 (% 22.3). The association of students with this category is based on the vital processes of fish and plants from aquatic life, and the effects of this environmental problem. High-frequency answer words in this category such as *"Death of fish (14)", "Aquatic creatures (9)", "It affects aquatic creatures negatively (6)" and "It affects plants negatively (3)"* are the words that clearly show and support this result. In other words, it has been seen that water pollution, which directly threatens the entire life form, is perceived by students as a vital problem for aquatic creatures in general. As a result, it can be concluded that water pollution, which is a general environmental problem, is comprehended by students superficially and they do not have comprehensive information about the effects of water pollution on other living things.

Table 3. Answer words and frequencies belonging to the possible effects of water pollution

Category 3	Concepts in the category and their frequencies		Total frequency of the category
The possible effects of water pollution	*Drought (4)* *Disease (4)* *Its negative effects for health (4)* *Human (4)* *Dirty water (3)* *Lack of water (3)*	*Mud (3)* *It affects ships (2)* *Foul water (2)* *Desert (2)* *CO_2 (2)*	33

Our third category is named as "Possible effects of water pollution" according to the characteristics of answer words (Table 3). In this category, the total frequency of 11 answer words with 2 or more frequency is 33 and rate was calculated as 11%. On the other hand, the total number of words with 1 repetition for this category is 11. These are; *"The reduction of nutrients", "It affects fishermen", "The contamination of drinking water", "Poor quality of life", "Hunger", "It is harmful", It affects the soil negatively", "It reduces the fertility of soil"* and *"Nitrogen"*. The relatively lower answer scores in this category when compared to first and second categories and the relatively higher number of words which was repeated just once indicate that students' information about the effects of water pollution is at a limited level.

Table 4. Answer words and frequencies belonging to the concepts related to water

Category 4	Concepts in the category and their frequencies		Total frequency of the category
Concepts related to water	*Oxygen (4)* *Hydrogen (3)*	*H_2O (3)* *Steam (2)*	12

The associations collected from the answer words of the students are brought together under the fourth category, "Water related concepts". The frequency of answers given by the students presented in Table 4 is 12 and its percentage is 3.99%. These answers show that participants provided their conceptual information about chemical and physical structures of water in general. In addition to the emergence of answer words such as *"Oxygen (4)"*, *"Hydrogen (3)"* and *"H2O (3)"* which are related to the chemical structure of the water as well as the *"Steam (2)*" which is related to physical structure shows that students have an accurate association in concepts about the structure of water. However, they cannot be expressed as the words explaining environmental pollution and water pollution. In this category, "NaOH" has become the answer word that repeated once.

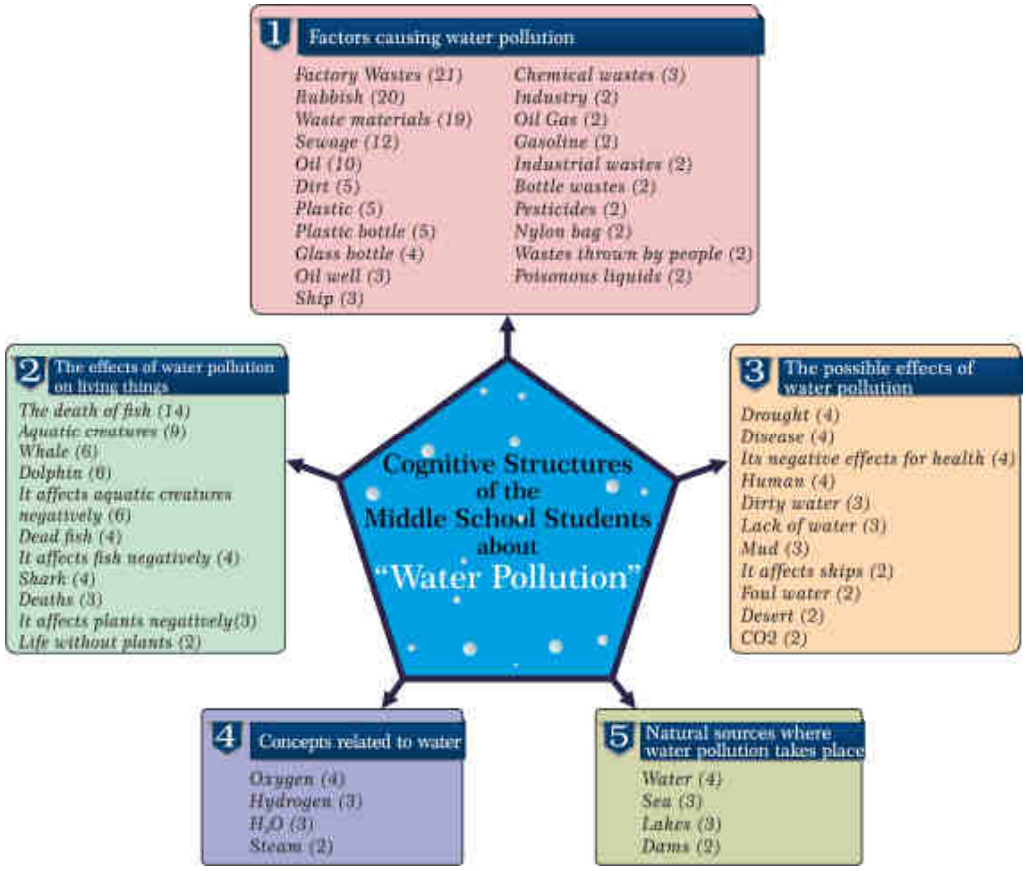
Table 5. Answer words and frequencies belonging to natural sources where water pollution takes place

Category 5	Concepts in the category and their frequencies		Total frequency of the category
Natural sources where water pollution takes place	*Water (4)* *Sea (3)*	*Lakes (3)* *Dams (2)*	12

In the fifth category, which is the last category with the heading "natural resources where water pollution takes place", the total frequency is found to be 16 for a total of 8 answer words. The total frequency of 4 answer words (Table 5) which have the highest frequency is 12 and the rate is 3.99%. Other answers such as "*Brook", "Ocean", "River" and "Stream"* were repeated once in this category, where cognitive structures of students show a correct association. When taken the given answers into consideration, it is seen that students generally have sufficient information about the environments in which water pollution takes place. It is thought that the information provided by different information sources and media (internet, TV, etc.) are important factors in the emergence of this result.

In addition to these five general categories, it was also found that the total frequency of 30 answer words containing misconceptions or not included in the categories is 31. These words and their frequencies are as follows; *Purification (2), Recycling (1), Chlorination (1), Irrigation in vain (1), Glacier melting (1), Using drip irrigation (1), Next generation (1), Wasting water (1), Livestock (1), It affects the world negatively (1), Bad (1), Permanent waste (1), Dirt (1), Stinky water (1), Uncontrolled irrigation (1), Perfume (1), Industrial Waste (1), Industrial era (1), Ozone layer (1), Germ (1), Temperature (1), Watered plants (1), Water globe (1), Agriculture (1), The reduction of water (1), Poison (1), Rocks (1), Boat (1), Life (1).*

In addition, a model (Model 1) was created by considering these categories obtained by analyzing collected data related to cognitive structures of 8th grade Middle School students about the concept of *water pollution*. As can be seen here, it is concluded that the students' conceptual structures related to the concept of *water pollution* from environmental problems are related to 5 basic categories.



Model 1. A Model for Cognitive Structures of 8th Grade Middle School Students Related to the Concept of "*Water Pollution*"

The sentences that students wrote regarding the concept of water pollution were also analyzed and classified. It has been identified that there are sentences which are non-scientific and containing misconceptions as well as scientific basis-based sentences. Some examples of this situation are given in Table 6. When these sentences are evaluated in terms of content, it can be seen that students can write scientific sentences covering almost all categories. This is thought to be the result of the Science and Technology course content of 8th grade middle school students.

Table 6. Students' Sample Sentences about the Key Concept of "*Water Pollution*".

Sample sentences containing scientific information	Sample sentences containing non-scientific or superficial information	Sample sentences containing misconceptions
- Oil which spills from the ships pollute the seas. - Water is not polluted unless we throw industrial wastes into water. - People and other living things are damaged because factory wastes are poured into the sea. - Water pollution affects the fish, soil, plants and water negatively. - As a result of water pollution, creatures living in streams and lakes lose their lives. - Water pollution is water's getting dirty. - Water pollution damages many living things in water and on land.	- Maybe we cannot even eat fish in the future because of the water pollution. - We should not waste water in our schools or at our homes. - We should not leave our wastes in the water and we should avoid water pollution. - We should not pour our wastes into the water. - Water pollution is a very bad thing. - Do not throw the waste into water, see the future. - Let's not pollute the water.	- Water pollution is a major pollution, manufacturers must be warned to prevent this. - It's a very bad thing. We may be dead. - Water is polluted when we throw many things in nature to the water and we get sick. - Rubbish pollutes the water. - I threw rocks into the sea. - Water is polluted when mud and plastic thrown into the water. - Pouring wastes such as oil and plastics to water causes water pollution.

On the other hand, sentences which contain superficial information and are not based on scientific grounds are attributed to inaccurate or incomplete information originating from the social background. In addition, it has been seen that participant students have some misconceptions.

4. Result and Discussion

As the issue of *water pollution* within the scope of environmental pollution is the concern of all segments of society, it is a serious problem to be addressed in all stages of education. In this context, secondary education, which forms the basis of education, plays an active role in this point. Therefore, it is very important to determine the cognitive structures of students about *water pollution* and their conceptual misconception. The WAT, which is an effective method for determining both cognitive structures and conceptual misconceptions, was used as a measurement tool and then a questionnaire was prepared. The data obtained from this questionnaire applied to 8th grade middle school students were evaluated. In this evaluation, the answer words given to the concept of *water pollution* were classified under 5 categories. The students produced a total of 105 answer words. And 51 of these answer words are included in categories. Some of the remaining answer words (a total of 24) were repeated just for once, so they were not shown in the tables in the categories, but were presented in the text under each category. The 30 words that were not included in the categories are unrelated words containing misconceptions and were mentioned in the text. The dominant category of these categories is the category called "Factors causing water pollution". There are 21 answer words in this category and its total frequency is 128. In this category, the word that repeated most by students is *Factory Wastes* and its frequency is 21. Our other categories, according to their frequencies are; "The effects of water pollution on living things (61)", "Possible effects of water pollution (33)", "Concepts related to water (12)" and "Natural sources where water pollution takes place (12)". In addition, 30 words that are not included in the categories have 31 frequency. A total of 105 answer words were obtained and their total frequency was determined as 301. The frequencies of the answer words included in the categories are calculated as 270.

Among the answer words given for the key concept of *water pollution*, students expressed the words most which are related to the factors causing water pollution and the environmental effects caused by water pollution. The conceptual structure of the middle school students about the concept of environmental problems is within the science's field of interest. At the same time, since water pollution is an interdisciplinary concept in many subjects, it is very important for the students to be able to grasp the conceptual relations of this concept. As a result this study, it is seen that middle school students can construct their conceptual structures together with many concepts, especially with the causes of water pollution. However, the words produced in the context of prevention of *water pollution* have extremely low frequency and cannot meet the expectations. This situation has also been revealed in similar studies (Malkoç 2011). In a study conducted with the university students about the environment (Özbebek et al., 2012), it has been concluded that the students have a relatively certain awareness of the environment but cannot establish a strong attitude about the personal measures to be taken to protect the

environment. Thus, as previously stated, environmental awareness appears to occur in the first stages of education and then have impacts on subsequent training processes.

When the sample sentences that students have established regarding the key concept of "*water pollution*" are examined (Table 6), there are some sentences containing scientific information but there are also some sentences which are not scientific or containing misconceptions. This shows that students have learned the concept of water pollution with its scientific nature relatively and have configured it thoroughly in their minds. On the other hand, both the sentences and the answers words have revealed that there is a limited knowledge of what measures and approaches are necessary for this environmental problem. Hence, it has been shown that more diverse strategies are needed for more comprehensive and integrated learning. New approaches have been the subject of current researches in recent years (Kok et al., 2017). It is known that students can comprehend the problems better when they hear or see. Therefore, in order to increase students' sensitivity to environmental problems, including water pollution, and to make environmental education more effective in their understanding of environmental problems, students should be encouraged to participate in various education projects that can be integrated with nature. It is also possible to make students learn more effectively by providing them a cooperation and a more active role in environmental education (experimental activities, land trips, etc.). Especially, it is emphasized in related literature that collaborative activities constitute more effective environmental awareness for students (Laniak et al., 2013).

As a result, science teachers' giving importance to the issues that involve environmental problems will contribute to students' awareness for environmental problems and their solutions. There should be more descriptive information about the environment and about the subjects which students can have conceptual misconceptions. It will be useful to explain these subjects by making them concrete while teaching. Students must certainly be informed about environmental issues. The environmental education programs that will be organized by the related organizations for solving these problems will also make important contributions to the teachers. In this way, the formation of permanent information about the environmental education in students' minds will provide an effective education model covering all the individuals in the education.

References

Ada, S. (2003), Determining the applications about the human health and environmental protection of women who are attending the courses in adult education centers, *Marmara University Atatürk Education Faculty Journal of Educational Sciences* **17**, 1-12.

Akçay, İ. (2006), *Environmental education for preschool students in different countries*, *Master Thesis*, Uludağ University Social Science Institute, Bursa.

Atasoy B. (2004), Fen Öğrenimi ve Öğretimi, *Asil Yayınevi*, Ankara.

Atasoy, E. & Ertürk, H. (2008), A field study about environmental knowledge and attidudes of elementary scool students, *Erzincan University Journal of Education Faculty* **10**, 105-122.

Bahar, M., Johnstone, A. H. & Sutcliffe R. G. (1999), Investigation of students' cognitive structure in elementary genetics through word association tests, *Journal of Biological Education* **33**, 134-141.

Bahar, M. & Özatlı, N. S. (2003), Kelime iletişim testi yöntemi ile lise 1. sınıf öğrencilerinin canlıların temel bileşenleri konusundaki bilişsel yapılarının araştırılması, Journal of *Balıkesir University Institute of Science and Technology* **5**, 75-85.

Birdsall, S. (2014), Measuring student teachers' understandings and self-awareness of sustainability, *Environmental Education Research* **6**, 814–835.

Blatt, E. N. (2015), An investigation of the goals for an environmental science course: teacher and student perspectives, *Environmental Education Research* **21**, 710–733.

Breunig, M., Murtell, J., Russell, C. & Howard, R. (2014), The impact of integrated environmental studies programs: are students motivated to act pro-environmentally?, *Environmental Education Research* **20**, 372–386.

Çolakoğlu, E. (2010), Haklar söyleminde çevre eğitiminin yeri ve türkiye'de çevre eğitiminin anayasal dayanakları, *TBB Dergisi* **88**, 151-171

Daskolia, M., Flogaitis, E. & Papageorgiou, E. (2006), Kindergarten teachers' conceptual framework on the ozone layer depletion, exploring the associative meanings of a global environmental issue, *Journal of Science Education and Technology* **15**, 168-178.

Dixon, H. & G. Ward. (2015), The value of masters study to teachers' professional practice: contradictory discourses within the workplace, *Australian Journal of Teacher Education*, **40**, 52–65.

Eguabor, V. (1998), Strategies for teaching water pollution in secondary schools, STAN *Journal Environmental Education Series* **2**, 49-54.

Eroğlu, B. (2009), Determination of pre-service elementary science teachers' knowledge level about global warming, *Master Thesis*, Gazi University Institute of Education Science, Ankara.

Gökçe, N., Kaya, E., Aktay, S. & Özden, M. (2007), Elementary students' attitudes towards environment, *Elementary Education Online* **6**, 452-468.

İslamoğlu, A. H. (2009), *Sosyal Bilimlerde Araştırma Yöntemleri*, Beta Basım Yayın Dağıtım A.Ş., İstanbul.

Kaya, B. and Akış, A. (2015). Determination of cognitive structure of geography students' on "weather" concept through word association test, *International Periodical for the Languages, Literature and History of Turkish or Turkic* **10**, 557-574.

Kok, J.L., Overloop, S. & Engelen, G. (2017), Screening models for integrated environmental planning-A feasibility study for Flanders, *Futures* **88**, 2017, 55-68.

Kurgun, E., Aydın, N. & Tarkay, N. (2002), *Çevre El Kitabı*, T.C. Çevre Bakanlığı, Ankara.

Kurt, H. (2013), Biology student teachers cognitive structure about "Living Thing", *Educational Research and Reviews* **8**, 871-880.

Kuzu, T. (2008), Aytül Akal'ın masallarıyla çocukta çevre bilinci geliştirme, *Journal of Selcuk Universty Institute of Social Science* **19**, 327-339.

Laniak, G.F., Olchin, G., Goodall, J., Voinov, A., Hill, M., Glynn, P., Whelan, G., Geller, G., Quinn, N., Blind, M., Peckham, S., Reaney, S., Gaber, N., Kennedy, R. & Hughes, A. (2013), Integrated environmental modeling: A vision and roadmap for the future, *Environmental Modelling & Software* **39**, 3-23.

Malkoç, H. (2011), *The examination of environmental attitude and metacognitive skills of classroom teacher candidates*, Master Thesis, Institute of Gazi University Educational Sciences, Ankara.

Mert, M. (2006), *Determination of consciousness level of high school students on the environmental training and solid wastes topics*, Master Thesis, Graduate School of Hacettepe University Educational Sciences, Ankara.

Miles, M.B. & Huberman, A. M. (1994), *Qualitative data analysis: an expanded sourcebook (2nd ed.)*, Thousand Oaks, California: SAGE.

Özatlı, N. S. & Bahar, M. (2010), Revealing students' cognitive structures regarding excretory system by new techniques, Journal of *Abant İzzet Baysal University* **10**, 9-26.

Özbebek, A.T., Ömür G.A. & Düren A. Z. (2012), Environmental awareness. *Journal of İ.Ü. Faculty of Political Sciences* **47**, 227-246.

Özdemir, O. (2007), A New Environmental Education Perspective: "Education for Sustainable Development", *Education and Science **32***, 23-39.

Sterling, S. (2010), "Learning for Resilience, or the Resilient Learner? Towards a Necessary Reconciliation in a Paradigm of Sustainable Education" *Environmental Education Research* **16**, 511-528.

Ünal, S. & Dımışkı, E. (1999), UNESCO-UNEP Himayesinde Çevre Eğitiminin Gelişimi ve Türkiye'de Ortaöğretim Çevre Eğitimi, Journal of *Hacettepe University Education Faculty* **16**, 142-154.

Uzun, N. & Sağlam, N. (2005), Effect of socio-economic status on environmental a w areness and environmental academic success, Journal of *Hacettepe University Education Faculty* **29**, 194-202.

Yavaş, S. & Erman Y. (2000), *Öğrenciler için Uygulamalı Çevrecilik Eğitimi*, *Beyaz Yayınları*, İstanbul.

Yıldırım, A. & Şimşek H. (2011), *Sosyal Bilimlerde Nitel Araştırma Yöntemleri*, Seçkin Yayıncılık, Ankara.

Yıldız, K., Sipahioğlu, Ş. & Yılmaz, M. (2005), *Çevre Bilimi*, Gündüz Eğitim ve Yayıncılık, Ankara.