REPUBLIC OF TURKEY
YILDIZ TECHNICAL UNIVERSITY
GRADUATE SCHOOL OF NATURAL AND APPLIED SCIENCES

EFFECTIVENESS OF ENVIRONMENTAL SCIENCE PROJECTS ON MIDDLE SCHOOL STUDENTS' ENVIRONMENTAL KNOWLEDGE AND ATTITUDES

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MSc. THESIS
DEPARTMENT OF MATH AND SCIENCE
PROGRAM OF SCIENCE EDUCATION

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İSTANBUL, 2019

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A thesis submitted by Cansu KESKİN in partial fulfillment of the requirements for the degree of **MASTER OF SCIENCE** is approved by the committee on 04/07/2019 in Department of Math and Sciences, Science Education Program.

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ACKNOWLEDGEMENTS

To my mother who has always been behind me, my husband who always supported me, and my son to finish my thesis one year late ☺

March, 2019

Cansu KESKİN

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LIST OF ABBREVIATIONS

EAS Environmental Awareness Scale

STEM Science Technology Engineering Mathematics

STEAM Science Technology Engineering Art Mathematics

WUAS Water Usage Attitude Scale

WUBS Water Usage Behavioral Scale

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ABSTRACT

EFFECTIVENESS OF ENVIRONMENTAL SCIENCE PROJECTS ON MIDDLE SCHOOL STUDENTS' ENVIRONMENTAL KNOWLEDGE AND ATTITUDES

Cansu KESKİN

Department of Natural and Applied Science

MSc. Thesis

Adviser: Assoc. Prof. Dr. Hakan AKÇAY

The aim of the study was to investigate the effects of Water Explorer Program on students' attitudes and behaviours of water usage behaviour, attitudes and environmental awareness. The study designed as a quasi experimental research. It is conducted at a state school in İstanbul 2018-2019 semesters. Four classes of 8^{th} graders which consisted of 36 girls and 51 boys totally 87 students were the participants. . Each of the participants were randomly selected. Traditional lectures were processed in the groups which did not attend Water Explorer Program. Science projects from Water Explorer Program were processed at the groups which attended Water Explorer Program. Water usage attitudes, water usage behaviour and environmental awareness tests were applied to all groups before and after the study. In addition to pre-post tests reflection papers and worksheets were applied to Water Explorer Groups. Results of the study are that groups which attended Water Explorer Program were significantly better than other groups which did not attend the program at all tests. Therefore such projects should be increased in the science curriculum.

Key words: Water explorer, Sustainable Development, STEAM, Water Saving, Environment Education

ÖZET

ÇEVRE İLE İLGİLİ FEN PROJELERİNİN ORTAOKUL ÖĞRENCİLERİNİN ÇEVRE BİLGİ VE TUTUMLARINA ETKİSİ

Cansu KESKİN

Doğal ve Uygulamalı Bilim Anabilim Dalı
Yüksek Lisans Tezi

Tez Danışmanı: Doç. Dr. Hakan AKÇAY

Bu çalışmanın amacı Su Kaşifi programının öğrencilerin su kullanımı tutum davranış ve çevre bilinçlerine etkisini araştırmaktır. Deneysel olarak tasarlanmıştır..2018-2019 yılında İstanbul'da bir devlet okulunda uygulanmıştır. Katılımcılar 36'sı kız 51'i erkek olmak üzere 87 kişiden oluşmaktadır ve rastgele seçilim yöntemi ile belirlenmişlerdir. Su Kaşifi programına katılmayan gruplarda geleneksel fen müfredatı işlenirken, bu programa katılan gruplarda programın içindeki projeler uygulanmıştır. Çalışma öncesi ve sonrasında tüm gruplara su kullanım tutumu, su kullanım davranışı ve çevre bilinci testleri uygulanmıştır. Testlere ek olarak, Su Kaşifi gruplarına açık uçlu çalışma kağıtları verilmiştir. Çalışmanın sonuçları, Su Kaşifi programına katılan grupların, tüm testlerde programa katılmayan diğer gruplardan anlamlı derecede daha iyi olduğu yönündedir. Bu nedenle öğrencilerin su kullanımı, davranışı ve çevre bilincinin arttılrılması için fen müfredatında bu tür projelere yer verilmelidir.

Anahtar Kelimeler: Su Kaşifi, Sürdürülebilir Kalkınma, STEAM, Su Tasarrufu, Çevre

CHAPTER 1

INTRODUCTION

1.1 Literature Review

In this era, it is very easy to reach the information and its spread is very fast. This situation put trivial to the knowledge in the books. Now it is important learn to learn instead of memorable knowledge. The age where learning is part of life, there is a great importance at critical thinking skills and science literacy [1]. DeBoer defines scientific literacy a wide and functional understanding of science and use the science for educational purposes [2]. Although there are different definitions of science literacy, all of them include being able to use scientific knowledge in real life situations. Researches show that huge amount of the students knows scientific knowledge but they cannot use everyday life activities. The students think that science is not a part of life. One of the research about the topic is PISA. In PISA 2006 is about science. The research shows that only %1.3 of the students from OECD countries know science and apply everyday life perfectly [3]. Considering the fact that most countries want individuals who are able to use the science, it can be seen how low this rate is. Many countries want citizens who scientifically literate and their science curriculum focus on the topic. Turkish science curriculum also has the emphasis on scientific literacy since 2004. In 2006, 2013, and 2018, science literacy is always emphasized in the changing Turkish science curriculum.

Internet is allowed to spread information very quickly. People spend most of their time on the net. The time can be used in favor. According to Fauville, Dupont and Lundin internet should be used as additional learning environment. Although it is not a full social learning environment, it has a positive effect on learning [4]. Online education support learning by serving different options to different type of learners. It gives opportunity to collaborative learning which allow students to learn together. It also allows everyone to learn at their own pace. Right to repeat is unlimited. In view of these benefits, it would

be very helpful to use the internet in education but there may be some disadvantages other than the benefits. For some points such as dangerous situations, abstract concepts and lack of equipment technology is used to meet the deficit. Students cannot know how much they know. They may also be inadequate in the use of technology. Whatever happens in this educational environment, it is necessary to reform educational systems according to the requirements of the era [5].

The advancement and rapid dissemination of science and technology also rapidly changes the concept of dominating nature. This change leaves the environmental consciousness in the second place. This creates a society that produces and consumes as much as possible [6]. So, there is a need for individuals who are respectful and sensitive to nature. As a result of this change, individuals who are aware of environmental awareness, protection and sensitivity should be trained. According to Ilgar definition of the environmentally sensitive individual is that a human who avoids harming the environment, consciously produces and consciously consumes, is aware of its being a part of this environment and sensitive to environmental problems [7]. Such a human model emerges in cultures that are aware that the environmental problem occurring anywhere in the world affects the whole world equally. Environmental education is very important for the formation of this culture.

In line with the digital needs of our age, it is now almost indisputable that students should prepare for this world, especially in terms of developments in the informatics sector, and even they need to have an education in this area to increase their creativity. Therefore, in order to be able to keep up with the development as countries in the 21st century and to be able to lead further, it has become an important issue to transfer the skills in this field to the new generation in the most accurate way. One of the most important training systems developed to meet these requirements is STEM.

STEM training is defined as a teaching model that is formed by combining four important disciplines such as science, technology, engineering and mathematics. STEM aims to educate qualified individuals in all these areas, and is a mathematical approach to dealing with problems in daily life. It is an approach that allows students to think differently and increase their ability to search for new solutions for various processes. According to the definition in the literature, it is a method that can be applied both in the curriculum and outside the curriculum from preschool to postgraduate education.

The approach of integrating all the principles and benefits of STEM education into art or art is called STEAM. Taking STEM education to another level, STEAM adds art as a fifth discipline among science, technology, engineering and mathematics. STEAM enables students to learn by linking what they learn in these important areas with art practices, elements, design principles and standards. STEAM training, where boundaries and restrictions are eliminated, provides a learning environment full of curiosity, critical thinking, questioning and innovation. STEAM was used in the research instead of STEM.

In the 1970s, environmental education was first discussed at higher education level [20]. The aim of environmental education is to make students aware of environmental problems and to act the problems [8]. In Turkey as in other countries, interest in environmental education has increased in recent years. The research conducted on this subject between 2012 and 2016 in Turkey has increased significantly and it is foreseen that this increase will continue.

Environmental education which has a very important place in science education. It is also a must for sustainable environment. At the Rio summit United Nations were told to use the concept of environmental education for sustainable development instead of environmental education. Within the framework of sustainability, human beings will see themselves as part of the ecosystem and respect the natural life. Therefore, instead of constantly destroying nature, it would prefer to find alternative sources and to evaluate waste. Tilbury said that there are three different approaches of environment education [9]. These are in environment, about environment and for environment. About environment is giving environmental knowledge to students. Currently science education in schools include the about environment group. Education of in environment includes activity-centered training. It is aimed to improve the environmental awareness of the individual through the studies conducted outside the classroom. Applications combined with non-formal education can be given as examples. Lastly, for environment education is much more comprehensive education. In addition to other two it includes individual participation and environmental problem solving. It is a holistic perspective. Unfortunately, the education is given to schools is that about environment. It is theoretic. Problems which affects the continuation of natural systems is not possible with the theoretical education. PISA 2006 data also indicates the level of implementation of scientific knowledge very low in Turkey [3]. It can be also showed that theoretical education is not enough for individual who aware of his environment and its problems.

Even if the students know environmental knowledge very well, they have difficulty in practice. But the solution of this problem which affects the continuation of natural systems is not possible with the theoretical education. PISA 2006 data also indicates the level of implementation of scientific knowledge very low in Turkey [3]. It can be also showed that theoretical education is not enough for individual who aware of his environment and its problems.

The research based on the last of these three approaches so “for environment”. Water exploration program was used in this study. The program gives information about the environment. It enables students to use this information with student-centered applications. It has a part of informal education. It improves empathy ability and gives the message of protecting the resources of the whole world and if it is trouble somewhere in the world this affects all countries [10]. In this respect, Water Explorer program enters the “for environment” which is exactly the desired environmental education.

According to Bahar and Kiras, only 5 percent of the work done between 2000 and 2016 in Turkey is related to the environment. The majority of these studies have been done in recent years. This indicates that a trend towards environmental issues in recent years [11]. The reason for the increase of studies may also be the emphasis on this issue recently in the curriculum. Since 2000, a total of 56 master's thesis and 14 doctoral theses have been published in Turkey. Research subjects of the master thesis environmental are education, environmental attitudes, environmental problems, environmental awareness, environmental literacy, science and technology program, sustainable environment, biodiversity, environmental knowledge, environmental identity, eco-school, environmental recycling, nature perception, environmental pollution, carbon footprint and global warming. The subjects are ranked as decreasing according to frequencies [14]. Some subjects are being processed while some subjects are not considered at all [15]. The most preferred group in thesis were primary and secondary school students.

In Turkey, newly increased for the study of environmental issues in general while other countries are specialized topic of water. When the studies carried out within the scope of environmental education are examined, it is seen that most of them talk about the efficient use of energy and protection of the environment in Turkey. There is an emphasis on water resources, water saving in the world. Contrary to the trend in the world, in Turkey there is no specific study on water [16].

Turkey is a country which is rich in water, counting before the year 2000. Today takes place in groups of countries experiencing water shortages. It is estimated that in the next 20 years it will fall into the water poor countries [17]. According to the Turkish Waste Report published in March 2017, those who wasted the most water are university graduates and those who save money are primary school graduates [18]. This is an indication of the failure of traditional environmental education. According to the report of United Nations will start water storage in 2025 [19]. Therefore, it is a necessity to train future generations to use water resources economically. This study was carried out by using water exploration program and focused on water education by mentioning sustainable environmental and environmental awareness issues.

1.2 Objective of the Thesis

The aim of the study is that to determine the effect of informal educational activity: Water Explorer Program at sustainable development topic on 8^{th} grade students' attitudes of water usage, behavior of water usage and environmental awareness.

1.3 Hypothesis

Is there significant difference at students' attitudes of water usage between pre-test and post-test with respect to Water Explorer Program education?

Is there significant difference at students' behavior of water usage between pre-test and post-test with respect to Water Explorer Program education?

Is there significant difference at students' environmental awareness between pre-test and post-test with respect to Water Explorer Program education?

1.4 Research Question

As an educator I aimed to research the effect of the program on students' attitudes of water using, behavior of water using and environmental awareness.

CHAPTER 2

GENERAL INFORMATION

2.1 Environmental Education

Science education are concepts of ideas or events that helps people examine the world they live in [20]. It is given theoretically in schools [7]. Environmental education is separated from science education at this stage. [21][22].Science education generally focus on teaching knowledge and skills but environmental education focuses on changing behaviors and incorporation of values [23].

The rapid advance of science and technology also changes the concept of dominating nature very quickly. This change leaves the environmental consciousness behind. There is a society that can reach everything and consume it constantly. There is a need for people who consciously produce and consciously consume, avoiding harm to the environment, are sensitive to environmental problems and can understand that they are part of nature. These individuals may be possible with environmental education [7]. They regarded scientifically literate person in particular can be called environmentally literate. According to Kışoğlu environmental behavior is a concrete indicator of the individual's environmental knowledge, attitudes, skills, and active participation in activities that contribute to the solution of the environmental problem [24]. The actual behavior shown for the protection of the environment is considered as environmental behavior. These behaviors are included in the literature as environmentally friendly behavior [25]. For an individual to be an environmental literate, only knowledge of ecology is not sufficient. If the individual exhibits environmental friendly behaviors as well as his / her knowledge, then the individual is considered as an environmentally literate [26].

Environmental education is also needed for saving world resources in order to prevent environmental problems. This topic is covered under the title of environmental education for sustainable development. Environmental education under this heading is divided into three [9]. These are “about environment”, “in environment” and “for environment”. About environment is a form of environmental education in schools. It aims to provide information to students about environment. In environment training covers extracurricular activities. The activities are student centered. They aim to develop the environmental awareness of individuals and to increase their interest in nature. Purpose of for environment training is that ensure environmental progress. In addition to other trainings, for environment aims to develop individual responsibilities and to take active role in solving environmental problems. For effective environment education for sustainable development, all their forms of environmental education are required.

2.2 Scientific Literacy

According to Haufler and Sundberg public does not know very much about science and that is one of the major problem for science [1]. Science education contributes to ability of understanding of using science in daily life and social responsibility. Many countries in the world want knowledgeable citizens who can make their own decisions. Such citizens are called scientifically literate. Natural research council defines scientific literacy is knowledge and a science process that make decisions about everyday life activities, social participation, culture and economic productivity [27]. Moreover international students’ assessments define scientific literacy ability to use scientific knowledge, draw evidence based conclusions and modification made by human activity. There are different definitions about scientific literacy. Common points of all definitions are the ability to use and evidence and data, evaluate the quality of information and discuss presented by mass media and scientists [28].

Shen classify scientific literacy into three categories that cultural scientific literacy, civic scientific literacy and scientific literacy practice. Cultural scientific literacy means understanding science as a person who have average intelligence and education of a culture. Civic scientific literacy making decisions using scientific information that is necessary a person. Scientific literacy practice is that a person has knowledge of problem solving such as how to illuminate the house becomes more economical.

2.3 Non-Formal Education

Non-formal education defines an education for those who have never been able to benefit from formal education, those who leave early from their school or those who are studying in formal education institutions and those who want to become more qualified in the profession. Now the definition of non-formal education is changing. It is widely accepted as a sub-system of educational system at almost all developed countries [29]. Not only adults but also children benefit from the non-formal education with their formal education at the same time. With the development of technology, the opportunities for non-formal education have increased a lot. The internet allows development of any knowledge especially science. People can receive any education from anywhere in the world through distance education.

In the information culture, interactive activities have gained great importance [30]. Mackey and Jacobson define a concept known as information literacy. It provides higher order thinking and requires to engage various media format and documents in collaborative internet environments [31]. Formal education is insufficient to these topics. Moreover, most education like environmental education wants lifelong learning process. This is also provided by informal education.

2.4 Sustainable Development

In today's world, if the current growth trend in food production, natural resources depletion, and industrial growth will continue, our planets resources and will be based on the border in the next century. When the last 200 years, the harmful effects of human activities on earth have increased. Because of the activities, environmental problems occur, natural resources are consumed unconsciously, the habitat of living spaces are damages and many species are extinct [32]. Because of these situations, sustainable development education is one of the important part of science curriculum. Dragoş and Mih says that "Science *education has a beneficial role in the knowledge of the surrounding world.*"

In Turkey science curriculum, there is a focus on sustainable development since 2004 [33]. At 2013 science curriculum sustainable development define as the issue of sustainable development includes the fulfillment of the needs of future generations by using natural resources economically, the development of awareness of the individual social and economic benefits of saving use. There are two kinds of sustainability: weak

and strong [34]. If economic growth is the primary objective, this is weak sustainability. The economies of today's countries are mostly based on capitalism. The production consumption chain requires a continuous spiral structure. The continuation of this depends on the environmental resources. Resources should therefore be protected. This is often the case with the emphasis of developing countries. The production-consumption chain requires a continuous spiral structure. The continuation of this depends on the environmental resources. Resources should therefore be protected. The aim of strong sustainability is to protect the environmental raw material. The procurement of all raw materials is realized in accordance with the ecosystem of production consumption and the recycling process of waste.

2.5 Project-Based Learning

Project-based learning is that students work individually or in groups to reveal concrete products. It is not new educational approach. It has long historical background but it is different from traditional teaching methods. Projects based learning is students centered. According to Oğuzkan project-based learning is a mixture of John Dewey's "problem solving" and Wrigley's "The project method" [35]. Project based learning consist of four elements. These are extended time frame, collaboration, an investigation or research and a task-based performance or a demonstration [36]. Project needs time varying between two or three lessons to a whole year of the education [37]. Students can work as a teams. In this way, time can be used effectively. Projects focus on real world situations [38]. It requires real world problem that is related to the students' everyday life. At the end of the project, a presentation, a performance or a product should occur [39].

This approach has both advantages and disadvantages. Project based learning increases student motivation [40]. Students are more involved science education in doing the projects themselves. Projects develop a lot of high level skills such as problem solving, evaluating themselves, being and independent researcher. Project based learning in this way, develops the knowledge and skills of the student. It is also increased collaboration between students who work with a groups. Students can learn how they work and produce as a team [41]. Moreover, project based learning provides interdisciplinary work opportunity [42]. Students can combine mathematics, science, literature and social science knowledge and can answer open ended questions related to the projects.

Project based learning has some limitations. The learning approach is not suitable for all topics. It is difficult to choose a topic for the aims from curriculum [43]. Moreover, it takes extended time [44]. The time allocated in the curriculum may not be sufficient for the projects. It is difficult to design some issues for teachers. What should the students know? At which level knowledge they research? Do students have the technology do the research? Finally, the project outputs are difficult to assess for teachers. Teachers more guide and less lectures.

2.6 Collaborative Learning

All individuals are different. For this reason, the learning style and speed of all individuals will vary. Some learn visual while others are verbal. In this era, it is important learn to learn and each individual is aware of his / her own learning style and speed [45]. It is also significant to plan the learning according to these. Traditional methods do not allow each student to learn in their own learning style and speed. Therefore, different methods are needed. One of the different methods developed for this sake is collaborative learning. This learning style enables students to learn in their own styles while at the same time increasing their academic success and improving the attitudes and interests of the students in relation to their subject area.

Collaborative Learning is the process of realizing the learning by helping students learn each other in small groups [46]. According to Demirel, it is to solve a problem in small groups or to work together for a common purpose [47]. There are many methods of collaborative learning. The most well-known method is jigsaw. In this method, subjects are distributed to groups. It is divided into sub-dimensions. Each student is responsible for a sub-dimension. Students who are responsible in the same sub-dimension form a specialized group. When they finish their studies, they return to their first group and tells them about their sub-dimension. Another method is that groups work together for a specific project or problem and each group finds its own solution. In this study, collaborative learning has been used as a working together of students for a specific problem.

2.7 Science Technology Engineering Art Mathematics (STEAM)

STEM is an abbreviation science, technology, engineering and mathematics and it can be defining as connection between activities and materials, measuring, and understanding student learning and connection across disciplines [48]. It can be also defining design

problem, exploring the problem, creating solutions to the problem and artifacts [49]. In STEM education, in addition to science and engineering knowledge, it is also important to practice and problem solving skills [50]. It is very important for individuals to make their own decisions about the problems they face in their daily life. STEM education purpose is to enable people to make their own decisions in the light of science. Science and engineering deals with a lot of issues dealing with people. Health problems, environmental problems and developments related to technology are issues that affect people's lives very closely. This makes it necessary to know different disciplines. Stem education has emerged as an education to meet all these objectives.

STEM education is not a new approach. American Association defines science as a discipline linked with other disciplines [51]. AAAS reports said that mathematics is a language of science [51]. The first to use STEM is at the undergraduate level [52]. Then researchers realize that students lose their science interest in earlier grades [53] [54]. After the situation, STEM education go into even primary schools' levels.

Krajcik and Delen clarify challenges of incorporating STEM education. Accordingly, a subject and purpose should be determined first. The course layout and plan must be prepared in advance. Solutions should be considered in order to involve and motivate students. Students should be allowed to do more than one experiment. Feedback should be given at every stage and students should be supported. It is necessary to ensure that the students base their studies on scientific knowledge. This should be emphasized continuously. Finally, student studies should be evaluated and feedbacks should be given for further studies.

STEAM is a form of STEM education. It also includes art. There is a debate about what is art which is found in STEAM education. Grinnel and Angal says that art is not the real meaning of the art itself. It is projects-based learning [55]. Sullivan notes that art can be viewed as more scientific, technological and practical [56]. Moreover, it will be an advantage for girls who have a low scientific attitude and interest to enter into a design and creativiy even if they are scientific[57]. For all these reasons STEAM was used in the research instead of STEM.

CHAPTER 3

METHOD

This chapter consists of participants, instrumentation, research design and procedure part.

3.1 Research Design

Experimental research type is best for testing hypothesis [58]. The research is conducted a state school in İstanbul. At the beginning of the study pretests: water use attitude scale (wuas), water use behavior scale (wubs) and environmental awareness scale (eas) are done all the students who are participate the study. After doing science projects during the four weeks, posttests: water use attitude scale, water use behavior scale and environmental awareness scale are done all the participants. In addition to this, students who are in experiment classes wrote reflection papers about water usage and our projects application. Then the students done worksheet about water usage.

Table 3.1 Applied Tests

CLASSES	PRETEST	APPLICATION	POSTTEST
CONTROL CLASSES	WUAS WUBS EAS	Traditional science education	WUAS WUBS EAS
EXPERIMENT CLASSES	WUAS WUBS EAS	Science education with environmental science projects about water	WUAS WUBS EAS

3.2 Instrumentation

3.2.1 Water Explorer Program

Water Explorer Program is an educational program that strengthens students across the world to lead action on water issues. The main producer of the program Global Action Plan which is a charity that is working for a green and thriving planet. It is also supported HSBC water program. The program has a website which has ready lesson resources for both teachers and students about water education. Students from schools which participate water explorer program can register the website and share their experiences and photos during the water education lessons and write blog posts about the education. The students can also read other schools' blog posts look their activity photos and comment or like them. All schools have a virtual water basin in a site. As the schools do the water activities their water basin is flourishing.

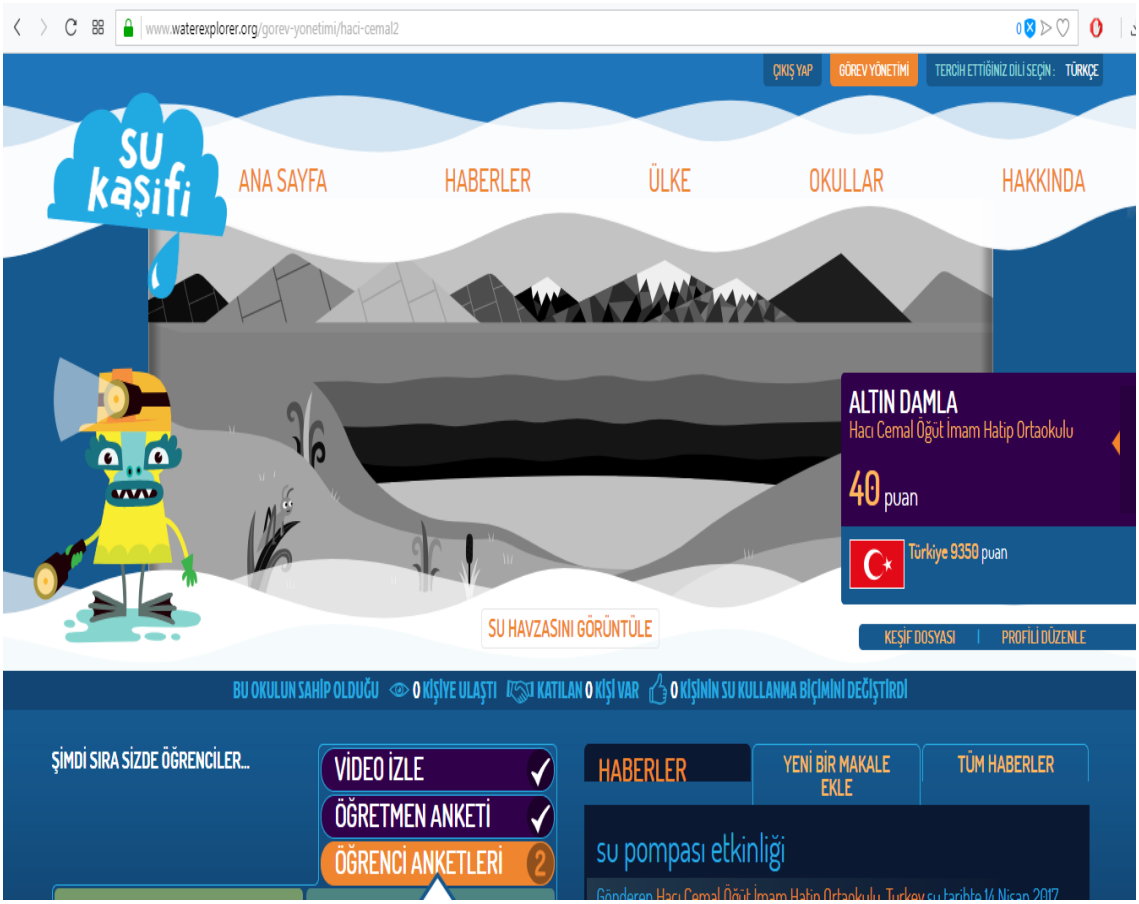

Figure 3.1 Water Explorer Website Homepage

Moreover, the website provides an international communication about water issues between schools which register the Water Explorer Program. The schools earn points from their activities, blog posts and comments about water issues.

Figure 3.2 Water Explorer Website

Water explorer program collects water savings four main titles. There are Fresher Water, Global Water, Secret Water and Precious Water. Fresher Water focus on issues that threaten clean water resources. The title emphasizes to protect existing water resources. Global Water focus on difficulty of reaching clean water for each individual. In addition, the title aim to recognize the inequality of the water resources use in the world. Third title of the water explorer program is that Secret Water. It focuses on where water is hidden in our food, clothes and other thing that we use everyday life. The last title is precious water emphasized that find ways to save water resources and money. It is also emphasized that not to waste our water resources.

At the end of the program, first 15 schools with the highest scores are selected by project coordinators. The water workshops are done to the schools by the coordinators. Then the 15 schools organize a water festival in their schools or in a local community organization they want. After the organization, project coordinators choses the first five schools. The

scores that are used to choose winner are not only from the websites. The project coordinators have a look at numbers of missions and challenges completed, evidence of impact of actions, total points earned, quantity and quality of blog posts, evidence of collaboration with local community and other schools' groups and good team working and demonstration of the water explorer values. The finalist school represents Turkey among 11 countries. Although this year is the fourth year of the program, Turkey was world winner two times. A state school in Kocaeli and a foundation school in İstanbul were world winner of the water explorer program.

3.2.2 Water Use Attitude Scale (WUAS)

Water use attitude test is developed by Eylem Yıldız Fevzioğlu, Ercan Akpınar, Gül Ünal Çoban Evren Capellaro, Ömer Ergin. 28 subscales of the items were applied 109 participants who selected randomly sampling. Then factor analysis was applied. T values calculated for all items are significant. ($p < 0.05$) [59].

According to the results of factor analysis, the attitude scale has a two-factor structure. Results of total correlations which is to determine reliability of dimensions' internal reliability coefficient of water use attitude test is 0,82. This value shows that the scale have high internal consistency. In the final form of the water use attitude scale consist of 12 items with Likert type 5 grading scales. "Absolutely Agree" (5), "Agree" (4), "Hesitant" (3), "Disagree" (2), "Absolutely Disagree" (1) statements are used. Scale has two negative items which are 3rd and 12th. The items overturned when they calculated. The respond time of the test max 10 minutes. The highest score of the scale is 60 and the lowest is 12.

3.2.3 Water Use Behavior Scale (WUBS)

Water use attitude test is developed by a group who develop water use attitude tests. 24 subscales of the items were applied 109 participants who selected randomly sampling. Then factor analysis was applied.

T values calculated for all items are significant. ($p < 0.05$)

According to Doğan (2002) if the first factor variance rate is less than 30% and the eigenvalue of the first factor is 3-3.5 times the eigenvalue of the second factor, the scale can be accepting is a single factor [60]. Hence, the eigenvalue of the first factor is 5.5 times the eigenvalue of the second factor, the scale is accepted as a single factor scale. Final form of the scale consists of 13 items and its Cronbach α internal consistency

coefficient is 0.87. This shows that scale internal consistency is high. Water use behavior scale consist of 13 items with Likert type 5 grading scales. “Absolutely Agree” (5), “Agree” (4), “Hesitant” (3), “Disagree” (2), “Absolutely Disagree” (1) statements are used. The scale has a negative item which is 12^{th}. The item overturned when it is calculated. The respond time of the test max 10 minutes. The highest score of the scale is 65 and the lowest is 12.

3.2.4 Environmental Awareness Scale (EAS)

Özdemir (2003) developed the environmental awareness scale used in the research [61]. The reliability coefficient of the scale was 0.86 and it consist of 24 items. The items are likert type 5 grading. “Absolutely Agree” (5), “Agree” (4), “Hesitant” (3), “Disagree” (2), “Absolutely Disagree” (1) statements are used. Scale has negative items which are 1^{st} ,3^{rd} ,5^{th} ,7^{th} ,9^{th} ,11^{th} ,13^{th} ,15^{th} ,17^{th} ,19^{th} ,21^{st} 23^{rd} and the items overturned when they calculated.

3.2.5 Reflection Paper

The reflection paper applied after the doing environmental science projects about water issues during lessons. It is formed by researcher and at the end of the application process to gather qualitative data from students. The answer of the students is evaluated by using categorization and frequency table.

3.3 Participants

Totally 4 classes two of which are control and two of which are experiment participate the study. Application is done by the researcher both experiment and control classes. 87 8^{th} grade students participate the study. Their age is range from 13 to 14. 51 (58.6%) of the students are girl and 36 (41.4 %) students of them are boy. Two classes consist of only girls and other two classes consist of only boys. A girl class and a boy class are selected experiment and the others are selected control randomly.

Table 3.2 The Number of Participants

Class	Number of Boys	Number of Girls
Experiment 1	18	-
Control 1	18	-
Experiment 2	-	24
Control 2	-	27
TOTAL	36	51

3.4 Procedures

The study is applied 2 control and 2 experiment classes by same teacher who is researcher of the study. Before the water education lessons, teacher who apply the study participate water explorer workshops. The workshops give information about both water explorer program and its implementation at schools. Then, Hacı Cemal Öğüt İmam Hatip Secondary School is registered the water explorer program. Students were announced the program and water explorer website was introduced. Students participated the program voluntarily. If a student in a class who does not want to participate the water explorer program did not participate the activities. Parental permissions of the students who want to attend the water explorer program were collected.

Water explorer program collects water savings four main titles. There are Fresher Water, Global Water, Secret Water and Precious Water. A water project activity from each titles is chosen in this study. The choice was made according to conditions of the school and students by the researcher. Application of the study lasted four weeks. After each week water education activities students share their opinions blog posts at the websites and they also share their activity photos. Each week a different activity from one title was performed. After application post-tests are implemented to all participants.

3.4.1 Introductory of Water Lessons

Water explorer activities were processed in accordance with the title of the Science Engineering, Technology, Community and Environment (FMTTÇ) in science

curriculum. The activities are in a harmony with sustainable development which is the basic philosophy of the science curriculum.

3.4.2 First Week Application of Water Lessons

Objective of the first week lessons is that students know what pollutes our planet's resources. We focus on resources especially water. The first week application of the study takes four lessons. A water explorer activity which is known "Drain" was used in first week. The activity is under the title of fresher water.

At the beginning of the class, photos of dirty water resources are shown to students and predictions of this dirtiness are requested from them. Worksheet which consist of questions about water pollution are distributed to students. After doing the worksheet, each group was given a computer and groups research questions on the web. When the whole groups were done research, what can be done about preventing water pollution was written on board. A presentation about water pollution and water resources was shown the groups. Then groups developed some projects for not polluting water resources. Groups projects were voted on. The project which is collection waste oil with the highest number of votes was implemented. All classes at school except 8^{th} graders were announced. At the end of the 1 month, the most waste oil collection class was awarded. Waste oil which collect scope of the project were given to the municipality. Although, the lessons lasted 4 hours, the project continued 1 month. At the end of the four hour lessons, worksheet consist of open ended questions were given to the students. Experimental group students wrote blog posts on the website after first week water lessons. Moreover, experimental groups students were visited the local water treatment facility. They learned things that should not be thrown out of the drain pipe.

At the control groups, objectives were treated by the method of the invention. Same as experimental group at the beginning of the class, photos of dirty water resources are shown to students and predictions of this dirtiness are requested from them. The students research about the topic. But control group was not to do any project about the preventing water pollution. Moreover, the groups were not any blog post. They were not use website.

3.4.3 Second Week Application of Water Lesson

The second application of the study takes four hours. The objectives of the second week were to produce ideas for the water saving and to raise awareness of water use in other countries. Name of activity which is apply second week "A Day in Life". Each groups

were given a worksheet showing the water use habits of some countries. While a country consumes 350 liters per a day, other consumes only 40 liters per a day. The worksheet which is used were taken from water explorer website. Groups were asked to the specific tasks special their countries by using water given to them. Once the tasks were completed, each country-specific problem card was given to the students and they were expected to solve these problems with their waters. Then all groups comparison water usage habits their specific countries and Turkey. Each groups were discussed for equal use of water of the countries in the world and what can be done to avoid wasting water especially in some countries. Measures were written on the board and to-do list was prepared. According to list students can examine the toilets in the school. If there is a leaky faucet or a faulty siphon, it can be reported to the school administration. Moreover, they started to study for opening water well in a country that have very lack of clean water. At the end of the second week activities, a worksheet was given to the students. The worksheet was prepared by the researcher paying attention to week objectives. It consists of three open-ended questions.

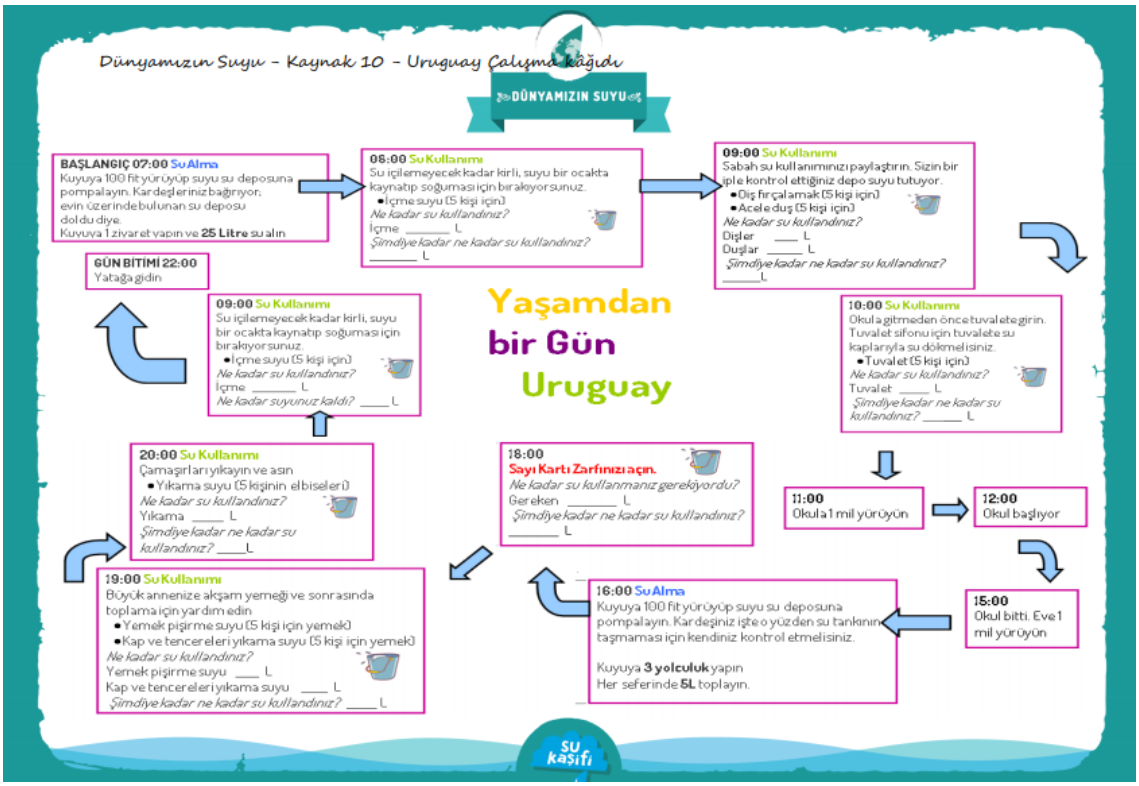

Figure 3.3 Worksheet Sample

At the control groups, traditional science lessons about the saving our planet resources were processed. A video about the topic was shown to the control group students. Then, exercise in the book was done by them.

3.4.4 Third Week Application of Water Lessons

The third application of the study takes four hours. The objectives of the third week same as one of the second week objectives was to produce ideas for the water saving. Name of activity which is apply third week "Fashionable Water". The activity is under the water explorer title of secret water. At the beginning of the third week activities, water conservation issues which were discussed previous week are reminded the students. It was asked to students that if we have only this way for saving water, or not. It was also asked that is there water in the clothes or not? By asking the students to help them discover the hidden water in their goods. If a single paper spends 10 liters of water and a cup of coffee spends 130 liters of water, they are asked to estimate how many liters of water are needed to produce a cotton t-shirt. After prediction, it was said that 2700 liters of water was wasted. The amount is equal the water which 900 days drinking of a person. It was discussed that what can be done to prevent this waste was. Then some project ideas were developed and one was chosen in them. Everyone brings his/her belongings to the class and trades them with his/her friends. Thus, students were not consuming water to buy new items and they access to the objects that can be used. Number of objects were exchanged was noted. The approximate number of water saving was calculated with information about water explorer program and it hanged on to the classroom. Moreover, some students convert their old t-shirt to a bag. Before and after photos of the t-shirt were showed to the class. At the end of the activity a worksheet was given to students. The worksheet was taken from the water explorer program.

At the control groups continued the traditional lessons. Its objective same as experimental groups was to know using resources economically. A presentation was done to the groups and then students did activities in their science books.

3.4.5 Fourth Week Application of Water Lessons

The third week application also take four hours. Objective of the fourth week lesson was that knowing how to use natural resources. The activity's name is Rain Water Barrel and it is under the water explorer title of precious water. According to this activity, at the beginning students was asked if there are other ways to save water. Then a question that

how to use rain water in our everyday life was asked them and let the one more minute think to the question. Then ideas written on the blackboard. The amount of rain falling to district which was the school is located was investigated. Various tools for collecting rainwater were discussed. Barrels were accepted for the purpose and these tools were placed in appropriate places of the school. Estimated water collection is calculated according to the rainfall. How much water were collected in a week was noted? After the barrels are filled, the school cleaning staff was asked to use this water for cleaning the school. At the same time, some of water were taken to the laboratory for using cleaning.

The control groups lessons objective was same as experimental groups. Saving water and energy part of the science books was read the lessons. Then students noted their everyday energy and water usage. A class discussion about saving energy/water and its advantages economy of their country. At the end of the week exercises from the science book were done.

Table 3.3 Sum of Application of the Study

# of Weeks	Water 1	Water 2	Control 1	Control 2
1st	Drain Activity (Water Explorer Program)	Drain Activity (Water Explorer Program)	Invention Water Pollution (Traditional Science Lesson)	Invention Water Pollution (Traditional Science Lesson)
2nd	A Day in Life (Water Explorer Program)	A Day in Life (Water Explorer Program)	Saving Planet Resources (Traditional Science Lesson)	Saving Planet Resources (Traditional Science Lesson)

Table 3.3 Sum of Application of the Study (Continue)

# of Weeks	Water 1	Water 2	Control 1	Control 2
3rd	Fashionable Water (Water Explorer Program)	Fashionable Water (Water Explorer Program)	Saving Planet Resources (Traditional Science Lesson)	Saving Planet Resources (Traditional Science Lesson)
4th	Rain Water Barrel (Water Explorer Program)	Rain Water Barrel (Water Explorer Program)	Saving Water and Energy (Traditional Science Lesson)	Saving Water and Energy (Traditional Science Lesson)

CHAPTER 4

RESULTS AND DISCUSSION

4.1 Results of Applied Tests

Table 4.1 Means and Standard Deviation of the WUBS Pre-test and Post-test Scores between Class

Class	N	Pre Tests		Post Tests		Pre-Post Tests
		Mean	Standard Deviation	Mean	Standard Deviation	Mean Difference
Experiment 1	18	3,05	0,61	3,80	0,41	0,75
Experiment 2	24	3,09	0,47	3,77	0,95	0,68
Control 1	18	2,95	0,63	2,93	0,68	-0,02
Control 2	27	2,82	0,39	2,79	0,50	-0,03

Table 4.1 shows that the WUBS's mean and standard deviation of the control and application groups' pre and posttests. The lowest mean score of pretest is observed control 2 group and the highest mean score is observed experiment 2 group. The lowest mean score of posttest is observed control 2 and the highest score is observed experiment 1 group. The increase of the experiment groups' mean score of WUBS is higher than the control groups' mean score of WUBS. The increase is in the scores of the t experiment groups after the intervention. (Experiment 1pre =3,05 Experiment 2post =3,80; Experiment 2pre =3,09 Experiment 2post =3,77)

Table 4.2 Means and Standard Deviation of the WUBS Pre-test and Post-test Scores between Gender

Gender	N	Pre Tests		Post Tests		Pre-Post Tests
		Mean	Standard Deviation	Mean Difference	Standard Deviation	Mean Difference
Female	51	2,94	0,45	3,25	0,90	0,31
Male	36	3,00	0,62	3,37	0,71	0,37

Table 4.2 shows that the WUBS's mean and standard deviation of the female and male pre and posttests. Female groups' mean is lowest male ones in both pre and posttests. Groups mean increased themselves. Males are more successful than females at water usage behavioral scale. (Femalepre =2,94 Femalepost =3,25; Malepre =3,00 Malepost =3,37)

Table 4.3 The effects of Water Explorer Program-based instruction on the WUBS

Dependent variable: Post Test						
Source	Type III Sum of Squares	df	Mean Square	F	Sig.	Significant Differences
Intercept	1673,895	1	1673,895	3288,166	.000	Exp1-Con2 Exp2-Con2 Exp2-Con1
Class	14,392	3	4,797	9,424	.000	
Gender	0,281	1	0,281	0,424	0,517	
Error	42,253	83	0,509			

An ANCOVA test conducted to determine the significance difference between the control and experiment groups in terms of their water usage behavioral test after the application

of Water Explorer Program based instruction. The results indicated that the application had significant impact on water usage behavioral test scores of students.

Analysis of ANCOVA indicated that there are significance differences among classes. To find out significance differences post-hoc comparison was made the results indicated that there are significant differences between Exp1-Con2 groups and the differences is 0,001; Exp2-Con2 groups significance differences value is 0,000; Exp2-Con1 groups significance differences value is 0,013.

Table 4.4 Means and Standard Deviation of the WUAS and its Subtitles

	N	Mean	Standard Deviation	Mean Difference
WUAS pre	87	2,9	0,45	0,0
WUAS post	87	2,9	0,52	
Sustainable Water Pre	87	2,6	0,55	0,6
Sustainable Water Post	87	3,2	0,72	
Saving Water Pre	87	3,3	0,87	-0,5
Saving Water Post	87	2,8	0,60	

Table 4.4 shows that the WUAS's and its subtitle's mean and standard deviation of the control and application groups' pre and posttests. The lowest mean score of pretest is observed sustainable water subtitles and the highest mean score is observed subtitle of saving on water. The lowest mean score of posttest is observed subtitle of saving water and the highest score is observed subtitle of sustainable water. Only subtitle of sustainable development is increasing. Subtitle of saving on water is decreasing. There is no difference between mean of the pre and posttests at water usage attitude tests. (WUAS pre =2,9 WUAS post =2,9; Sustainable Water pre =2,6 Sustainable Water post =3,2; Saving on Water pre 3,3 = Saving on Water post= 2,8)

Table 4.5 p and t Values of Pre-Post Tests of WUAS and its Subtitles

	N	Mean	Standard Deviation	sd	t	p
WUAS pre	87	2,9	0,4	86	-4,267	,000
WUAS post	87	3,2	0,7			
Sustainable Water Pre	87	2,9	0,5	86	-3,984	,000
Sustainable Water Post	87	3,3	0,9			
Saving Water Pre	87	2,7	0,5	86	-2,110	,038
Saving Water Post	87	2,8	0,6			

After Water Explorer Program lessons, there is a significant difference between pre and posttest of water usage attitude scales. (t= -4,267, $p < .05$) There is also significant differences between pre and posttests of subtitle of sustainable water. (t= -3,984, $p < .05$) There is also significant difference between pre and posttest of subtitle of saving water. (t= -2,110, $p < .05$)

Table 4.6 Multiple Comparison of WUAS Between Classes

	N	Mean	Standard Deviation	Experiment 1	Experiment 2	Control 1	Control 2
Experiment 1	18				p>.05	p< .05	p>.05
Experiment 2	24			p>.05		p< .05	p< .05
Control 1	18			p< .05	p< .05		p>.05
Control 2	27			p<.05	p< .05	p>.05	

Table 4.6 shows that there is significant difference between experiment1 and control1, experiment2 and control1, experiment2 and control2 classes. There is also significant difference between control 1 and experiment 1, control1 and experiment2, control2 and experiment1, control2 and experimetn2 classes ($p < .05$) There is not found significant difference between experiment1 and experiment2, experiment1 and control2, experiment2 and experiment1, control1 and control2 classes.

Table 4.7 MANOVA test scores of WUAS

	Wilks' Lambda	F	Df	p
Time	0,822	18,414	1	.000

Table 4.7 shows that according to do one way of MANOVA analysis, there is a significance between experiment and control classes in terms of unified variables at water usage attitude scale. ($F= 18,414$, $p < .05$)

Table 4.8 Means and Standard Deviation of the EAS Pre-test and Post-test Scores between Class

Class	N	Pre Tests		Post Tests		Pre-Post Tests
		Mean	Standard Deviation	Mean	Standard Deviation	Mean Difference
Experiment 1	18	2,68	0,22	2,85	0,18	0,17
Experiment 2	24	2,87	0,22	3,00	0,12	0,13
Control 1	18	2,80	0,23	2,81	0,26	0,01
Control 2	27	2,80	0,21	2,75	0,21	-0,05

Table 4.8 shows that the Environmental Attitude Test's (EAS) mean and standard deviation of the control and experiment groups' pre and posttests. The lowest mean score of pretest is observed experiment1 group and the highest mean score is observed experiment 2 group. The lowest mean score of posttest is observed control 2 and the highest score is observed experiment 2 group. The increase of the experiment groups' mean score of EAS is higher than the control groups' mean score of EAS. The increase is in the scores of the t experiment groups after the intervention. (Experiment 1pre =2,68 Experiment 2post =2,85; Experiment 2pre =2,87 Experiment 2post =3,00 Control 1pre= 2,80, Control 1post= 2,81, Control 2pre= 2,80, Control 2post= 2,75)

4.9 Table The effects of Water Explorer Program-based instruction on the EAS

Dependent variable: Post Test						
Source	Type III Sum of Squares	df	Mean Square	F	Sig.	Significant Differences
Intercept	3120,510	1	3120,510	11820,446	.000	Exp2-Con1 Exp2-Con2
Class	1,969	2	0,985	3,729	.028	
Error	21,647	82	0,264			

An ANCOVA test conducted to determine the significance difference between the control and experiment groups in terms of their environmental attitude test after the application of Water Explorer Program based instruction. The results indicated that the application had significant impact on environmental attitude scale test scores of students.

Analysis of ANCOVA indicated that there are significance differences among classes. To find out significance differences post-hoc comparison was made. The results indicated that there are significant differences between Exp2-Con2 groups significance differences value is 0,022; Exp2-Con1 groups significance differences value is 0,04.

4.2 Results of Reflection Papers

Reflection papers were applied after the implementation of water lessons. The duration was four weeks. The reflection paper results showed that nearly 90% of the students were

happy to participate Water Explorer Program. Nearly 10% of the students have no ideas positive or negative towards the program. None of the students who participate the study have negative view of the program.

Student 20 said that *"I would like to join the program again because it was so much fun. I was especially excited about the projects I made with my friends and the exchange markets we established at the school and informed me about the water*."

Student 30 said that "*It was the best program I am attended. I liked the activities that we do very much. They were all very nice. I'm always happy to do it again.*"

Student 17 said that "*The activities were nice but I don't know if I would attend again.*"

Student 1 said that "*I save water and energy in my home. Hence the program does not change my behavior about water."*

Table 4.10 Students' View of Participating Water Explorer Program

	Numbers of Students	**Percentage %**
Satisfied Participating the Program	39	90
No Opinion	4	10
Regret the program	-	-

Students generally said that Water Explorer Program have an effect on their water usage. Nearly 88% of the students said that they did not waste water any more. Nearly 9% of the students said that they have no idea about their water usage. Nearly 2% of the students said that their water usage did not change. They were continued to waste water.

Student 3 said that "*I have no idea about I save water or not. Before I am not thinking about saving.*"

Student 7 said that "*I think I have used less water already, so it didn't change my behavior*."

Student 21 said that "*I used to drain the water in the faucet to bring hot water. Now I'm using a bucket… I also warn the households to use water-saving."*

Table 4.11 Awareness Level of Students

	Number of Students	**Percentage %**
Raised Awareness	38	88
Undecided.	4	9
Not Raised Awareness	1	2

Reflection papers those who save water were examined again. The reasons which did not wasting water were collected under 3 headings. These are "Other countries attract water scarcity." "For economy and future of our country." "Our world of running out of resources." 71% of the reflection papers focused on that we must water economically because other countries in the world have not enough water. 18% of the reflection papers mentioned about that we must water economically because of the economy and future of our country. 37% of the reflection papers mentioned about that we must use water economically because our world of running out of resources. 10% of the reflection papers mentioned about both of other countries' water scarcity and economy and future of our country. 26% of the reflection papers mentioned about both other countries' water scarcity and our world running out of resources. Nearly 10% of the students said that they use water economically but they did not base on a reason.

Student 40 said "*I had heard that there was no water in African countries, but I didn't know their condition was so bad. It made me very sad that we were the reason for this."*

Student 27 said that "*The water resources of our world are distressed and this is actually the concern of everyone in the world. For this, everyone needs to save water*."

Student 19 said that "*In order for our country to come to better places, it is necessary to contribute to the economy by using our resources economically*."

Table 4.12 Students' Water Saving Reasons

Heading of	Number of Students	Percentage %
Other Countries' Water Scarcity	13	35
Economy and Future of Our Country	3	8
World's Limited Resources	4	11
Both of Economy and Future of Our Country and Other Countries Water Scarcity	4	10
Both of World's Limited Resources and Other Countries Water Scarcity.	10	26
Use Water Economically but No Reason	4	10

4. 3 DISCUSSION

This study was conducted to investigate the impact of science projects which are combined with non-formal education on students' water usage behavior, water usage attitude and environmental awareness. Reaching any information is very easy today. For this reason, there is a need for students who know how to learn more than those who know memorable knowledge. Instead of knowing how to learn there is also a great importance at critical thinking and problem solving skills. All these skills together form the science literate individual. In PISA 2006 scientific literacy defines an ability to apply scientific information to life situations [3]. Moreover, OECD also clarify six scientific literacy scales. Level 1 estimate low scientific literate and level 6 is very high. Results of PISA 2006 %94.8 students who participate the PISA 2006 from OECD countries are level 1. Only % 1.3 of the students is level 6 [3]. This situation shows that students cannot use their scientific knowledge in real life situations. In order to be a good citizen, people need

to know science but only knowing science is not enough. The citizens can make their own decisions using scientific knowledge. The effect of science education on the use of the world resources and to ensure the continuity of the resources is great.

Science literacy has now been replaced by environmental literacy. Ilgar defines environmentally literate people is that a human who avoids harming the environment, consciously produces and consciously consumes, is aware of its being a part of this environment and sensitive to environmental problems. [7] It is only possible to educate environmentally literate individuals with a special environmental education. According to Titiz teachers use traditional learning methods generally [62]. The environmental education given by traditional methods does not provide the desired outputs. It is imperative to revise the principles according to the requirements of the age and to use student-centered interactive approaches [5] Şimşek and his colleagues research about student-centered approaches at school in rural areas in science lessons. They apply collaborative education to their experiment group and they concluded that experiment groups which are applied student centered learning activities are more successful that control groups which are applied traditional learning methods [63]. The results of this research show that student-centered education is more effective than traditional education.

Today, where main objective is learning to learn, student-centered practices are becoming more and more important. They are developed and diversified in order to achieve better student-centered training. One of the new developed student-centered educational practices is STEAM. The Water Explorer program activities used in this study are based entirely on STEAM. One of the main reasons for choosing the Water Explorer program was that it had STEAM features. What does this training provide for us? To understand this, a phone example is enough, says Carey. How is life before the phone, or how is life before artificial finger a man who cannot use his finger is affect? [64] Knowing the effects of these in human life will suffice the effects of the STEAM. In this education, students are not only using science knowledge but also students need to know how to work with people. This skill is essential for future business life. For this reason, STEAM education is putted the training first at the undergraduate level. Further research has shown that as age increases, interest in science decreases [54]. Therefore, the effectiveness of this training at the undergraduate level has been debatable. Beginning at a very early age, students have contributed significantly to their interest and attitudes to science [66].

According to liliawati and friends Steam education increases students' mastery skills [67]. Two weeks of the planned three weeks' study can be realized. Even before the study was not completed, the effects were positive. 16 percent of the students had high level problem solving skills than before the application. Moreover, as a result of the study, the information of students about water pollution and seasons is more increased than control group in the study [67]. The results of this study indicate the positive effect of the stem in accordance with our study.

Beginning of the study water usage behavioral, water usage attitude and environmental awareness scale scores of both control and experiment groups are almost same level. This means that the groups are selected to be similar. After the application of the study when experiment groups water usage behavioral scale scores are increasing, scores of control groups does not changing. These shows that there is no effect traditional education on students' water usage behavior. On the other hand, water explorer program application has effects on students' water usage behavior. There is no significant difference between girls and boys in terms of water usage habits.

After testing hypotheses, the findings of the study disclosure that the experiment group increased the post score of the water usage attitude scale scores are better than the control group. The results found significance difference between experiment1 and control1, experiment2 and control1, experiment2 and control2 classes. There is also significant difference between control 1 and experiment 1, control1 and experiment2, control2 and experiment1, control2 and experimetn2 classes ($p < .05$) It means that applying project learning method combined with non-formal education totally named is STEAM education is effect students' water usage attitude scale. Water usage attitude tests has two subtitles on it. These are sustainable water and water saving. At sustainable water subtitle mean scores of experiment groups increase more than the mean scores of students' on water saving subtitle. The reason for the little increment in water saving test is learned student reflection papers. Student 9 says that "*Before Water Explorer Program, I thought I was saving water, but I learned that I was not actually saving water*." The student comments and the others students' comment like that show students have lack information about water saving. When the secondary school science curriculum is considered, it is seen that the concept of hidden water is not included [68]. Hence almost all students do not know about the saving water with not consuming clothes and other staffs. Most of them know

water saving is not consuming water. Students 16 says that "*I think that water saving is only not consuming water but it is not.*"

Although the subject matter was on water in the research, in general, environmental awareness was examined. As in other tests, there was a significant difference in environmental awareness test. This showed that although the study was related to water, it contributed to environmental awareness in general. At the end of the study, students write reflection papers about Water Explorer Program. %90 of the students happy to participate in the program and they have fun the program. Liliwati also showed that stem education increased the students' intrinsic motivations and provided them to work pleasantly [67]. Students 20 said that *"I would like to join the program again because it was so much fun. I was especially excited about the projects I made with my friends and the exchange markets we established at the school and informed me about the water*." %88 of the students said that their awareness is raised with the Water Explorer Program. The vast majority of students have affected water shortages in other countries to save water. It was not overlooked that the students did not know the situations about water shortage in other countries.

According to the results of the research, the environmental education given in schools is not sufficient to give students behavior and consciousness about water in general environment. Behaviors which are important for individuals in accordance with the requirements of the age cannot be given with traditional science education methods. Environmental education in schools will be more effective if it is conducted with interactive applications in cooperation with non-formal education. STEAM education is a good practice of it. Water Explorer Program is an application sample for effective environmental education. It constitutes project based, collaborative learning and it is interdisciplinary approach like in STEAM. Project based learning provide working interdisciplinary [42]. Students' feedback of using Water Explorer Program in the science classes is positive. They declare that it is enjoyable, playful, and observable. The statements show that students have motivation to participate to lessons and they are more active. It is also compatible with research in this field. Project based learning increase students' motivation [35]. On the one hand, project-based learning becomes more effective when used with other methods. Project-based learning is more effective at high school level than university level. It was found to be effective at secondary level with this

study. Project based learning approach increases students' achievements in the fifth grade science lessons of primary education [36].

In addition to the researches which have different effects on project-based learning and STEM education, there are also some researches that have been used together. The researcher looked at the effect of STEM education that was used in project-based education in mathematical concept learning. At the end of the study, p value was found to be 0.1 and a significant difference was found. It has been found that STEM-based learning combined with project-based learning is more effective than traditional education in learning students' math concepts [69]. The studies which is used project based learning with STEM education are insufficient. This thesis also contributes to the literature.

Another study investigating the effect of stem education was on 4th grade students. The research order is a mixed type research design which is very similar to the layout of this research and also includes open-ended questions. At the end of this study, STEM education was found to be more effective than traditional methods to increase students' success. The students stated in their reflection papers that they like STEM activities and they would like to do again in the future. Şahin (2013) also stated that students who participated in STEM activites tended to more commonly choose STEM areas after their secondary education [70]. In addition to all of these, they said that they learned more about these activities and stated that they would like to choose a profession related to science in the future. This finding mirrors those of previous studies [71-79]

Another topic that needs to be addressed is the sustainable development. The changing use of resources together with the changing world has a very important place in environmental education. countries began to give importance to this issue within their own bodies. Turkey is among the countries who are working on this issue and identified 17 objectives in this regard. The sixth of these purposes is access to healthy water [80]. The purpose is achieving universal and fair access to reliable and affordable drinking water for all by 2030. Ministry of Turkey customs and trade has published the report in order to determine the starting point of Turkey waste. In this report published in March 2017, remarkable results have emerged. According to this report, water is wasted by people who are most educated. It is emphasized that primary school graduates use resources more efficiently compared to those who have the highest level of education [19]. This result can be considered as an indication that the environmental education given

in schools does not actually contribute to the students as a behavior and remains in theory. Many studies have emphasized that traditional teaching methods are not useful [81].

4.4 Conclusion

As a result of the research, it was determined that water exploration activity which is a project-based education and STEM training application combined with non-formal education has a positive effect on the students' environmental awareness, water use attitudes and behaviors. The results of the study support the results of similar studies in the field. The students' papers showed that they liked this form of education and they wanted to participate more in STEM activities. This finding is in line with Gökbayrak and Karışan's (2017) results. [82] In this study, 6th grade students stated that they wanted to participate in STEM activities and they found such courses motivating and mentally challenging.

4.5 Implementation of Future Research

- When the researches in the field are examined, there is no research about the subject of water. There is a need for research of all ages.
- Research on the impact of non-formal education on environmental literacy.
- Studies related to STEM generally measure success. There is a need for more research on attitudes and behavior.
- The number of researches in which STEM and project-based learning are combined is very small. Further research is needed.
- The number of researches in which STEM and non-formal education are combined is very small. Further research is needed.
- How long the students' water saving behavior lasts can be followed by long-term research.
- The impact of non-formal education on environmental knowledge can be viewed through environment success tests.
- The impact of technological learning environments, blogs and forums on students' environmental awareness can be investigated.

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APPENDIX-A

LESSON PLANS SAMPLES

A.1 Lesson Plan 1

WEEK 1

Kazanım: Suyu nelerin kirlettiğini bilir.

Suların kirlenmemesi için neler yapılabileceğini araştırır ve sunar.

4 ders saati

8. sınıf

- Kirlenmiş su kaynaklarının fotoğrafları ile sınıfa girilir. Bu fotoğrafların neden olabileceği sorulur. Öğrenci fikirleri alındıktan sonra her bir gruba bir adet bilgisayar verilir ve bu konuda araştırma yapmaları istenir. Araştırmayı yaparken aramaları gereken sorular her bir gruba verilir.
- Grupların araştırmaları okunur. Tüm sınıfın araştırmalarından yararlanarak tahtaya kısa bilgiler yazılır.
- Bu konu hakkındaki sunum izlenir.
- Bu bilgiler doğrultusunda sularımızın kirlenmemesi için bizim neler yapabileceğimiz yorumlanır.
- Tahtanın bir köşesine de yapılabilecekler listesi hazırlanır.
- Gruplardan tüm bu bilgilerden yararlanarak yapılabilecekleri bir proje haline getirmeleri istenir.
- Proje önerileri oylamaya sunularak en çok oyu alan proje tüm sınıfın projesi olarak uygulamaya konur.
- Süreç takip edilir.

Neler arıyoruz?

1. Suların kirlenmesinin başlıca nedenleri nelerdir?

2. Evsel atık ne demektir? Neler evsel atık sayılır?

3. Sıvı- Katı yağlar suları nasıl kirletir?

4. Tıkalı tahliye boruları nasıl kirlenmeye yol açar?

5. Kirlenmiş suların arıtılması mümkün müdür? Mümkünse nasıl yapılır?

Neler öğrendik?

1) **Aşağıdakilerden hangisi evsel atıklar için doğru değildir?**
   a) Evlerimizde ürettiğimiz katı atıklara evsel katı atık denir.
   b) Yiyecek atıkları ve evimizde kullandığımız ürünlerin boş ambalajları, meyve suyu kartonları ve şişeleri evsel atıklara örnek gösterilebilir.
   c) Evlerimizde kullandığımız şampuan, bulaşık deterjanı gibi maddeler evsel sıvı atıktır.
   d) Ambalaj atıkları çöp sayılmaz.

2) Sıvı katı yağlar suyu nasıl kirletirler? Açıklayınız.

3) Su arıtma basamaklarını yazınız.

4) Su kaynaklarımızın kirlenmemesi için biz neler yapabiliriz?

5) Sizce insanların evlerinde aldığı önlemlerin dünyamızın su kaynaklarını korumasında etkisi nedir?

A.2 LESSON PLAN 2

WEEK 2

Kazanım: Suyun tasarruflu kullanımına yönelik fikirler üretir.

Kendi ülkeleri dışındaki ülkelerin su kullanımı konusunda farkındalık oluşturur.

4 ders saati

8. sınıf

- Her gruba bir ülkenin su kullanım alışkanlıklarını gösteren çalışma kağıtları verilir. (Yaşamda bir gün klasörünün içinde mevcut.)
- Gruplardan onlara verilen ülkelerdeki suları kullanarak yine o ülkelere özgü görevleri yapmaları istenir.
- Görevler tamamlandıktan sonra her ülkeye özgü sorun kartları öğrencilere verilir ve onlardan bu sorunları çözmeleri beklenir.
- Sonra her gruptan Türkiye ile gruplarına verilen ülkelerin su kullanım alışkanlıklarını karşılaştırmaları istenir.
- Eşit su kullanımı için ve de suyun israf edilmemesi için neler yapılabileceği sınıfça tartışılır.
- Alınabilecek önlemler tahtaya yazılır ve bir yapılacaklar listesi hazırlanır.
- Bu konu hakkında bir proje geliştirilir, proje fikrinde zorlanılırsa su israfını önleme adına bir taahhüt hazırlanarak okulda bilgilendirme yapılabilir.
- Gruplar okuldaki tuvaletleri inceleyebilir. Akıtan bir musluk ya da bozuk bir sifon varsa okul idaresine bildirilebilir.

SUSUZ BİR GÜN

Bir gününüzde harcadığınız su miktarını düşünün. Evinize kova ile su taşıyor olsaydınız yine aynı miktar suyu harcar mıydınız? Neden?

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Dünyanın her ülkesinde suya erişim eşit düzeyde midir? Sizce neden?

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Su israf ettiğinizi düşünüyor musunuz? Cevabınız ***evetse*** israfı önleyebilmek için neler yapabilirsiniz? Cevabınız ***hayırsa*** suyu hangi yöntemlerle israf etmediğinizi anlatınız.

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A.3 LESSON PLAN 3

WEEK 3

Kazanım: Suyun tasarruflu kullanımına yönelik fikirler üretir.

4 ders saati

8. sınıf

- Bir önceki hafta tartışılan su tasarrufu konuları hatırlatılır.
- Sadece bu yolla mı su tasarrufu yapabiliriz sorusu sorulur.
- "Kıyafetlerimizde kullandığımız eşyalarda su var mıdır?" sorusu da sorularak öğrencilerin eşyaların içindeki saklı suyu keşfetmelerine yardımcı olunur.

- Öğrencilere bir pamuklu tişört gösterilir ve “Bunun içinde su var mıdır? Sizce ne kadardır?” soruları sorulur.
- Eğer tek bir kağıt 10 litre su ve bir kupa kahve 130 litre su harcıyorsa bir pamuklu tişörtün üretilmesi için kaç litre suya ihtiyaç olduğunu tahmin etmeleri istenir. 2700 lt su harcanıyor olduğu söylenir. (Bir insanın 900 günlük içme suyu)
- Bu israfı önlemek için neler yapılabileceği tartışılır. (Eski pamuklu tişörtleri değerlendirmek bir fikir olabilir.)
- Sınıf içinde tüketimi azaltan bir takas projesi de geliştirilir.
- Herkes kullanmadığı eşyasını sınıfa getirir ve arkadaşlarınınki ile takas yapar. Böylece yeni bir eşya alıp su tüketmemiş hem de kullanabileceği eşyalara ulaşır.
- Ayrıca eski bir tişörtünü ya da herhangi bir eşyasını dönüştürü kullanan birisi varsa ondan sınıfa göstermesi istenir. (Önceki hali ve sonraki halinin fotoğrafı öğrencilere gösterilebilir.)
- Değiş tokuş yapılan giysi sayısı not edilir. Bu sayılarla yaklaşık olarak ne kadar su tasarrufu yapıldığı hesaplanır. Sınıf kapısına asılır.

1. **Aşağıdaki olayları su kullanımı açısından değerlendirin. Hangilerini yaparsınız hangilerini yapmazsınız nedenleri ile açıklayınız?**

➢ Çok giysi alın böylece daha az eskirler.

➢ Küçük gelen giysileri küçük kardeşlerinize verin

➢ Eski giysilerinizi hayır kurumlarına verin

➢ Çamaşır makinenizde ekonomik program kullanın

- İkinci el dükkanından uygun bir şey bulun

- Kumaşı korumak için her giydikten sonra giysileri yıkayın

- Daha ucuz giyecekler satın alın

- Eski giysileri sakın atmayın - tekstil geri dönüşüm noktalarına götürün

- Yeniden dönüştür: Eski bir giysiyi yenilemek üzere düzenleyin

- Daha pahalı giysiler satın alın

- Diğer insanların da giysilerimizdeki saklı su hakkındakileri bilmesini sağlayın

- Arkadaşlarınızla giysi değiş tokuşu yapın

- Sürdürülebilir tarım ürünü olan pamuklu giysileri tercih edin

- Giysileri çok sıcak su ile yıkayın ki kumaş iyice temizlensin ve daha uzun süre dayansın

- Giysilerinize iyi bakın Yaratıcı ol: eski kumaş torbalardan yeni bir şey yap

APPENDIX-B

APPLIED TESTS

B.1 Water Usage Behaviour Scale (WUBS)

Table B.1 Water Usage Behaviour Scale (WUBS)

Bu bölümde çeşitli cümleler ve bu cümlelerin karşısında; çok sık, sıkça, ara sıra, oldukça az, hiçbir zaman şeklinde seçenekler verilmiştir. Her cümleyi okuduktan sonra size uygun gelen seçeneği çarpı işareti (X) koyarak işaretleyiniz. Lütfen hiçbir cümleyi atlamayınız ve boş bırakmayınız.					
SU KULLANIMI DAVRANIŞ ÖLÇEĞİ	**Çok sık**	**Sıkça**	**Ara sıra**	**Oldukça az**	**Hiçbir zaman**
1. Su ile çalışan ev aletlerini satın alırken suyu tüketme özelliklerine dikkat ederim.					
2. Bireylerin su konusunda eğitilmesi ilgili sorunların çözümüne yardımcı olurum.					
3.Ailemdekileri su tasarrufu yapmaları konusunda uyarırım.					
4. Çevremde gördüğüm su kaçaklarını yetkili kişilere bildiririm.					
5. TV de su tasarrufu ile ilgili programları izlerim.					

Table B.1 Water Usage Behaviour Scale (WUBS) (Continue)

Bu bölümde çeşitli cümleler ve bu cümlelerin karşısında; çok sık, sıkça, ara sıra, oldukça az, hiçbir zaman şeklinde seçenekler verilmiştir. Her cümleyi okuduktan sonra size uygun gelen seçeneği çarpı işareti (X) koyarak işaretleyiniz. Lütfen hiçbir cümleyi atlamayınız ve boş bırakmayınız.					
SU KULLANIMI DAVRANIŞ ÖLÇEĞİ	**Çok sık**	**Sıkça**	**Ara sıra**	**Oldukça az**	**Hiçbir zaman**
6. Su tasarrufu yöntemlerini çevremdeki insanlarla her zaman paylaşırım.					
7.Evsel kullanımda su tasarrufu yapmak için her zaman bilgi toplarım.					
8. Evsel su tasarrufu için yeni çıkan tasarruflu su araçlarından satın alırım.					
9. Evsel su kullanımda ortaya çıkan az kirli suları (gri suları) ikinci defa kullanırım.					
10. Su tasarrufu zorunluluğunu herkesle tartışırım.					
11. Katı ya da sıvı atıkları suları kirleteceği için rastgele yerlere atmam, özel yerlerinde depolarım.					
12.Dişimi fırçalarken musluk sürekli açık olur.					
13. Su tasarrufu ile ilgili yazılı basını izlerim.					

B.2 Water Usage Attitude Scale (WUAS)

Table B.2 Water Usage Attitude Scale (WUAS)

Bu bölümde çeşitli cümleler ve bu cümlelerin karşısında; TAMAMEN KATILIYORUM, KATILIYORUM, KARARSIZIM, KATILMIYORUM VE HİÇ KATILMIYORUM şeklinde seçenekler verilmiştir. Her cümleyi okuduktan sonra size uygun gelen seçeneği çarpı işareti (X) koyarak işaretleyiniz. Lütfen hiçbir cümleyi atlamayınız ve boş bırakmayınız.					
SU KULLANIMI TUTUM ÖLÇEĞİ	**Tamamen Katılıyorum**	**Katılıyorum**	**Kararsızım**	**Katılmıyorum**	**Hiç katılmıyorum**
1. Ailelerin çocuklarını suyun tasarruflu kullanılması konusunda bilinçlendirmelerini isterim					
2. Suyu tasarruflu kullanmayı öğretme işinin sadece resmi kurumlara bırakılmasına üzülürüm.					
3. Banyo yaparken suda tasarruf yapmak hoşuma gitmez.					
4. İnsanlar daha az su kullanarak da bugünkü hayat kalitesinde yaşayabilseler ne güzel olur.					
5. Apartmanlarda merdivenleri su ile yıkamak yerine silerek su tasarrufu yapmak hoşuma gider.					
6. Tarımsal su kullanımında nasıl tasarruf yapılacağı konusunda kişilere eğitim verilmesinin doğru bir yaklaşım olduğuna inanıyorum.					
7. Su tasarrufu alışkanlıklarının her yaştan insana aynı düzeyde kazandırılabileceği düşüncesi beni mutlu eder.					

Table B.2 Water Usage Attitude Scale (WUAS) (Continue)

Bu bölümde çeşitli cümleler ve bu cümlelerin karşısında; TAMAMEN KATILIYORUM, KATILIYORUM, KARARSIZIM, KATILMIYORUM VE HİÇ KATILMIYORUM şeklinde seçenekler verilmiştir. Her cümleyi okuduktan sonra size uygun gelen seçeneği çarpı işareti (X) koyarak işaretleyiniz. Lütfen hiçbir cümleyi atlamayınız ve boş bırakmayınız.					
SU KULLANIMI TUTUM ÖLÇEĞİ	**Tamamen Katılıyorum**	**Katılıyorum**	**Kararsızım**	**Katılmıyorum**	**Hiç katılmıyorum**
8. Şehirleşmenin su kaynaklarındaki kirlenmeyi arttırması sonucu su kıtlığına yol açacağından kaygı duyuyorum.					
9. Yaşam kalitesindeki artışın su kıtlığını arttırmasına üzülürüm.					
10. Tarımda gübre ve ilaç kullanımının su kaynaklarındaki kirlenmeyi ve dolayısıyla su kıtlığını arttırıyor olması canımı sıkar.					
11. Tek başıma olsam bile yapacağım su tasarrufunun gelecek nesillerin yaşamına olumlu katkı yapacağını düşünmek beni rahatlatır.					
12. Evlere su tasarruflu araçlar, musluklar, makineler satın almak için masraf yapmayı gereksiz buluyorum.					

B.3 Environmental Awareness Scale (EAS)

Table B.3 Environmental Awareness Scale (EAS)

Bu bölümde çeşitli cümleler ve bu cümlelerin karşısında; TAMAMEN KATILIYORUM, KATILIYORUM, KARARSIZIM, KATILMIYORUM VE HİÇ KATILMIYORUM şeklinde seçenekler verilmiştir. Her cümleyi okuduktan sonra size uygun gelen seçeneği çarpı işareti (X) koyarak işaretleyiniz. Lütfen hiçbir cümleyi atlamayınız ve boş bırakmayınız.					
ÇEVRE BİLİNCİ ÖLÇEĞİ	**Tamamen Katılıyorum**	**Katılıyorum**	**Kararsızım**	**Katılmıyorum**	**Hiç katılmıyorum**
1.İnsanlar yaşamlarını devam ettirmek için diğer canlılara ihtiyaç duymaz.					
2. Aç hayvanları beslemekten zevk duyarım.					
3. Çevreyi korumak önemli değildir.					
4. Yağış ve sıcaklık bir bölgenin bitki örtüsünü belirler.					
5. İnsanların doğal kaynakları savurganca kullanmaya hakkı vardır.					
6. Çevre koruma faaliyetlerinde gönüllü olarak çalışmak isterim.					
7. Her mevsimde avcılık yapmak doğrudur.					
8. Hayvan seven biriyimdir.					
9. Dünyanın sadece insanlar için olduğunu düşünüyorum.					
10. Her canlı kendine uygun olan çevre koşullarında yaşar.					
11. Tehlikeli hayvanları yok etmeliyiz					

Table B.3 Environmental Awareness Scale (EAS) (Continue)

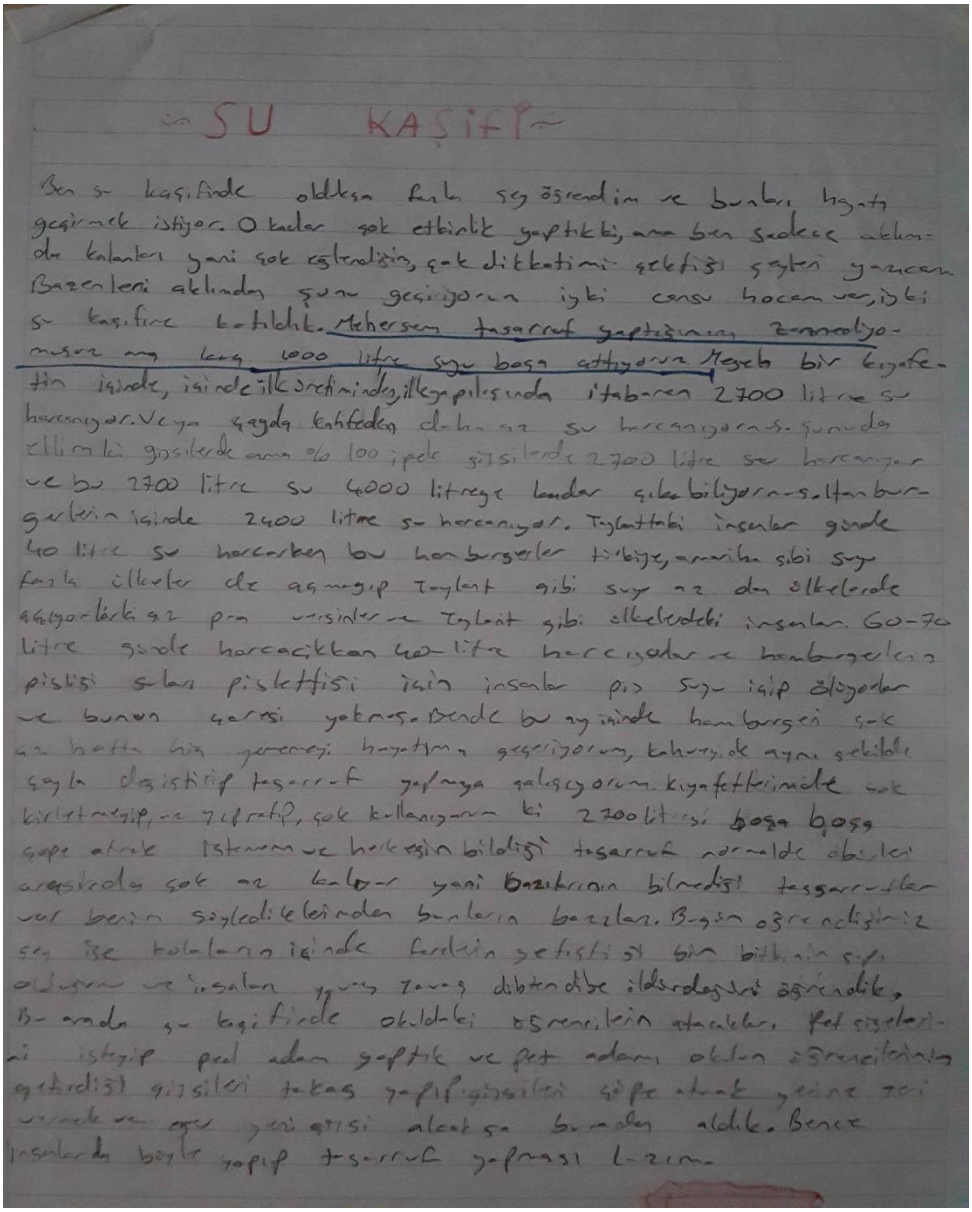
Bu bölümde çeşitli cümleler ve bu cümlelerin karşısında; TAMAMEN KATILIYORUM, KATILIYORUM, KARARSIZIM, KATILMIYORUM VE HİÇ KATILMIYORUM şeklinde seçenekler verilmiştir. Her cümleyi okuduktan sonra size uygun gelen seçeneği çarpı işareti (X) koyarak işaretleyiniz. Lütfen hiçbir cümleyi atlamayınız ve boş bırakmayınız.					
ÇEVRE BİLİNCİ ÖLÇEĞİ	**Tamamen Katılıyorum**	**Katılıyorum**	**Kararsızım**	**Katılmıyorum**	**Hiç katılmıyorum**
12. Havayı, suyu ve toprağı kirletenlere karşı mücadele etmek isterim.					
13. Çevre temizliği sadece belediye işçileri ve çöpçülerin görevidir.					
14. Hayvanları koruyan biriyimdir.					
15. Çevre kirliliği beni ilgilendirmiyor.					
16. Çevre koşulları değiştiğinde bazı canlılar yok olur.					
17. Sokakta dolaşan hayvanlara taş atarım.					
18. Gelecekte ağaç dikme kampanyaları düzenleyen biri olmak isterim.					

Table B.3 Environmental Awareness Scale (EAS) (Continue)

Bu bölümde çeşitli cümleler ve bu cümlelerin karşısında; TAMAMEN KATILIYORUM, KATILIYORUM, KARARSIZIM, KATILMIYORUM VE HİÇ KATILMIYORUM şeklinde seçenekler verilmiştir. Her cümleyi okuduktan sonra size uygun gelen seçeneği çarpı işareti (X) koyarak işaretleyiniz. Lütfen hiçbir cümleyi atlamayınız ve boş bırakmayınız.					
ÇEVRE BİLİNCİ ÖLÇEĞİ	**Tamamen Katılıyorum**	**Katılıyorum**	**Kararsızım**	**Katılmıyorum**	**Hiç katılmıyorum**
19. Elimde olsa tüm hayvanları kafese kapatıp büyük bir hayvanat bahçesine koyarım.					
20. Yaralı hayvanlara yardım etmezsem kendimi rahatsız hissederim.					
21. Kelebek koleksiyonu yapmaktan büyük zevk duyarım.					
22. Erozyonla mücadele eden biri olmak isterim.					
23. Vahşi havyaların tehlikelerden korunmak için öldürülmeleri gereklidir.					
24. Kirlilik kontrolü yapılmasının çevre kirliliğini yavaşlattığını ancak tamamen önleyemediğini düşünüyorum.					

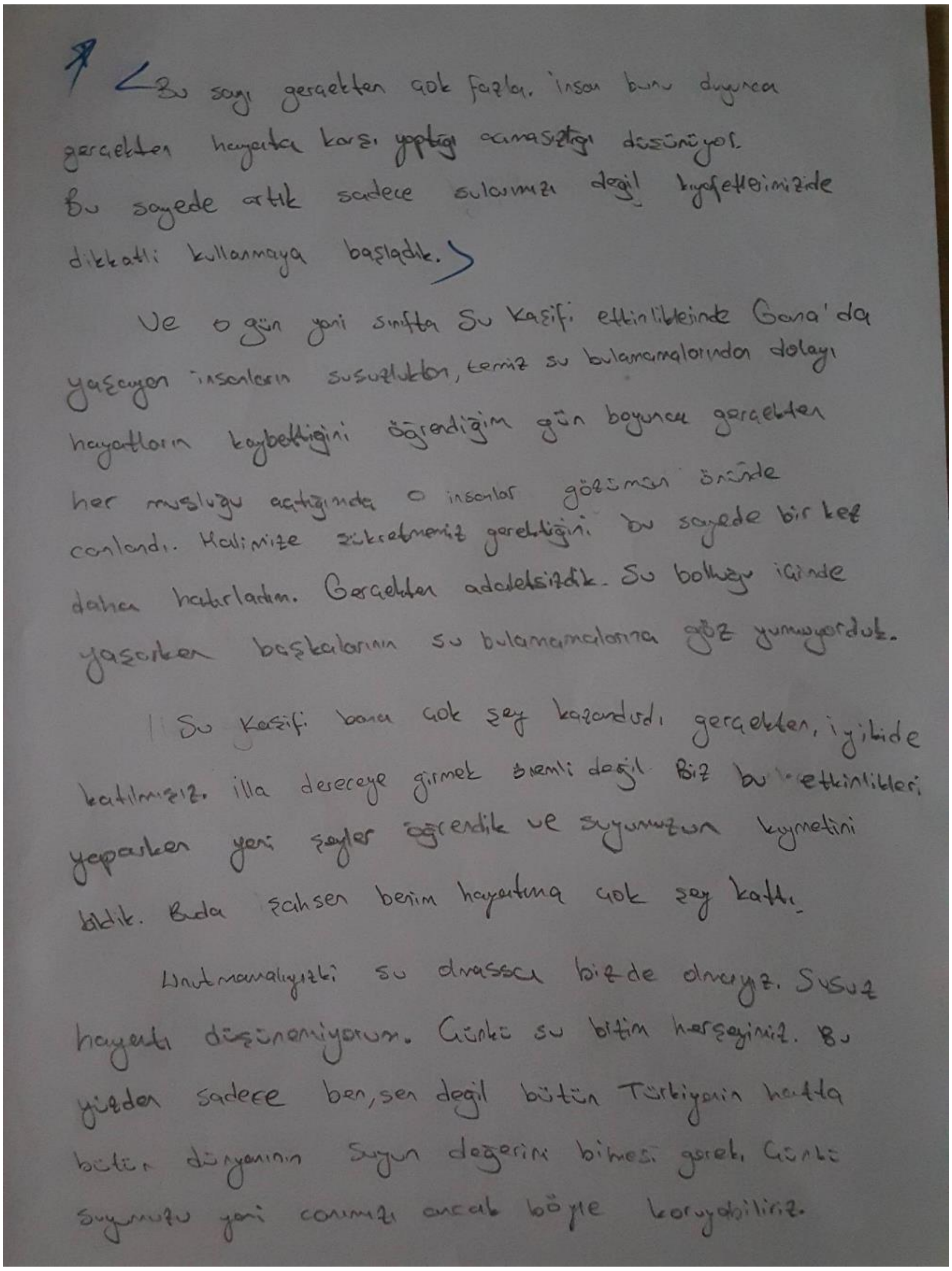
APPENDIX-C

REFLECTION PAPER SAMPLES


SU KAŞİFİ

Bu su kaşifinde oldukça farklı şeyler öğrendim ve bunları hayatıma geçirmek istiyorum. Okuldaki çok etkinlik yaptık ki, ama bu en çok aklımda kalanları yani çok eğlendiğim, çok dikkatimi çektiği şeyleri yazacağım. Bazılarını aklımdan şuan geçiriyorum ilki canım hocam verdiği su kaşifine katıldık. Meğersem tasarruf yaptığımızı zannediyormuşuz ama kaç 4000 litre suyu boşa attığımızı. Meğer bir kıyafetin içinde, içinde ilk üretiminden, ilkleştirilmesinden itibaren 2700 litre su harcanıyor. Veya çaydaki tahtadan dolayı az su harcanıyormuş. Günde elimizdeki gösterde ama %100 pekte gösterde 2700 litre su harcanıyor ve bu 2700 litre su 4000 litreye kadar çıkabiliyormuş. Hamburgerlerin içinde 2400 litre su harcanıyor. Tüketim tabi insanlar günde 40 litre su harcarken bu hamburgerler tüketiyor, amerika gibi suyu fazla olanlar da aşırı tüketim gibi suyu az olan ülkelerde yaşıyorlarki az para veriyorlar ve Tayland gibi ülkelerdeki insanlar 60-70 litre günde harcacakken 400 litre harcıyorlar ve hamburgerlerin pişmesi için pişirtmesi için insanlar pis su içip ölüyorlar ve bunun karşısında bende bu ay içinde hamburgeri çok az hatta hiç yemeyeceğim hayatımda geçiriyorum, tahmini aynı şekilde şeyle değiştirip tasarruf yapmaya çalışıyorum. Kıyafetlerimde çok kirletmeyip, az yıkayıp, çok kullanıyorum ki 2700 litresi boşa boşa çöpe atmak istemem ve herkesin bildiği tasarruf normalde dediği aralıkta çok az kalıyor yani bazılarının bilmediği tasarruflar var benim söylediklerimden bunların bazıları. Bugün öğrendiklerimiz suyu ise kolalarının içinde fırlatılan yetiştiği bir bitkinin suyu olduğunu ve insanın yüzü zayıf dibinde ölüdüğünü öğrendik. Bu arada su kaşifinde okuldaki öğrencilerin atıklarını, pet şişelerini istiyip pool adam yaptık ve pet adamı okulun öğrencilerinin getirdiği şişeleri tokaş yapılışişeleri çöpe atmak yerine geri dönüşüme ve eğer geri getirsi alacak su bunları aldık. Bence insanlarda böyle yapıp tasarruf yapması lazım.

Figure C.1 Students' Reflection Paper



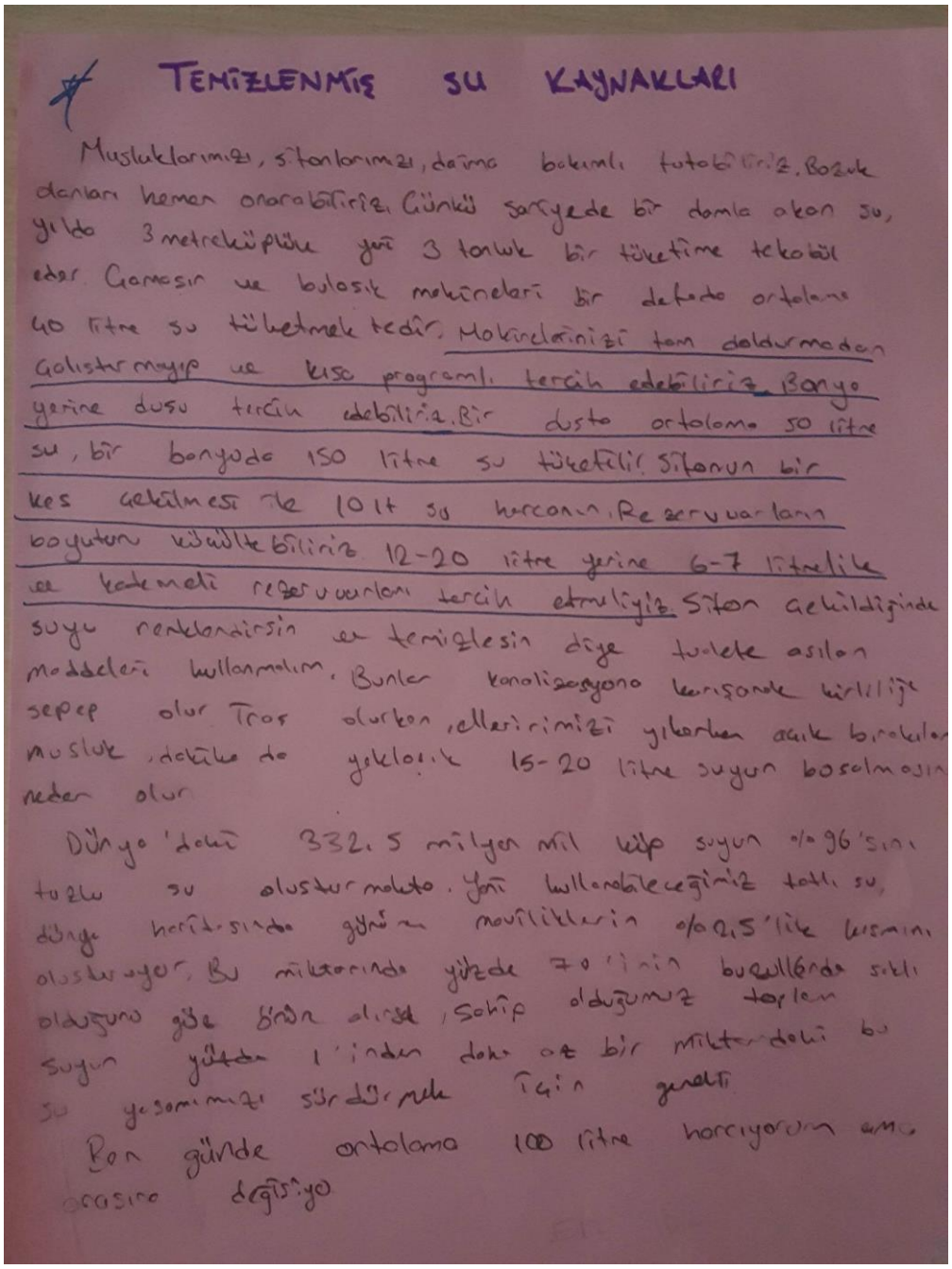
<Bu sayı gerçekten çok fazla. İnsan bunu duyunca gerçekten hayata karşı yaptığı acımasızlığı düşünüyor. Bu sayede artık sadece sularımızı değil kıyafetlerimizide dikkatli kullanmaya başladık.>

Ve o gün yani sınıfta Su Kaşifi etkinliklerinde Gana'da yaşayan insanların susuzluktan, temiz su bulamamalarından dolayı hayatların kaybettiğini öğrendiğim gün boyunca gerçekten her musluğu açtığında o insanlar gözümün önünde canlandı. Halimize şükretmemiz gerektiğini bu sayede bir kez daha hatırladım. Gerçekten adaletsizdik. Su bolluğu içinde yaşarken başkalarının su bulamamalarına göz yumuyorduk.

Su Kaşifi bana çok şey kazandırdı gerçekten, iyikide katılmışız. İlla dereceye girmek önemli değil. Biz bu etkinlikleri yaparken yeni şeyler öğrendik ve suyumuzun kıymetini bildik. Buda şahsen benim hayatıma çok şey kattı.

Unutmamalıyızki su olmassa bizde olmayız. Susuz hayatı düşünemiyorum. Çünkü su bizim herşeyimiz. Bu yüzden sadece ben, sen değil bütün Türkiye'nin hatta bütün dünyanın suyun değerini bilmesi gerek. Çünkü suyumuzu yani canımızı ancak böyle koruyabiliriz.

Figure C.2 Students' Reflection Paper



TEMİZLENMİŞ SU KAYNAKLARI

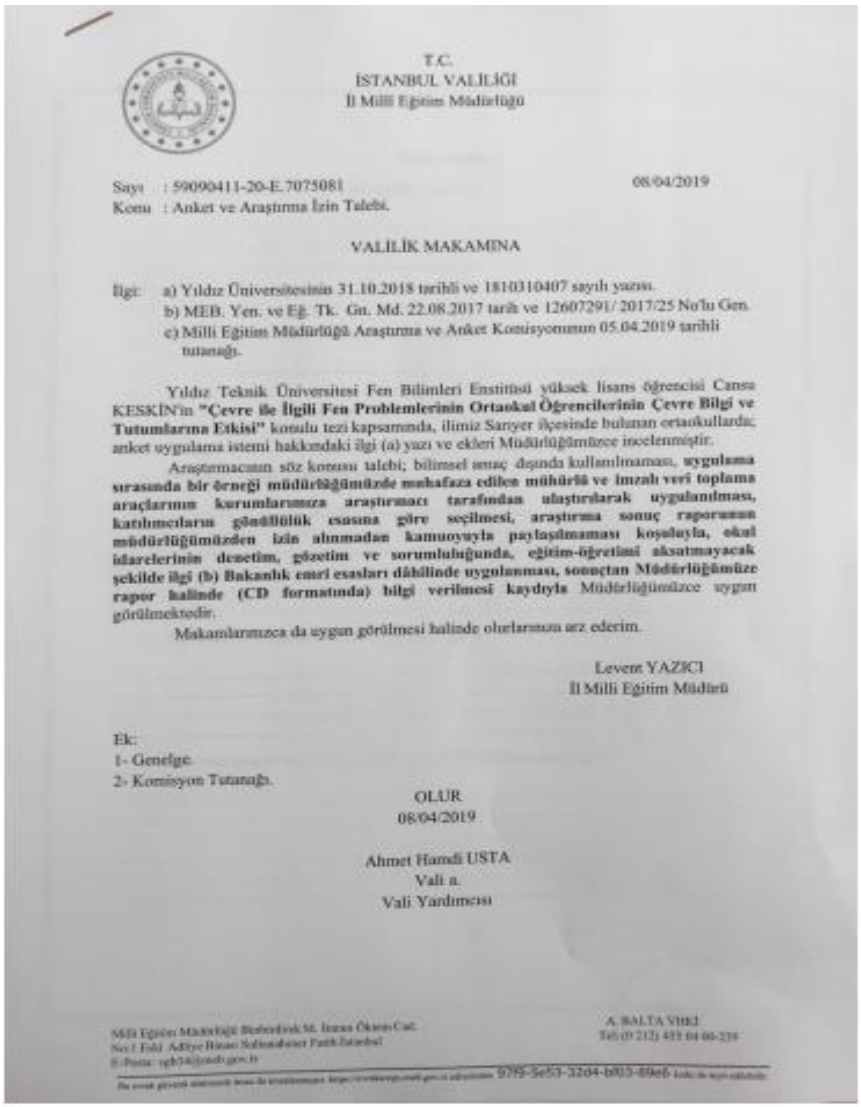
Musluklarımızı, sifonlarımızı, daima bakımlı tutabiliriz. Bozuk damlası hemen onarabiliriz. Çünkü saniyede bir damla akan su, yılda 3 metreküplük yani 3 tonluk bir tüketime tekabül eder. Çamaşır ve bulaşık makineleri bir defada ortalama 40 litre su tüketmektedir. Makinelerinizi tam doldurmadan çalıştırmayıp ve kısa programlı tercih edebiliriz. Banyo yerine duşu tercih edebiliriz. Bir duşta ortalama 50 litre su, bir banyoda 150 litre su tüketilir. Sifonun bir kez çekilmesi ile 10 lt su harcanır. Rezervuarların boyutunu küçültebiliriz. 12-20 litre yerine 6-7 litrelik ve kademeli rezervuarları tercih etmeliyiz. Sifon çekildiğinde suyu renklendirsin ve temizlesin diye tuvalete asılan maddeleri kullanmalım. Bunlar kanalizasyona karışarak kirliliğe sebep olur. Traş olurken, ellerimizi yıkarken açık bırakılan musluk, dakikada yaklaşık 15-20 litre suyun boşalmasına neden olur.

Dünya'daki 332.5 milyon mil küp suyun %96'sını tuzlu su oluşturmakta. Yani kullanabileceğimiz tatlı su, dünya haritasında gördüğümüz mavilikların %0,25'lik kısmını oluşturuyor. Bu miktarında yüzde 70'inin buzullarda sıklı olduğunu göz önüne alırsak, sahip olduğumuz toplam suyun yüzde 1'inden daha az bir miktardaki bu su yaşamımızı sürdürmek için gerekli.

Ben günde ortalama 100 litre harcıyorum ama arasına değiyo.

APPENDIX-D

MEB PERMISSION PAPER



T.C.
İSTANBUL VALİLİĞİ
İl Milli Eğitim Müdürlüğü

Sayı : 59090411-20-E.7075081 08/04/2019
Konu : Anket ve Araştırma İzin Talebi.

VALİLİK MAKAMINA

İlgi: a) Yıldız Üniversitesinin 31.10.2018 tarihli ve 1810310407 sayılı yazısı.
b) MEB. Yen. ve Eğ. Tk. Gn. Md. 22.08.2017 tarih ve 12607291/ 2017/25 No'lu Gen.
c) Milli Eğitim Müdürlüğü Araştırma ve Anket Komisyonunun 05.04.2019 tarihli tutanağı.

Yıldız Teknik Üniversitesi Fen Bilimleri Enstitüsü yüksek lisans öğrencisi Cansu KESKİN'in **"Çevre ile İlgili Fen Problemlerinin Ortaokul Öğrencilerinin Çevre Bilgi ve Tutumlarına Etkisi"** konulu tezi kapsamında, ilimiz Sarıyer ilçesinde bulunan ortaokullarda; anket uygulama istemi hakkındaki ilgi (a) yazı ve ekleri Müdürlüğümüzce incelenmiştir.

Araştırmacının söz konusu talebi; bilimsel amaç dışında kullanılmaması, **uygulama sırasında bir örneği müdürlüğümüzde muhafaza edilen mühürlü ve imzalı veri toplama araçlarının kurumlarınıza araştırmacı tarafından ulaştırılarak uygulanılması, katılımcıların gönüllülük esasına göre seçilmesi, araştırma sonuç raporunun müdürlüğümüzden izin alınmadan kamuoyuyla paylaşılmaması koşuluyla, okul idarelerinin denetim, gözetim ve sorumluluğunda, eğitim-öğretimi aksatmayacak şekilde ilgi (b) Bakanlık emri esasları dâhilinde uygulanması, sonuçtan Müdürlüğümüze rapor halinde (CD formatında) bilgi verilmesi kaydıyla** Müdürlüğümüzce uygun görülmektedir.

Makamlarınızca da uygun görülmesi halinde olurlarınıza arz ederim.

Levent YAZICI
İl Milli Eğitim Müdürü

Ek:
1- Genelge.
2- Komisyon Tutanağı.

OLUR
08/04/2019

Ahmet Hamdi USTA
Vali a.
Vali Yardımcısı

Figure D.1 Meb Permission Paper

CURRICULUM VITAE

PERSONAL INFORMATION

Name Surname : Cansu KESKİN

Date of birth and place : 01.03.1991 İstanbul

Foreign Languages : English

E-mail : cansuaydogdukeskin@gmail.com

EDUCATION

Degree	Department	University	Date of Graduation
Undergraduate	Science Education	Boğaziçi University	2014
High School	Anatolian High School	Ergün Mehmet Öner	2009

WORK EXPERIENCE

Year	Corporation/Institute	Enrollment
2014-2019	Hacı Cemal Öğüt İmam Hatip Ortaokulu	Science Teacher
2013-2014	Darüşşafaka Eğitim Kurumları	Intern Science Teacher
2012-2013	Birey Etüt Merkezi	Math Teacher
2010-2012	İstanbul Eğitim Danışmanlık	Science Teacher

PUBLISHMENTS

Conference Papers

1. Effectiveness of Environmental Science Projects On Middle School Students' Environmental Knowledge and Attitudes, Uluslararası Bilimsel Araştırmalar Kongresi (UBAK) 2019, Yalova.