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Research Article

The Effect of Context-Based Approach on Gifted Students' Understanding the Topic of Global Warming

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Abstract

The aim of this study is to investigate the effect of context based approach on gifted students' ability of understanding the global warming subject. A simple experimental method was used in this study. Word Association Test (WAT) which is conducted as a pre-test post-test was used as a data gathering tool. The sample of the study consists of 18 (7 male, 11 female) 7th grade gifted students who took part in the study voluntarily from Science and Art Centre. The results obtained from the present study point to a positive effect of the content-based approach on students' conceptual understandings and alternative conceptions about the global warming. Thus, the science teachers who would like to make their lessons more enjoyable and challenging can use the context based approach instead of presenting the subject theoretically.

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Introduction

In the 21st century, environmental sensitivity issues and the necessary application approaches increasingly begin to come into prominence. In order to provide next generations with living in a healthier and safer environment, it has become an urgency to grow up environmentally conscious individuals. One of the global environmental problems is global warming. With regards to the potential importance of global warming, the necessary education on this subject has a great importance (Boyes & Stanisstreet, 1992). The process of temperature increase in the earth's solid parts and in the atmosphere's closer parts to earth surface artificially resulting from the increases of some gases occurring due to various activities of human beings and named as 'greenhouse gases', is called as global warming. Global warming stems from the warming effects of the greenhouse gases named as greenhouse effect (McKinney & Schoch, 2003; Çepel, 2008; Eroğlu, 2009). It is likely that along with the global warming, our life becomes more difficult and we face serious health

problems. Also, the species which cannot adapt themselves to short term changes that may occur in the climates will face with the danger of extinction and this situation would affect the ecosystem negatively (Aksay et. al., 2005). This is basically an education problem because human beings' attitude and behaviors cause global environmental problems. Education can be benefitted as a tool of raising the individual awareness. Environmental education has an important role in making provision on the environmental problems, gaining necessary awareness, developing positive attitude and behaviors towards the environment (Arsal, 2010).

Students may have different ideas from the scientifically approved concepts on global warming. This is because sufficient knowledge cannot be provided in the school and students mainly get the knowledge on this issue from the written and visual media. Thus, it is vital for our future that students get sufficient knowledge about global warming, the causes of global warming, negative results that it may lead to, and necessary precautions for global warming. Because most children will be affected by the growing environment problems and they are required for the solutions of these problems (Campell, Waliczek & Zajicek, 1999).

Almost in every teaching grade, researches have been conducted related to comprehending the environment problems. The results of the researches on global warming proved that there are similar alternative concepts in the students who are at the elementary education (Andersson & Wallin, 2000; Rye, Rubba & Wiesenmayer, 1997; Pruneau et. al., 2003), secondary education (Aydın, 2010; Boyes, Chuckran & Stannisstreet, 1993; Boyes, Skamp & Stanisstreet, 2009; Boyes & Stanisstreet, 1993) and higher education (Aksüt, Doğan & Bahar, 2016; Arsal, 2010; Boyes & Stanisstreet, 1992; Eroğlu, 2009; Şahin et al., 2004) levels. However, there hasn't been a study done with gifted students about the context-based learning approach among them. Since gifted students are individuals who have the characteristic of leadership that can lead the communities, and can make inventions that enlighten them for the community development, their education on the current issues is very important. If these individuals are well trained in accordance with their gifts, they will take part in the communities' decision making mechanism. It is supposed to increase the number of such studies related to the training of gifted individuals and they should guide teachers who work at these intuitions educating on this topic. Therefore, it is considered that this study will contribute to the research area that works on gifted ones. Besides, it is pointed out

in the literature that teachers at the science art centers do not have sufficient expertise in teaching gifted students and they aren't subjected to enough in-service training on this area (Sak, 2009). For this reason, teachers have problems about how to teach gifted students. The number of available activities for gifted students is also limited (Çepni, Gökdere & Küçük, 2002). Most students who are gifted in their field cannot encounter the appropriate level of thought-provoking, challenging and interesting content in the activities at their schools (Altıntaş & Özdemir, 2015). Therefore, this sort of studies aiming at developing teaching material, have become significant.

As it is mentioned above, the researches on global warming intended to determine alternative concepts and level of conceptual understanding. Alternative concepts regarding environmental subjects require scientific based and more comprehensive education researches (Cordero, 2001). By this way, it can be provided that students properly evaluate the information that they acquire especially about global environmental problems and their precautions, and they restructure them. One way of achieving this is to use the Context-Based Approach that has recently gained popularity in our country. This approach argues that the concepts studied in classroom should be connected to situations and events that are faced in real world. In this study, the context based approach was preferred because of the fact that it is interrelated with today's Science-Technology-Society-Environment education (Demircioğlu, 2008; Schwartz, 2006; Tekbıyık, 2010). In addition, global warming is preferred because it is one of the current topics that affect our lives, and contains science, technology, society, and environment concepts.

Theoretical Framework

Teaching chemistry with a context based approach has an advantage over traditional approaches for several reasons. Traditional approaches tend to focus on the repetition of mathematical problems, the following of cook-book style laboratory work, and the memorization of chemistry facts and formulas (King, 2007). Therefore, students find chemistry uninspiring, abstract, and irrelevant to their lives (Bulte et al., 2006; King, 2007). In contrast, teaching with a context-based approach to chemistry lends itself to topics and tasks that are "interesting, relevant, and effective for conceptual learning" (King et al., 2008, p. 379).

One of the major goals in teaching chemistry with a context based approach is that students develop the ability to understand and make decisions about issues they may face in

their everyday lives outside the classroom (King, 2007; King, Bellocchi, & Ritchie, 2008). This need-to-know basis of content ensures that the science concepts taught arise from the context rather than being presented as disconnected fragments of knowledge (King, 2009). Context-based approaches help students to make connections between chemistry concepts and real-world applications (King, Bellocchi & Ritchie, 2008; Demircioğlu, 2012; Demircioğlu, Dinç & Çalık, 2013). The concepts are a natural result of understanding the context in depth, which makes learning more meaningful for a greater range of students (Bulte, et al., 2006; King, 2009). Thereby, it yields a "need to know" basis and increases their enthusiasm towards science (Pilot & Bulte, 2006; Demircioğlu, 2012; Demircioğlu, Dinç & Çalık, 2013). Through a context-based approach, students can develop their analytical skills, critical judgment skills, and risk-benefit assessment skills, all of which are important to develop in order to become informed participating members of society (Schwartz, 2006).

Due to the abstract nature of science concepts, students often see science as disconnected from their lives. However, science has immense cultural significance, and science education should highlight the major landmarks and people in our understanding of the natural world (Irwin, 2000). Context-based chemistry education aims at making connections between real life and the scientific content of chemistry courses. Using science stories, thematic teaching, and popular science literature allows for a more humanistic view of science (Stinner, McMillan, Metz, Jilek & Klassen, 2003). Contexts are used as the starting point and anchors for learning new concepts, thereby giving significance and meaning to the content (Osborne & Dillon, 2008; Bennett, Lubben & Hogarth, 2007; Gilbert, 2006; Nentwig, Parchmann, Demuth, Gräsel, & Ralle, 2002). In such education, students should understand and appraise the meaning of the learning of science, because they experience its relevance to some aspects of their lives (Gilbert, 2006).

This contrasts with more traditional approaches that cover scientific ideas first, before looking at applications. Contexts are intended to provide a rationale for selecting representative chemistry content. Using the need-to-know principle for students (Bulte, Westbroek, De Jong & Pilot, 2006), it is decided what concepts, relations and procedures will be addressed in the educational unit, selecting only those that are needed with respect to the context. Knowledge acquisition on the basis of the need-to-know principle should enable students to develop a coherent mental schema, helping to give meaning to what they are learning about chemistry. Also, since students perceive the relevance of the context based

approaches; their enthusiasms towards science can be enhanced (Barker & Millar, 1999; Barker & Millar, 2000; Belt, Leisvik, Hyde & Overton, 2005; Potter & Overton, 2006; Demircioğlu, 2012; Demircioğlu, Dinç & Çalık, 2013) and a context-based approach is often cited as having a positive impact on student's learning (Bennett & Holman, 2002). Thus, the context based learning and teaching get students to have a better understanding of science concepts. To provide various scenarios of life applications, the context-based approach of science learning emphasizes learners' experiences, stories from home and communities, everyday materials, and so forth, and it has helped to bring out students' active learning and everyday relations of scientific knowledge to life (Lubben, Campbell & Dlamini, 1996; Kim, Yoon, Rae Ji & Song, 2012).

The author preferred the teaching model developed by King (2009) for the context-based approach. The teaching and learning sequence of each lesson had the following pattern: start with a context, investigate a solution through a context-based problem, identify the heat concepts within the context and apply these concepts to new contexts.

1. *Start with a context*: Each lesson started with a context to focus student attention. The context was set to probe student prior knowledge and understanding at the beginning of a lesson. Student prior knowledge was elicited through brainstorming, discussion or testing intended to help students see how the science concept related to their lives and experiences.

2. *Investigate a solution through a context-based problem*: Students were encouraged to answer the questions or solve problems that they faced in step 1 through experiments, demonstrations, reading assignments, group and class discussions of reading assignment, and/or by working through examples or exercises.

3. *Identify concepts through the context*: The teacher encouraged students to report the results of their investigations back to the class, to discuss and make summaries of the global warming, greenhouse effect, greenhouse gases, Kyoto protocol, and climate change concepts.

4. *Apply concepts to new contexts*: Students were presented with at least one new context which linked to the concepts they had learned and were asked to explain the new contexts.

The Aim of the Study

The aim of this study is to investigate the effect of the context-based approach on the 7th grade gifted students' understanding and alternative conceptions about topic of the global warming. Within this aim, the following research question is specifically explored; "Does the

context-based approach cause a change in the levels of students' understanding of global warming?"

Method

A simple experimental method was used in this study. 7th grade students have taken part the implementation and before and after the implementation their views have investigated WAT (Word Association Test).

Sample of Research

The study was conducted with 18 (7 male, 11 female) 7th grade gifted students who took part in the study voluntarily from Science and Art Centre (SAC).

Data Collection Tool

WAT (Word Association Test) that was carried out before and after the activity was used as a data gathering tool in this study. In the process of forming the test five key concepts were selected related to 'Global Warming' topic. These concepts are considered to set up a substructure for the topic and as the most important concepts. While the test was being prepared, students' levels were regarded by having investigated elementary school program. Besides, while the test was being formed, a lecturer and two research associates from the department of elementary education, a lecturer and a research associate from the department of Chemistry Education, four post graduate and doctoral students, a Chemistryand a Physics teacher from Science and Art Center were asked their opinions. In the practice, each word was arranged as to be in one page. A sample page layout was submitted below.

Greenhouse Effect …….
Greenhouse Effect …….
Greenhouse Effect …….
Greenhouse Effect …….
Related sentence: …….

The selected keywords are *Greenhouse Effect, Greenhouse Gases, Global warming, Climate Change and Kyoto Protocol*. In the literature, it is stated that in most of the studies done before about WAT, 30 seconds time was sufficient (Bahar, Johnstone & Sutcliffe, 1999). However, these studies were conducted at high school and university levels. Considering students' levels, Ercan et. al. (2010), determined this time as 1 minute in the study they did with 7th grade elementary school students. Regarding the results of that study, response time of the test was decided and applied as one minute for each concept in the present study.

Before the test was administered, students were enabled to read the instructions and investigate the example; then necessary explanations were done. Students continue to write down as many answer concepts as possible within the provided time. For instance, at the end of one minute time for the first key concept, students were asked to pass the second key concept. Related sentences were investigated, but they weren't evaluated because they were few.

Development of the Worksheet

There is an interesting picture related to the topic and a remarkable question in the introduction part of the worksheet submitted in the Appendix 1. In the application part of the activity, there is a laboratory activity that was prepared in accordance with Prediction-Observation -Explanation (POE) model. It was benefitted from the literature to prepare the activity (Lueddecke et. al., 2001). This activity includes an experiment representing the greenhouse effect. The last stage consists of the questions relating to the examination, and questioning the relation between the experiment and "Global Warming". During the process of developing the worksheet, a lecturer and two research associates from the department of elementary education, a lecturer and a research associate from the department of Chemistry Education, four post graduate and doctoral students, a Chemistry and a Physics teacher from Science and Art Center were taken their opinions.

Application of the Study

By planning the research, certain alternative concepts related to the topic in the literature were analyzed. Although, it is a current issue, not many alternative concepts were found. It was observed that most of the existing alternative concepts are technical concepts and difficult to understand for students. Considering the literature; data, pictures, story and worksheet were prepared. Besides, a documentarily film intended to global warming was brought out. WAT was administered as a pre- test.

Action plan done by regarding King's (2009) model, was presented thoroughly for each lesson in Table 1. The discussion process that was realized in the lessons was videotaped by another researcher. At this stage, students worked as five groups consisting of four groups of four and one group of two. During this process, the class teacher also did observation. After all the activities were completed, WAT was administered as a post- test. Each of the activities having been conducted for three days was completed in four course hours (4 × 45 minutes). The story used in the study is in Appendix 1 and worksheet used in

the study is in Appendix 1. All activities having been managed in the application were developed by the researcher.

Data Analysis

The results of pre-test and post-test were analyzed in details and a frequency table showing which words or concepts were used for the key concept and how many times they were repeated, and therefore the interconnectness between key and response words using word frequencies were formed. The breakpoint technique revealed by Baharet. al. (1999) was adopted for producing the theinterconnectness between key and response words using word frequencies in order to present cognitive structure and conceptual change clearly. In this technique, 3 or 5 numbers below the most repeated response words given for any key concept appearing in the word association test was taken as the breakpoint. The responses which are over the response frequency are written in the first part of the Figure 1 and 2. Then, the breakpoint is levelled down at certain intervals and this procedure goes on until all the key words appear in the interconnectness between key and response words using word frequencies. The data obtained by videotape were used to support the argument.

Table 1. An outline of the teaching design

Lesson Plan	CBA Teaching and Learning Sequences	Teachers' role	Students' role

First day	***First lesson***	*Start with a context*	• Six pages of pictures were posted on the board to attract students' interest and they were asked to write their ideas by interpreting these pictures. • Students' works were analyzed by the teacher and put into categories.. • The story about global warming was presented and students were asked to find the key concepts in it. • Later, some questions such as: "To you, how does the rate of greenhouse gases increase? What kind of precautions can be taken to prevent the rise of greenhouse gases, global warming and climate change? What kind of preventions does the Kyoto Protocol include? Were asked by the teacher related to the story and a class discussion was done.	• Students wrote down their ideas about the pictures. • After having listened the story carefully, students tried to find out the key concepts. • Students attended the class discussion and expressed their ideas.
	Second and third lesson	*Investigate a solution through a context-based problem*	• Worksheets were handed out to students. • They were asked to write down their predictions before they started the activity. • After completing the activity, they were asked to find out and write the similarities and differences between the model used in the experiment and greenhouse effect in the real world.	• Students worked in groups. • They wrote their predictions and make explanations. • Later, they compared their predictions to results having made observations during the experimentation. They explained the points that didn't overlap with their predictions. • Students answered the questions at the end of the worksheet.
	Fourth lesson	*Identify concepts through the context*	• The writings were analyzed and deficiencies were determined. • For the last time, similarities and differences were discussed. • The categories formed in the first lesson were discussed with students. • The first day was completed by assigning students research homework related to "Kyoto Protocol" for the second day.	• Students took part in the discussion all together and presented their writings and ideas.
Second day	***First lesson***		• Students were watched a CD illustrating *Global Warming*. This CD includes animations that can take students' interest, true life events, scientific information and simulations. • While watching, brief explanations were done by the teacher at the interesting and important points, and students were provided with better understanding.	• Students watched the CD, and the teacher made explanations during this process.
	Second and third lesson		• A discussion on "Kyoto Protocol" that had been assigned as homework was done. Below questions were discussed as a whole class in this respect. 1. What does the protocol include? 2. While some countries signed this protocol, why didn't some sign it? 3. What are the reasons of those counties that did not sing? 4. What are the reasons of those countries that signed? 5. How much those countries that didn't sign contribute the global warming?	• Students asked questions about the CD they watched. They did class discussion.
	Fourth lesson		• Students were asked to draw the model that they created in their minds about the topic.	• Students illustrated their ideas on global warming.

Table 1 (continued)

Third day	***First and second lesson***	*Apply concepts to new contexts*	• Students had a brief explanation to remind them the previous activities. • Later, students were put into groups. • These groups were organized as developing slogan, writing poem, designing a brochure or poster, drawing picture, developing project.	• Students worked in the groups that they chose. • Students in the first group prepared a brochure and wrote a slogan, • Second group draw picture, • Third group prepared a power point presentation, • Fourth group wrote essay, • Fifth group prepared a project about global warming, greenhouse effect and climate change.

	Third and fourth lesson			• All the groups presented the studies that they prepared and shared them with friends.

Finding and Discussion

The number of the response words produced in the pre-test and post-test for each key concept in the WAT was presented in Table 2. Shavelson (1974) indicated that the number of the response words produced for the key concepts is one of the methods that were used for the assessment of the data in this technique. The number and the property of the words associated with a concept can be used in determining whether this concept is understood or not (Ercan et. al., 2010). It can be argued that a concept that isn't associated with any word becomes meaningless and as the number of the associated words increases the meaning does also increase (Ercan et. al., 2010). Total number of the response words in the pre-test which measures the level of readiness before the activity is 341, and the total number of the response words in the post test done after the activity is determined as 519.

Table 2. The numbers of response words given for the key concepts in the word association test

Key Concepts	The number of the words	
	Pre-test	**Post-test**
Greenhouse Effect	89	100
Greenhouse Gases	62	103
Global Warming	98	107
Climate Change	75	109
Kyoto Protocol	17	100
Total	**341**	**519**

As it is presented in Table 2, after the activity, there was an increase in the number of response words given for all the key concepts. This result indicates that there is an increase in the level of understanding key concepts. Understanding and learning develop in parallel with the increase in the number of concepts, and the associations between concepts. Therefore, it can be stated that students' understanding and learning related to the increasing concepts and the topic.

The first was established in accordance with the word association test conducted before the activity. Figure 1 presents this. The results in the Figure 1 can be interpreted as:

1. Not being faced any concept for the breakpoint 15 and over indicated that the response words given for the key concepts were inadequate to reveal the association.

Especially when the words were analyzed, it was seen that although there are a lot of response words, they were in a wide range.

2. It is pointed out that for the breakpoint between 11-14, the numbers of the concepts and associated concepts increased, however, it wasn't a great increase and the concepts which are frequently used in daily life (*greenhouse effect, global warming and melting of icebergs*) emerged.

3. A significant increase is observed in the numbers of both key concepts and the associated words with key concepts for the breakpoint between 7-10. Four of the presented key concepts (*greenhouse effect, greenhouse gases, global warming and climate change*) emerged in this interval. At the same time, both the association between the concepts has begun to emerge (for instance, while from these concepts, only the "global warming" concept was associated with two key concepts, "greenhouse effect and climate change" concepts were associated with just one key concept, "greenhouse gases" wasn't associated with any key concept) and also an increase is observed in the number of associated words belonging to themselves for each key concept. Besides, according to other studies in the literature (Bahar, Johnstone& Sutcliffe, 1999), there are few numbers of key words and therefore, there are few breakpoint intervals, so it can be the reason of these words' emerging in this part.

4. For the breakpoint between 3-6, all key concepts, both between each other and associated concepts within themselves emerged clearly. Furthermore, key concepts and associated words were accompanied by some alternative concepts. For example, students associated "Greenhouse effect" concept with "green housing and hormone" concepts. They offer alternative concept by having associated greenhouse effect, related to global warming, with the green housing.

Breakpoint 15 and over it

Breakpoint between 11 – 14

Breakpoint between 7 – 10

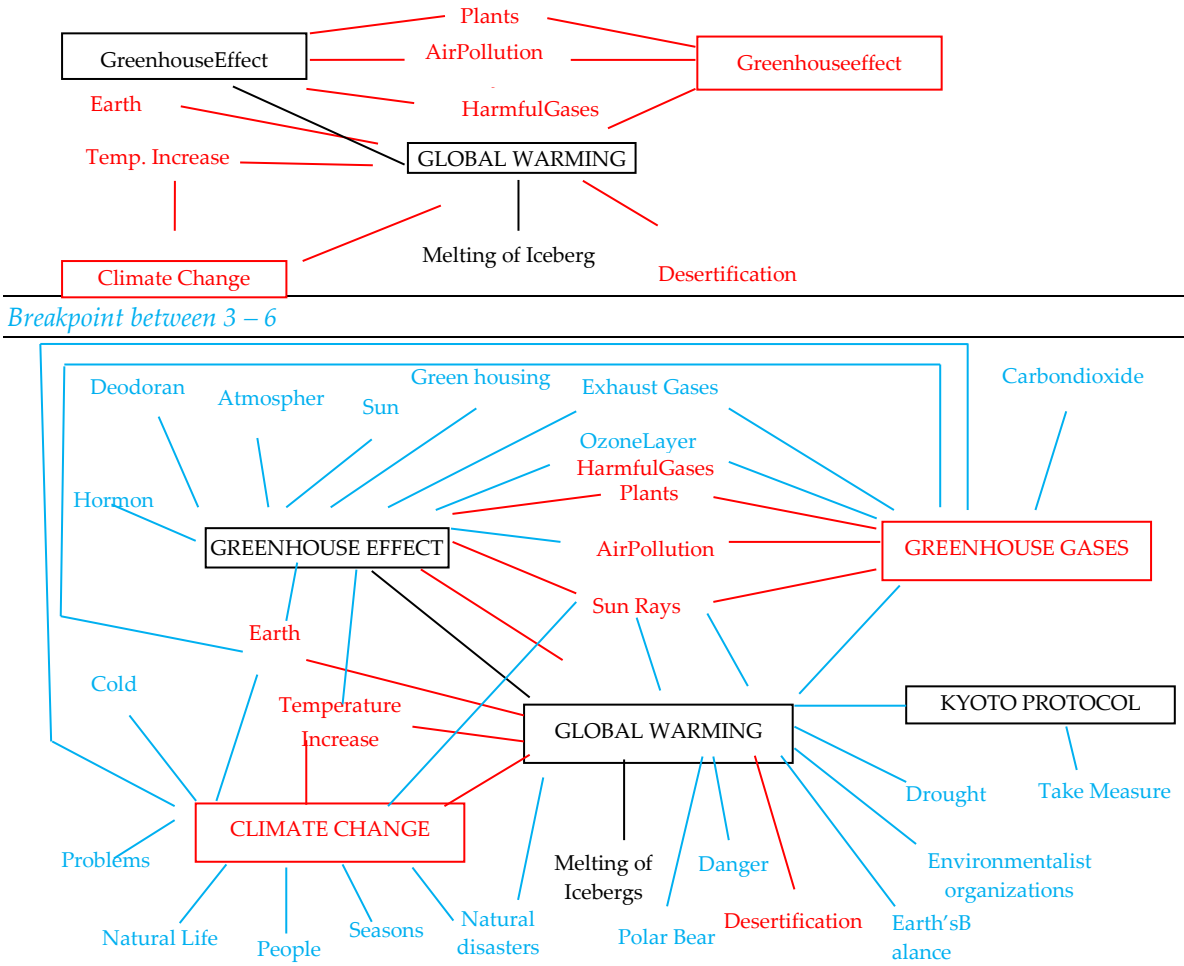
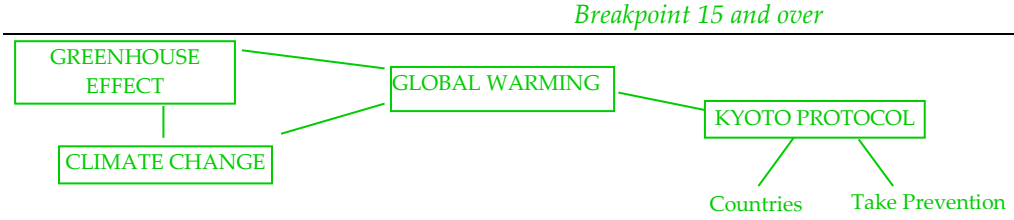


Figure 1. The interconnectness between key and response words using word frequencies in the pre-test

In regard to the word association test conducted at the end of the activity, second the interconnectness between key and response words using word frequencies were created. These interconnectness between key and response words using word frequencies are presented in Figure 2. The results in Figure 2 can be interpreted as:

1. It is indicated that for the breakpoint 15 and over, regarding the pre-test frequency chart the number of the key concepts increased and even at this stage, the association between the key concepts became evident. This case was seen between 7-11 in the pre-test. Distinctly, at this point one key concept was replaced with another key concept (for instance, instead of greenhouse gases, Kyoto Protocol was used). It is remarkable that four key concepts emerged in this interval and apart from one concept; other three concepts were associated with at least two key concepts.



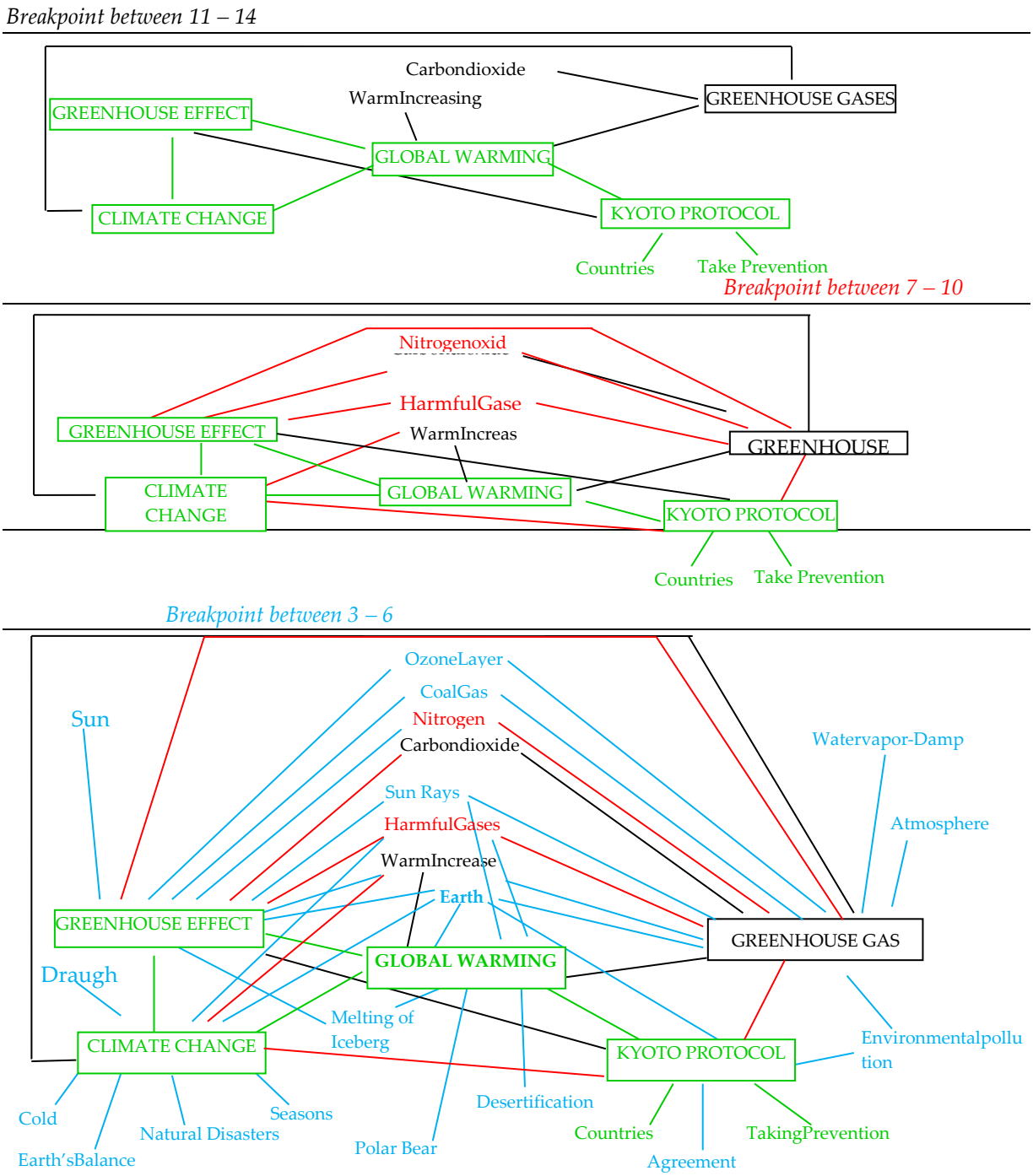


Figure 2. The interconnectness between key and response words using word frequencies in the post-test

2. All key words in the breakpoint were emerged between 11-14. This case was seen in the breakpoint between 3-6 in the pre-test. This finding indicates that there is a quantitative positive conceptual change in the students. Furthermore, it is also an expected situation in terms of conceptual change that rather than the words used in daily life, used concepts are the words that have scientific meanings. In other words, the conceptual change of the students showed both a quantitative and a qualitative development. While two key

concepts and a word association emerged in this interval of the pre-test, it is remarkable that in the post-test all the key words emerged.

3. For the breakpoint between 7-11, it is observed that similarly there is an increase in the number of scientific words. For example, "nitrogen oxide" concept associated with "greenhouse gases" key concept appeared in this interval in the post-test. Besides, while carbon dioxide which is one of the greenhouse gases was observed between 3-6 breakpoint in the pre-test, breakpoint was observed between11-14 in the post-test. This situation presents that applied activities had a positive effect on the students' conceptual development.

4. For the breakpoint between 3-6, whole Figure 2 between both key concepts and associated words was appeared. Besides, the words such as "*green housing, hormone and plants*" related to greenhouse effect given in the pre-test were replaced with the words such as "*coal gas, nitrogen oxide*" in the post-test and this indicates that incorrect information was corrected. Although there were a lot of words in this interval and the words were in a wide range and dispersed in the pre-test, this situation disappeared in the post-test. In the post test new words sharing the common association with the key concepts emerged and the dispersion in the associations was removed. Besides, all key concepts were directly associated with each other. While in the pre-test breakpoint between 3-6, only nitrogen oxide was stood out as a greenhouse gas, in the post-test this word emerged in the breakpoint between 11-14. Also, nitrogen oxide which didn't appear in the pre-test, appeared in the breakpoint between 7-10 and coal gas and water vapor words emerged in the breakpoint between 3-6 in the post-test. When the interconnectness between key and response words using word frequencies in the post-test were analyzed, key concepts' emerging much earlier in the post-test demonstrates that there is a conceptual change and development. It can be interpreted that applied teaching was efficient, productive, and conceptual change was substantially provided because some alternative concepts faced in the pre-test were eliminated and there were more associations between the key concepts.

While in the pre-WAT, the number of the students who gave responses like 'green housing" and "hormone" which aren't related with the topic, was 6 and 5 respectively, and in the post WAT, greenhouse word was used by 2 students and the word hormone wasn't used. At this point, the discussions that were carried out based on the activities might have affected it. Context based teaching approach aimed at students' realizing permanent and

meaningful learning by discussing their STSE situations and getting them be interested in the social dimension of the science. By this way students can be familiar with the nature of science and can use the science on behalf of the society. If it is considered that especially gifted students lead the scientific studies, STSE will become more significant. In this study, students were presented a story titled as" Global Warming" and "Kyoto Protocol" as STSE. When the pre WAT was analyzed, it was proven that students couldn't express any idea and even they didn't hear about Kyoto Protocol. As a support for this finding, in a study in the literature it was determined that 44% of the university students haven't heard about Kyoto Protocol (Oğuz, Çakıcı & Kavas, 2011). To the post WAT there was a significant increase in the number of the response words related to this key concept. For instance, while the number of the response words given for this concept was 17, this number reached to 100 in the post-test. This result points out that context based teaching is very efficient. The findings obtained from the discussion videos promoted it. It was observed that students worked in groups and discussed the results that they obtained and the concepts about the topic. Having created a discussion environment by presenting a context from the real life (pictures and the story on global warming) the students were provided with a good opportunity to share their ideas and their personal experiences. At the end of this observation it was determined that students are very sensitive, and even in their way they wrote and offered solutions for the events and situations that cause global warming. Some of them are like below:

E1: " …Nobody uses public transportation vehicles. We release so much harmful gas to the environment that the earth cannot struggle with us… everyone thinks that earth resources won't consume. We waste water carelessly. We disturb the natural balance…icebergs are melting, climates are changing…"

E 2:"…while one side of the world lives summer, another side of the world is freezing and some countries are becoming desert. If we don't become conscious, maybe we will face a new ice age…"

E 3: There should be reduction in buying and selling the products that cause air pollution. We keep the environment clean and natural. We should plant more trees.

E 4: "Factories should attach filters; public awareness should be raised, rubbish shouldn't be thrown to environment, water shouldn't be wasted, trees should be watered enough, there should be plantation, campaigns can be organized to plant trees. Public awareness should be raised by using posters and conferences, rubbish shouldn't be dumped to rivers and seas, perfumes should be used less, there should be serious legislations about the environment and we should avoid consuming."

The Science-Technology-Society-Environment learning field includes three basic dimensions: the nature of science and technology, the relationship between science and technology, and the social and environmental context of science and technology (Aydın & Ersoy; 2013). One of the aims of science education is to provide this unity. In order to achieve this aim, students should be sensitive to a current issue. The most gains in environmental education are achieved in the Science-Technology-Society-Environment learning field in secondary school Science and Technology Course Teaching program (MEB, 2005). It is very important to provide these environmental skills to students starting from an early age in terms of developing a sustainable environmental awareness.

Conclusion and Suggestions

The purpose of this study is to determine the effect of context based teaching approach on the levels of students' understanding of global warming. Findings offered that conceptual understanding in the students was realized, and also some alternative concepts in the pre-test were replaced with their correct meanings in the post-test. This result overlaps with the results of studies done on context based teaching approach that is used with the aim of realizing meaningful learning in teaching different topics and concepts (Demircioğlu, 2008; Demircioğlu, Demircioğlu & Çalık, 2009; Tekbıyık, 2010; Demircioğlu, 2012; Demircioğlu, Dinç & Çalık, 2013; Avargil & Piorko, 2022).

In addition, activities prepared according to context based teaching approach contribute students' developing a positive attitude towards chemistry. Informal in-class observation done while the activities were being carried out proved it. Students stated that they liked applied activities, and they wanted to do this kind of activities again. They were very eager to find out the key concepts presented in the story, to discuss with their friends and to perform the duties they were given in the worksheets and they worked in cooperation. Such an effect may stem from the nature of the context-based approach that motivates the students to learn their science courses and that stimulates their interest towards science (Bennett et. al., 2003; Demircioğlu, Dinç & Çalık, 2013). Since the context based approach contributes to increase the interaction between student-student, and student-teacher in every conducted stage, the application became both interesting and effective. However, after completing each activity, discussions enabled students to see how their peers thought and to share their ideas by investigating, analyzing and explain the phenomena

presented or contradictory theories (Yan & Erduran, 2008). Thus, it was concluded that this approach arouse students' interest and motivation towards teaching.

Teachers who want to turn science lessons into interesting and enjoyable classes can use context-based approach and practices instead of teaching lessons theoretically. By this way, more substantial teaching environments can be created through the contexts in which students can actively take part (Demircioğlu et. al., 2009; Balaban & Özdemir, 2019). Further, if the introduction and use of contexts is accompanied with a lot of care for bridging the meanings of concepts in a daily life context with those in a chemistry context, the students have an opportunity for grasping the relevance of chemistry/science to their lives (De Jong, 2008). In order to create a sustainable environment in countries, human behavior must first be changed. In this context, it is very important both educationally and socially for gifted students, who are likely to take part in our country's decision-making mechanisms in the future, to be conscious of socio-scientific issues such as global warming. The role of educational activities is very important in coping with environmental problems and producing permanent solutions to these problems (Uzun & Sağlam 2007). Studies showing that students' interest in the subject increases by associating the subjects with events selected from daily life with the context-based learning approach and they become aware of the relationship between events in daily life and science support this result (Barker & Millar, 1999, 2000; Demircioğlu, Dinç & Çalık, 2013; Potter & Overton, 2006).

Researchers can study in this area because such studies based on the context-based learning approach about gifted students are limited. These students should be well motivated at the beginning of the application and be informed about the goal in order to work with them efficiently. It is hard to work with gifted students, yet it is also as much pleasant. These kinds of students are inquisitorial so that researchers should have information about the application topic and the characteristics of these students.

Since gifted students do not enjoy writing much, alternative techniques should be used for the evaluation. In this study, it was explored that WAT is a suitable assessment and evaluation technique for gifted ones.

Gifted students' level of understanding and comprehension is very high so that the models they drew and their comments may express a lot. Students' these gifts can be evaluated for different studies. It is thought that gifted students voluntarily would take part

in science topics associated with STSE situations. Science teachers can use this model based on discussion in their classes.

There aren't many studies done on global warming, thus, the studies that will be done might be notable. Particularly the studies aimed at determining and eliminating alternative concepts can be handled. Studies in the literature on this topic are at the high school and university levels so the studies regarding elementary school students and gifted students are needed. By getting students draw pictures, alternative concepts can be brought out. In addition, if the students are talked about their drawings, drawings can be interpreted in a more meaningful way.

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Author Contribution Statement

Hülya BALABAN: *Conceptualization, literature review, methodology, writing and translation.*

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Appendix 1. The story used in the study

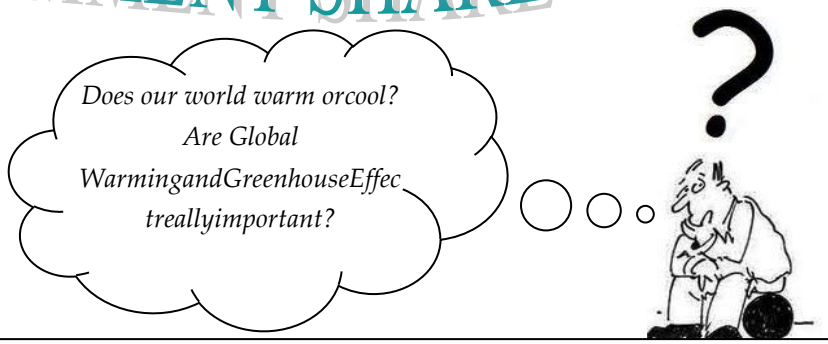
GLOBAL WARMING

While Fatih is doing a research on a homework that his teacher assigned, an article attracts his attention. There is an expression in the article like that: "Increase in greenhouse effect is worrying". When he reads it, he wonders it and asks his father the meaning of greenhouse effect. His father responds "In fact, greenhouse effect is important to keep the world in livable warmth. Greenhouse effect is that some gases in the atmosphere create a livable environment by keeping the world's heat balance as a result of reflecting back some part of the sun rays that reach the earth. Faith asks what these gases are and whether they are harmful or not. His father answers: "these gases called greenhouse gases are carbon dioxide (CO_2), methane (CH_4), nitrogen oxide (NO_2) and water vapor (H_2O). Although these gases provide earth's livable heat balance, when their rates in the atmosphere increase unrestrainedly due to various reasons, earth will be hotter and the heat rate will increase. This situation will lead to global warming". His father asks Fatih to research how the rate of these gases increases. At the end of the researches that Fatih does about this topic, he concludes that it is an important issue. He decides to discuss this topic with his teacher and friends at school. He gets permission from his teacher and tells his friends what kind of effects global warming has on the environment. He expresses that global warming will cause climate change. This situation makes it important to take prevention against global warming. They discuss the measures that they can take as a whole class. Irem takes turn and says that there are necessary things that countries should do. While some countries signed a practice called "Kyoto Protocol," some didn't. Turkey is among these 110 countries which signed this protocol; however, some countries such as the USA, Australia, Croatia, and Monaco are among those which didn't sign. In fact, these countries are those which most exhale greenhouse gases.

Appendix 2: Worksheet used in the study

Name and Surname: **Group name:**

THINK-COMMENT-SHARE



Follow the instructions and do theexercisebelowwithyourgrouppeers.

Materials

- ✓ Thermometer (2)
- ✓ Lightsource (1)
- ✓ LemonJuice (200 ml)
- ✓ Bakingpowder (2 packets)
- ✓ Plasticpipe (1, 20cm)
- ✓ Flask (2)
- ✓ Single hole stopper(2)
- ✓ Two hole stopper (1)

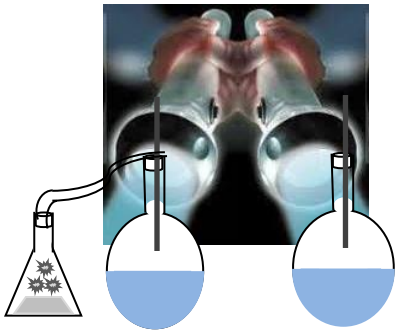


Figure 1: Testing Apparatus

Process Steps

Follow these instructions when founding the apparatus in Figure 1

1. Place one of the Thermometers into two hole stopper and put it into flask 1. Put the plastic pipe in the other hole of the pipe.
2. Fill one third of the number 1 flask with tap water.
3. Put the other thermometer in single hole stopper and place it in number II flask.
4. Fill one third of the number two flask with tap water.
5. Measure the heat of water in both flasks and note them in the below table
6. Pour down two pockets of baking powder in Erlenmeyer.
7. Put the plastic pipe in the number one flask in the other single hole stopper and place the stopper in erlenmeyer.
8. Plug in the light sources and close them to the flasks and turn on the light sources

PREDICT:

Predict what will happen now and write it down.

……

……

……

OBSERVE:

Open erlenmeyer and put 200ml lemon juice in it, then close it immediately.

Observe them for 16 minutes; read the heat of thermometers in the flasks every two minutes and note them to the table.

Time (minute)	2	4	6	8	10	12	14	16
Heat (°C) 1st Flask								
Heat (°C) 2nd Flask								

EXPLAIN:

9. Are your observations the same as your predictions? If they are different write down the reason.

……
……
……

10. What is the reason of difference in the heats of thermometers? Explain.

……
……
……

11. What can happen when greenhouse effect increases? Write your ideas.

……
……
……

12. Is there a relation among greenhouse effect, global warming, and climate change? Write down.

……
……
……