

Review Article

Permanent Solution to Water Conservation: Educating Responsible Citizens from All Ages

Suyun Korunmasında Kalıcı Çözüm: Her Yaştan Sorumlu Yurttaşların Eğitimi

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Abstract

This study was conducted to review current research about water and environmental education and to discuss what educators can do for teaching responsible citizens variables to conserve water and environment. Literature was reviewed for this study. In this resepect, It was reviewed within four main topics: Responsible citizenship variables in water and environmental education; studies about water related environmental science literacy; teaching methods used in water and environmental education; studies conducted about water and environmental education in Turkey. The results of the study have shown that there are many important responsible citizenship variables such as having emphathetic perspective about environmantal problems, having active role in environmental issues, having awareness about these issues, having self esteem to solve issues, understanding recycling waste management issues... The results also indicate that the characteristics of water, the hydrological cycle, the conservation of matter and the nature of the scientific processes are abstract and difficult to understand by the individuals. The other important results are that education provides the most important solution for preventing environmental problems before it emerges; many research conducted on environmental education in Turkey have concerned the attitude of students toward the environment; educators should implement student-centered teaching methods that enhance active involvement of individuals in water and environmental issues. I beside developing cognitive skills such as literacy about environmental issues, affective skills, such as emphatic perspective toward environmental issues, values and attitudes toward water and environment should be integrated into school curriculum for educating responsible citizens from all ages.

Keywords: *Water conservation, environmental education, educating responsible citizens.*

Öz

Bu çalışmada, su ve çevre eğitimi ile ilgili güncel araştırmalar gözden geçirilerek bireylerde suyu ve çevreyi korumak için sorumlu vatandaşlık davranışları kazandırmak amacıyla su ve çevre eğitimi kapsamında neler yapabileceği tartışılmıştır. Çalışmanın metodu olarak literatür taraması yapılmıştır. Literatür taramasının dört ana başlığı bulunmaktadır: Su ve çevre sorunları konusunda sorumluluk sahibi vatandaşlık değişkenleri; su ve çevre bilimi okuryazarlığı ile ilgili çalışmalar; Su ve çevre eğitiminde kullanılan öğretim yöntemleri; Türkiye'de su ve çevre eğitimi üzerine yapılan çalışmalar. Çalışmada sonuç olarak, çevre sorunlarına karşı empati kurmak, çevre konularında aktif rol almak, bu konularda bilinçli olmak, çevre sorunlarını çözmede kendine güveninin olması, atık yönetiminin

anlaşılması gibi birçok sorumlu yurttaşlık değişkeninin olduğunu görülmüştür. Ayrıca, yapılan literatür çalışmasının çıktıkları, bireyin su ve çevreyi korubilmesi için gerekli olan suyun özellikleri, hidrolojik döngü, maddenin korunumu ve bilimsel süreçlerin niteliği konularını anlamada güçlük çektiğini göstermiştir. Çalışmanın diğer sonuçları da; eğitimin, çevresel sorunların ortaya çıkmadan önlenmesi için en önemli çözümü sağladığı; sorumluluk sahibi yurttaş yetiştirmek için, bireyin su ve çevre konularında aktif katılımını artıran öğrenci merkezli öğretim yöntemlerinin uygulaması gerektiği; Türkiye’de çevre eğitimi ile ilgili yapılan çalışmaların çoğunun öğrencilerin çevreye karşı tutumları ile ilgili olduğu tespit edilmiştir. Sonuç olarak tüm yaştan su ve çevre korumaya sorumlu vatandaşlar yetiştirmek için su ve çevre konuları okur-yazarlığı gibi bilişsel becerilerin yanı sıra, çevre olaylarına karşı empatik perspektif geliştirmek, çevre olaylarına karşı empati geliştirmek, su ve çevreye yönelik değerler ve tutumlar gibi duyuşsal becerilerde okul müfredatına entegre edilmelidir.

Anahtar sözcükler: *Suyun korunması, çevre eğitimi, sorumlu vatandaş yetiştirilmesi.*

Introduction

Education is a systematic process through which a child or an adult acquires knowledge, experience, skill and attitude. It makes an individual civilized, refined, cultured and educated. For a civilized and socialized society, education is the only means (Parankimalil, 2012). Hungerford and Volk (2013) imply that fundamental aim of education is shaping human behavior. Human societies establish educational systems in order to develop responsible citizen who will behave in desirable ways. In education, some of the desired behaviors are sharply defined, e.g., skills useful in reading and mathematics. Other desired behaviors are more complex, e.g., conscious consumerism, productive employment, responsible citizenship behavior.

Individuals having responsible citizenship behaviour help people and the planet, have knowledge about their role in their communities, their country, and their world. Therefore, they participate in activities that make their world a better place by solving environmental problems. Hungerford and Volk (2013) defined environmentally responsible citizens as one who has (1) an awareness and sensitivity to environment and its problems and issues (2) a basic understanding of environment and its problems and issues, (3) having concern for the environment and motivation for actively participating in environmental protection, (4) skills for identifying and solving environmental problems and issues, and (5) active involvement at all levels in working toward solution of environmental problems and issues.

An early and widely accepted model for environmental education has been described as: “Increased knowledge leads to favorable attitudes... which in turn lead to action promoting better environmental quality” (Ramsey and Rickson 1976). However, recent research argue that environmental education should not only advocate a particular viewpoint or course of action, but also it should teach citizens how to weigh various sides of an issue through critical thinking and it enhances their own

problem-solving and decision-making skills. Study conducted by Covitt, Gunckel and Anderson (2009) described the goal of environmental education is to aid citizens in becoming environmentally knowledge-able and, above all, skilled and dedicated citizens who are willing to work, individually and collectively, toward achieving and/or maintaining a dynamic equilibrium between quality of life and quality of the environment. That is, most educators firmly thought that, if we teach learners about something, behavior can be modified. In some cases, perhaps, this is true. However, in educating for generalizable responsible environmental behavior, the evidence is to the contrary. Issue awareness does not lead to behavior in the environmental dimension. Environmental issues that must be resolved through investigation, evaluation, values clarification, decision making, and finally, citizenship action.

Teaching responsible citizenship skills to conserve water and environment require different instructional practices. Therefore, it is necessary to introduce current research about water and environmental education and to discuss what educators can do for teaching responsible citizens variables. For this reason, this study has conducted to review current research about water and environmental education and discussed how to improve education that enhances individual's responsibility about water and environmental conservation.

Method

Literature was reviewed in this study. Review has four main topics: Responsible citizenship variables in water and environmental education; studies about water related environmental science literacy; Teaching methods used in water and environmental education; studies conducted about water and environmental education in Turkey.

Responsible Citizenship Variables in Water and Environmental Education

Studies carried out by Hines et al. (1986/1987) categorized the environmental education variables that contribute to responsible citizenship behaviors: (1) entry-level variables, (2) ownership variables and (3) empowerment variables. Entry-level variables enhance a person's decision making. One of these variables are environmental sensitivity which is defined as an empathetic perspective toward the environment. Other entry-level variable androgyny is a variable that describes individuals who are active in helping solve environmental issues. One of the other variable is knowledge of ecology that refers to an ecological conceptual basis for decision-making, e.g., concepts associated with population dynamics, nutrient cycling, succession, homeostasis etc. Attitudes toward pollution technology economics are variables that have shown themselves to be significant in some of the research.

Second level variables are ownership variables. The individual having these variable owns the issues, i.e., the issues are extremely important, at a personal level. In-depth knowledge (understanding) of issues appears crucial to ownership. Before individuals can engage in responsible citizenship behavior, they must understand the nature of the issue and its ecological and human implications. When individuals have an in-depth understanding of issues, they appear more inclined to take on citizenship responsibility toward those issues.

Next ownership variable is personal investment. In that case, the individual is strongly related with the environmental issue because person has a special interest in it. For example, an individual who thoroughly understands the economics of recycling and who uses a substantial amount of recyclable material and who might feel a substantial personal economic investment in recycling. However, the motivation might not necessarily have to be economic, it could be environmental in nature if the person has good ecological concepts about waste disposal, biodegradability and nutrient cycles and understands the broad human involvement in these things. Recycling might become a strong personal need which could be translated as “personal investment”

Third level variables are empowerment variables that are crucial in the training of responsible citizens. These variables give human beings a sense that they can make changes and help solve important environmental issues. One empowerment variable is perceived skill which can be translated as human beings believing that they have the “power” to use citizenship to help resolve issues. Training also results in improved students’ self concepts and a belief that they have been more fully incorporated into society.

Knowledge of environment action strategies is that the skill component is dependent on the knowledge variable. In the studies that examined behavior, learners gained an in-depth knowledge of issues as well as learning about action strategies. Thus, it would appear unlikely that citizenship action skills taught without issue related knowledge would prompt responsible behaviour in individuals (Holt 1988).

Locus of control refers to an individual’s belief in being reinforced for a certain behavior. A person with an internal locus of control expects that she/he will experience success or somehow be reinforced for doing something. Success, in turn, appears to strengthen his/her internal locus of control. On the other hand, a person with an external locus of control does not believe that he/she will be reinforced for doing something and therefore, probably will not do it. An individual who believes that he/she has good fishing skills is more likely to attempt fishing because there is an expectation of success or reinforcement for this behaviour. This person has an internal locus of control for fishing.

An individual who believes that he/she is powerless to make changes in society probably will not act in a citizenship dimension. There is no expectation of success or reinforcement for acting. This person has an external locus of control for trying to help resolve environmental issues. An improved locus of control may well result when students have had an opportunity to apply these skills successfully in the community.

Intention to act seems also related to the empowerment variable. If a person intends to take some sort of action, the chances of that action occurring are increased. It is likely that this variable is closely related to both perceived skills in taking action and locus of control. Intention to act may also share a synergistic relationship with personal investment.

Other study conducted by Barr (2003) mentioned about campaigning, DEFRA 2002, using a range of media to disseminate environmental information. It focused five environmental behaviors: Water conservation, energy saving, sustainable transport use, waste management and noise reduction. Citizens are urged to find out the “facts” and increase their awareness by appreciating the various savings that can be made by, for example, switching off lights or using a water butt. The campaigning helpfully recognizes the significance of the need for incentives and the necessity for environmental action to be seen as normative behaviour alongside awareness raising.

One other research carried out by Burgess et al (1998) argued that sustainability is predicated on the belief that individuals and institutions can be persuaded to accept responsibility for the production of environmental problems and change their everyday practices to alleviate future impacts. They also argued that behaviour is dependent on a greater range of influences than merely a linear process of information to action, which seeks to fill the “value action gap” in a system that has been described as AIDA (Awareness-Information-Decision-Action). In the study, Barr (2003) summarized the three factors that influence environmental actions as: Social and environmental values; situational factors and psychological variables. The research presented in this paper indicated that waste minimization and recycling behaviours have widely differing antecedents. In terms of recycling, high levels were achieved when convenience was maximized, effort minimized and subjective norms activated. From the recycling viewpoint, individuals appear to be well aware of the need to recycle and generally do so if given the means. The data show that recycling is well accepted by citizens as an activity that is worth undertaking, so long as the means exist. In contrast, waste minimization behaviour is far more infrequent than recycling and appears to be dependent on various value-based and demographic criteria. The evidence presented therefore, points to three flaws in assuming that increasing awareness of environmental problems can change behaviour. In the first instance, behaviour is contingent upon at least three

alternative sets of factors: Personal situation, psychological perception and personality characteristics, and finally environmental values. The second flaw relates to the first in that alternative behaviours, even within the same behavioural realm (such as waste management) have divergent antecedents. The third flaw relates to the implementation of policy in particular awareness campaigns that take little account of the demographic trends in environmental behaviour.

Studies about Water Related Environmental Science Literacy

Environmental science literacy is defined as the capacity to understand and participate in evidence-based decision making about the effects of human actions in environmental systems. The need for an environmentally literate citizenry is evident given the scientific consensus that human populations are fundamentally altering the natural systems that sustain life on Earth. Today, all, citizens need to be able to understand environmental issues and make informed decisions that will help maintain and protect Earth's life supporting systems. For example, individuals should be able to trace water and the materials that water carries through visible and invisible parts of systems. Water can become invisible as it goes underground or evaporates, invisible parts of systems, and it can become visible as it comes up through springs or condenses into precipitation. Similarly, materials in water can take both visible (e.g., sediment, trash) and invisible (e.g. bacteria, dissolved pollutants) forms. As water and other materials cross the boundaries between visible and invisible, they do not cease to exist, and they can be traced through systems in their invisible and visible forms (Coyle, 2005).

Another supportive research was conducted by Covitt, et al. (2009) developed a framework of empirically grounded curricular goals for water-science literacy and documented the challenges that students face in achieving these goals. Water related environmental science literacy requires an understanding of multiple issues ranging from atomic-molecular (changes of state and solutions) to large (watersheds, aquifers and human water-purification and distribution systems). Yet, the authors found that most students do not systematically trace water and other materials through systems and do not account for invisible aspects of water systems at the atomic molecular and landscape scales. The authors discuss curricular implications and the importance of helping students develop a richer understanding of water systems. They came to appreciate that describing visible movements of water is not the same as tracing water or materials that it carries through connected systems. Students who reasoned informally fail to account for water after it is no longer visible (e.g., when the ground soaks it up or when it runs off or evaporates). They also show little awareness of parts of systems that are too small (e.g., molecules in solution) or too large (watersheds) to

be readily visible. On the other hand, environmentally literate citizens can systematically account for water that enters a system (e.g. watershed); every molecule that enters will stay in the system until it leaves, and individuals can trace all those molecules through the system. Likewise, they can systematically trace materials in water-such as pollutants and sediments-as they enter, travel with, and separate from water.

The study conducted by Sobel, Vo, Alred, Dauer and Fores (2017) was about students' scientifically informed decision making about socio-hydrological issues. They mentioned that students need to understand the properties of water and the nature of scientific processes and practices in order to engage effectively with contemporary water-related challenges with scientific and social dimensions. However, students have difficulty in understanding core hydrologic concepts, and more work is needed to determine how they structure their decision making about socio-hydrological issues. In their study, they investigated undergraduate students' decision making with a focus on the resources to make and support their decisions about socio-hydrological issues. They showed that students more effectively form a clear and consistent decision than support their decision with accurate scientific information statements or provide support for their opinion statements. Their findings of the study provide understanding of the development of scientific literacy and engagement with decision making about socio-hydrological issues among undergraduate students. As a result of their study, existing literature was improved by offering a frame by which students can learn to engage in decision making and preliminary analysis of how introductory students consider decision making about socio-scientific issues as a foundation for more work to advance these skills.

Having a connected understanding of water in environmental systems is one important aspect of responsible environmental decision making. Although other aspects including understanding of social and economic systems and personal values and practices are also important (Dietz, 2003), a fundamental understanding of water in environmental systems is essential in helping citizens reason effectively about how human actions impact natural and environmental systems services. Consequently, water science literacy is central to preparing citizens to make informed decisions. Author's research on students' understandings shows that individuals are not developing fundamental water literacy in school. K-12 standard science curriculum does not support students in developing their literacy about water in connected natural and human-engineered systems. Although many domains need to be addressed in preparing students for citizen responsibilities, educators cannot neglect the importance of building a strong K-12 science curriculum and teaching methods that provides students with the tools necessary for making informed decisions.

Teaching Methods Used in Water and Environmental Education

Different kinds of teaching methods are used for water and environmental education. Study conducted by Middlestadt et al. (2001) examined the effect of recommendation water conversation at the household level and impact of using interactive teaching methods to promote conservation behaviors among students and their families. Comparisons were made among 671 students (424 experimental, 247 control) belonging to high school eco-clubs in central Jordan. Most students were girls in rural settings. The experimental group consisted of students whose teachers implemented an interactive curriculum and promoted household water-conservation behaviors. Teachers of students in the control group did not participate in curriculum implementation, but those students were exposed to lectures about biodiversity issues. The results indicated that students who were exposed to the new curriculum demonstrated a higher level of knowledge about water conservation and performed recommended behaviors more often than students in the control group.

One another teaching method implemented for improving water awareness is modeling. It is a core scientific practice for learners in conceptualizing, investigating and explaining natural phenomena and persuading others about their conclusion (Gilbert, 2004). Past research has highlighted the challenges elementary students experience when engaging in modeling (Lehrer & Schauble, 2010). When elementary students are provided both curricular and instructional supports to engage in the practice of modeling, they can learn to use models effectively to reason about complex processes and the dynamics that underlie large-scale systems. One such systems is the hydrologic cycle, a core topic introduced in the elementary grade (NGSS Lead States, 2013). They concluded that students require opportunities to engage in the practices of modelling to learn about the hydrologic cycle. Similarly, Vo et al. (2015) carried out a study with elementary teachers. In their study they emphasized that elementary teachers play a crucial role in supporting students' model based reasoning about natural issues such as water cycle. They mentioned that little research existed about elementary teachers' learning to foster model centered, science learning environment. They conducted an study using qualitative research methods to investigate six 3rd-grade teachers' pedagogical reasoning and classroom instruction around modeling practice (construct, use, evaluate and revise) and epistemic considerations of scientific modelling (generality/abstraction, evidence, mechanism, and audience). Their study findings pointed out that all teachers emphasized a subset of modelling practices- construction and use- and the epistemic consideration of generality/abstraction. There was observable consistency between teachers' articulated conceptions of scientific modelling and their classroom practices. Another finding of the study indicated that a subset of the teachers more strongly emphasized additional epistemic considerations

and, as a result, better supported students to use models as sense-making tools as well as representations. These findings provide important evidence for developing elementary teacher support to scaffold students' engagement in scientific modelling.

One another study about teaching hydrologic cycle with modeling was conducted by Forbes, Zangoni and Schwarz (2015). In their study they mentioned that water was a crucial topic therefore, students should concern themselves articulation, negotiation, and revision of model-based explanations about hydrologic phenomena. However, past research has shown that students, particularly early learners, often try to understand hydrologic phenomena and that scientific modeling remains underemphasized in elementary science learning environments. For this reason, more research should be needed to understand and promote early learners' engagement in domain-specific modeling practices. To answer this need, they made use of design-based research to encourage and search 3rd-grade students' model-based explanations for the water cycle, They reported on the development of a set of empirically based learning performances that comprised K-12 grades. Second, they reported on findings from research investigating 3rd-grade students' model-based explanations within the students generate and highlight both target concepts and modeling practices emphasized in students' model based explanation for hydrologic cycling.

Another study was conducted by Rosen, Scanlon & Smith (2007). They concerned about better ways to educate students about water because current education was failing to promote good decisions about water by citizens and political leaders. They emphasized that current education system create water savvy citizens of tomorrow who will take personal action to ensure effective stewardship of water support evidence-based water policies. Their study the Texas Aquatic Science Project and Curriculum arose after researchers learned that educational enhancements such as an instructional video smart phone application, interactive learning game, or even many of these taken together, would have little effect on fulfilling the objective of Headwaters to Ocean Project to better educate students about water. Where there is no context for integrating use of technology-enhanced educational materials into a course of study, there will be little or no use by teachers or students. Their work indicated that building this context for education about water through Texas Aquatic Science would allow for the integration of technology-based educational products into teaching. But even more important, the new comprehensive curriculum would enable more effective teaching by teachers and better learning students about water in the classroom and through informal place-based experiential education.

Studies Conducted about Water and Environmental Education in Turkey

A wide range of solutions to environmental problems are proposed by many researchers. Education provides the most important solution for preventing environmental problems before it emerges (Şimşekli 2001). Many researchers in Turkey conducted study about students' attitudes towards the environment (Önder, 2015; Tuncer et.al., 2009; Kahyaoğlu, 2009). The attitudes affect how individual relate to the other people and to all our activities in the environment, and so have major influence on our prospects for achieving a sustainable water and environment. Having positive attitudes towards environmental protection can be seen as serious steps for problem solving. The study conducted by Önder (2015) examined the attitudes of primary school students toward environment in terms of gender, whether they live in a house with garden or not; they have pets or not, their schools have environmental clubs or not, if they are participated in the club activities or not, if they participate in the environmental or scout camps or not, whether they plant or not. Results showed that girls' environmental attitudes are more positive compared to the boys'. However, there is no significant difference between the scores of boys and girls towards environment in terms of living in house with garden or not, having a pet or not, having clubs at school or not. The findings also showed that the students who participate in club activities have more positive attitudes towards the environment compared to the students who do not participate in. In addition, the students' participation in environmental camp does not a cause a significant difference on their environmental attitudes. Also, there is no significant difference between the attitudes of the students who plant and do not plant. In their research Tuncer et. al. (2009) concluded that individuals are aware of the importance of environmental issues although they do not imply the awareness in their life style.

The study conducted by Kahyaoğlu (2009) argued that environmental problems cannot be solved by using technology and legislation, because solving these problems are related to attitudes and values of the people. In another study Gaye et al. (2009) investigated environmental literacy of pre-service teachers at public universities in Turkey. The results showed that environmental background of pre-service teachers is positively related to environmental literacy and students' attitudes in favor of gender. Taştepe and Aral (2014) studied with 3rd year undergraduate child development students enrolled in the elective course "Child and Nature", for their evaluation of the course as well as to reveal their perspectives on environmental awareness. The results of the study showed that while the "Child and Nature" course sufficiently covers environmental problems, its shortage of lecture hours and lack of real life application reduce the effectiveness of environmental problem coverage.

When looked studies searching about relationship between attitudes and students' age, it was advised that the environmental sensitivity of families ought to be encouraged by implementing ecological activities from small aged children to elderly people (Kahyaoğlu, 2009). In his study Alim (2013) found that the third year students educated with basic concepts of the environment are more successful than the first year students who have not taken any course about the environment and showed the differences which can be accounted for the gender although it is a general consensus that these differences fade away depending on their attainment of the environmental education.

Beside to studies about students' attitudes, some studies are about the instructional methods used in environmental education in Turkey. For example, Kahyaoğlu & Kaya (2012) argued that lecturing is not enough to internalize the environmental issues. Currently, student in many schools of different countries are taught with active learning method rather than just lecturing knowledge. Eco-schools are example to these teaching method (Kahyaoğlu & Kaya, 2012) studied a water school workshop with students. The data were gathered through qualitative and quantitative instruments before and after the water school. The results showed that the water school is generally effective on the students' conception about water, attitudes toward water usage, awareness of environment and general opinions related to the water. Some other studies argue that developing students' sensitivity to the environment can be improved by cooperation with non-governmental organization (Taştepe & Aral, 2014; Kahyaoğlu & Kaya, 2012). In this context, UNESCO, UNEP, Ministry of Environment, Universities, Municipalities and some non-governmental organizations (NGOs) studied about environmental education in Turkey. Environmental issues covered in the education because curriculum is not enough for improving environmental awareness (Ünal et al., 1999, Kulköylüoğlu, 2000, Kiziroğlu 2000, Şimşekli 2001). In this respect, Taştepe & Aral (2014) suggested to develop individual's environmental knowledge, skills and attitudes together with theoretical and active learning methods.

Conclusion and Recommendations

Environmental problems grow gradually and their effects are felt in various ways. Among the various solutions offered to solve these problems, enhancing individual responsibility towards water and environmental issues has been considered as priority. Thus, education provides the most important solution for preventing environmental problems before it emerges (Şimşekli 2001). For this reason, teaching responsible citizens who have knowledge, experience, skills, values and attitude should be the primary goal to conserve water and environment.

The results of this study concerning environmental literacy show that the students who have difficulty in understanding core hydrologic concepts, water cycle, conservation of matter and water. Particularly, early learners often have difficulty in conceptualization and explaining water-related phenomena, for example groundwater and subsurface dimensions of the water cycle (Forbes, Zangori, & Schwarz, 2015). Students who reasoned informally fail to account for water after it is no longer visible (e.g., when the ground soaks it up or when it runs off or evaporates). Water can become invisible as it goes underground or evaporates, and it can become visible as it comes up through springs or condenses into precipitation. They also show little awareness of parts of systems that are too small (e.g., molecules in solution) or too large (watersheds) to be readily visible. On the other hand, environmentally literate citizens can systematically account for water that enters a system (e.g. watershed); every molecule that enters will stay in the system until it leaves, and individuals can trace all those molecules through the system. Likewise, they can systematically trace materials in water-such as pollutants and sediments-as they enter, travel with, and separate from water (Covitt et al, 2009). From these results it can be concluded that, all citizens need to be able to understand environmental issues and make informed decisions that will help to maintain and protect Earth's life supporting systems. For this reason, they have to know complex and abstract issues for making decision and solving problems related with water and environment. In addition, current concepts such as, water footprinting, participation in decision making for environmental issues, polluter pays principle of environmental law, water treatment, the treatment stages of drinking water need to be embraced and have to be integrated into curriculum by considering students' conceptual level, for educating responsible individuals towards water and environmental conservation.

The results of the study concerning environmental objectives and variables have shown that there are many important responsible citizenship variables such as having empathetic perspective about environmental problems, having active role in environmental issues, having awareness about these issues, having self esteem to solve environmental issues, having perception that they can make charges and help solve important environmental issues, having improved self concepts and a belief that individuals have been more fully incorporated into society, locus of control, personal investment (Covitt, 2009), understanding waste management, waste minimalization and recycling (Burgess et. al,1998). It can be noticed that these variables are mostly related with emotions/affections and values.

These type of responsible citizen variables, can be developed by student-centered active learning methods such as video smart phone applications, interactive learning and modelling. They are suitable for water and environmental education

(Kahyaoğlu & Kaya, 2012; Taştepe & Aral, 2014,). On the other hand it should not be ignored that responsibility of individuals cannot occur without knowledge (Holt 1988). There is mutual interaction between teaching cognitive skills, such as, issue related knowledge and teaching emotional/affective skills.

The research about environmental education in Turkey mainly focused on emotional variable, the attitudes and awereness of students towards the environment and methods of teaching water and environmental issues (Çoban et. al. 2011; Kahyaoğlu & Kaya, 2012; Taştepe & Aral, 2014). They argued that The 2005 Science and Technology Course Curriculum, in which environmental education topics are given, is not designed to equip students about environmental issues (Taycı & Uysal, 2009). The results of this literature review also support this information and indicate that the instruction must go beyond an awareness or knowledge transfer thereof environmental issues should become an integral part of the instruction designed for behavioral change. In other words, objectives of instruction should encompass not only knowledge, attitudes, and skills, but also create emphatic perspective towards the environment and active participation in the society. Students must be given the opportunity to develop an environmental sense and are prompted to become responsible and active citizens.

Recommendations for Teaching Responsible Citizenship

Developing responsible citizenship needs to be taught fostering both cognitive and emotional/affective skills. For improving cognitive skills, educators should make deep content analysis to emerge what students know, which topics they have difficulty in and how to teach the difficult topics. Therefore, existing curriculum concerning about water and science issues should be analyzed in detail to find out what it is required in order to increase the number of water and science literate citizens. While arranging the water and environmental education, individual's cognitive level should be considered from kindergarden to university, because students' from different ages have different conceptual understanding level (Ahioglu-Lindberg, 2011). Therefore, curriculum should be designed with respect to conceptual level. Content should be organized from simple to complex, from concrete to abstract.

Educators should implement student-centered instructional methods that help citizens having a deeper understanding of water and environmental conservation and developing skills to make informed and responsible decisions such as hands-on, inquiry based, and applicable to life. For improving emotional/affective domains such as values and attitudes, students should participate actively to the learning process. For example, educators can hold a discussion on what citizenship means including the

rights and responsibilities of the citizens. It should also be provided the environment where students share personal stories on solutions to water related and environmental problems. Encouraging to write a poem, story, play or song about citizenship are also good examples for teaching values and attitudes. In addition, the students can be asked to search for local citizens who contribute to the creative solutions to water and environmental problems. Motivating or honoring the students is another advisable way to teach values and attitudes. Individuals can be encouraged to read, analyze and debate on newspaper articles related to the topics concerning water and environment. Guest speakers may be invited to share their knowledge of water and environmental issues. Students should be encouraged to visit science museums and national parks. They may be motivated to participate in community service projects related to water and environmental issues.

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**Extended Turkish Abstract
(Geniřletilmiř Trke zet)****Suyun Korunmasında Kalıcı zm: Her Yařtan Sorumlu Yurttařların Eđitimi**

Bu alıřmada, su ve evre eđitimi ile ilgili gncel arařtırmalar gzden geirilerek bireylerde suyu ve evreyi korumak iin sorumlu vatandařlık davranıřları kaznadırmak maksadıyla su ve evre eđitimi kapsamında neler yapabileceđi tartıřılmıřtır. evre sorunlarına ok eřitli zm yolları nerilse de sorunların kaynađında, ortaya ıkmadan nlenmesi en kayda deđeridir. Bunun iinde en nemli faktrn eđitim olduđu birok evrelerce kabul edilmektedir. Bu nedenle alıřmada, su ve evre eđitimi ile ilgili gncel arařtırmalar gzden geirilerek sorumlu vatandařlar yetiřtirmek maksadıyla su ve evre bilimi eđitimi konusunda mevcut durum tespiti yapılmıř eđitimcilerin neler yapabileceđi tartıřılmıřtır. alıřmada yapılan literatr taramasının drt ana bařlıđı bulunmaktadır: Su ve evre sorunları konusunda sorumluluk sahibi vatandař deđiřkenleri; su ve evre bilimi okuyazarlıđı ile ilgili alıřmalar; su ve evre eđitiminde kullanılan đretim yntemleri ve Trkiye'de su ve evre eđitimi zerine yapılan alıřmalar.

alıřmada yapılan literatre taraması sonucu, su ve evre sorunlarına karřı sorumlu yurttařlarda olması gereken davranıřların su ve evre olaylarına karřı empati kurmak, evre sorunları hakkında aktif rol almak, bu konularda bilinli olmak, evre sorunlarını zmede kendine gveninin olması, atık ynetiminin anlařılması, su ve evre sorunlarını zebileceđi ve deđiřtirebileceđini dřnmesi, sorumluluk alabilme algılamaları, nemli evresel problemleri zmeye yardımcı olma, kendine zg konseptler geliřtirme ve bu konudaki inanları geliřtirme, kiřisel yatırım, isel motivasyon (Covitt, 2009), atık ynetimini, atıkların minimumlařtırılmasını ve geri dnřmn anlamak (Burgess ve diđerleri, 1998) gibi birok nemli deđiřkenin olduđunu gstermiřtir. Bu deđiřkenlerin birođu biliřsel olduđu kadar duyuřsal ve deđerlerle ilgilidir.

Yapılan literatr taramasının ıktıları bireyin su ve evreyi korubilmesi iin gerekli olan suyun zellikleri, hidrolojik dng, suyun gzle grlemeyen molekular zellikleri, suyun halleri, havza kavramı, maddenin korunumunu ve bilimsel srelerin niteliđi konularını anlamada glk ektiđini gstermiřtir. rneđin, suyun yeraltına getiđinde ya da buharlařtıđında grnmez olması ilkokul đrencilerine anlařılması zor gelmektedir. Bununla birlikte suyun gzle grlmeyen molekler boyutu gibi suyla ilgili kavramların en byk boyutu olan havza konusunu da anlamakta glk ekmektedirler. Fakat su ve evre konularında okuyazar đrenciler, her bir su moleklnn ekosisteme girmesini ve hareketini takip edebilecek yeteneđe sahip olduđu tespit edilmiřtir. Ayrıca, suya kirletici olarak katılan materyalleri takip edebilmektedirler. Bu nedenle, suyun ve evrenin korunması iin bireylerin evre konularını analiz edebilecek ve deđerlendirme yapabilecek derecede bilgiye sahip olmaları gereklidir.

Sorumluluk sahibi vatandař davranıřlarını artırmak iin bireyin su ve evre konularında aktif katılımını ve karřılıklı iletiřimi artıran, soyut kavramları somutlařtıran modellemeler gibi đrenci merkezli đretim yntemleri uygulanmalıdır. Sonu olarak, her yařtan sorumlu vatandařlar yetiřtirmek iin su ve evre okur-yazarlıđı gibi biliřsel becerilerin yanı sıra, su ve evreye ynelik deđerler ve tutumlar gibi duyuřsal becerilerin okul mfredatına entegre edilmesi gereklidir. Ayrıca su ayak izi, suyun artımı, ime suyunun evlere ulařana kadar getiđi evreler, evre Kanunu'nda yer alan kirleten der ve katılımcılık prensibi gibi bireylerin su ve evrenin korunmasında aktif sorumluluk ve katılımını n plana ıkaracak ve onları su ve evre konularında bilinli ve sorumlu bireyler haline getirecek konular, mfredata yerleřtirilmelidir.

Çalışmanın diğer sonuçları da; eğitimin, çevresel sorunların ortaya çıkmadan önlenmesi için en önemli çözümü sağladığı; Türkiye’de çevre eğitimi ile ilgili yapılan çalışmaların çoğunun öğrencilerin çevreye karşı tutumları ile ilgili olduğu tespit edilmiştir. Sonuç olarak tüm yaştan su ve çevre korumaya sorumlu vatandaşlar yetiştirmek için su ve çevre konuları okur-yazarlığı gibi bilişsel becerilerin yanı sıra, çevre olaylarına karşı empatik perspektif geliştirmek, çevre olaylarına karşı empati geliştirmek, su ve çevreye yönelik değerler ve tutumlar gibi duyuşsal becerilerde okul müfredatına entegre edilmelidir. Sonuç olarak her yaştan su ve çevre konularına duyarlı ve sorumlu yurttaşlar yetiştirebilmek için geleceğin su ile ilgili karar mekanizmalarında yer alacak, geleceğin ebeveynleri olarak toplumu oluşturacak bireylerin, öğrencileri merkeze alan, bilişsel yetenekler kadar duyuşsal yetenekleri geliştirmeyi hedefleyen, doğaya ve insana duyarlı, değerleri ve tutumları ön plana alan bir eğitim sistemi ile eğitilmesi gereklidir.