Green Energy and Technology

Ibrahim Dincer
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Environmentally-Benign Energy Solutions

Springer

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Preface

Environmental problems, including air, water, and soil pollution as well as climate change, have become major concerns to many in achieving a sustainable future. Such problems need to be overcome both locally and globally through joint efforts in all sectors, including government, industry, and academia. Several abatement methods and solutions have been proposed during the past decade to reduce the negative impacts of these environmental problems and utilize energy resources more effectively. Researchers, engineers, and scientists from different disciplines have proposed new materials, designs, and modeling approaches for improving the performance of the renewable and alternative energy technologies and reducing the emissions from the conventional energy technologies in this regard.

This book consists of four key sections on *environmental issues and strategies*, *renewables and waste management*, *system analysis, modeling, and simulation*, and *alternative materials and designs* which are based on numerous invited conference papers which were selected from the 7th Global Conference on Global Warming (GCGW-2018), which was held in Izmir, Turkey, between June 24–28, 2018. This conference aimed to provide a forum for the exchange of technical information, dissemination of high-quality research results, presentation of the new policy and scientific developments, and promotion of future priorities for more sustainable development and energy security. Participants from all disciplines related to global warming (e.g., ecology, economics, education, engineering, information technology, management, natural sciences, physical sciences, and social sciences) contributed to this unique event. The recent research findings in several topics linked to global warming included sustainable transportation, hydrogen energy and fuel cells, energy storage systems, bioenergy, wastewater management, sustainable buildings, refrigeration systems, solar energy, wind energy, geothermal energy, computational fluid dynamics, energy conversion and storage, and environmental policies and strategies.

This edited book covers a number of major topics linked to global warming, including material, design, analysis, assessment, evaluation, improvement, modeling, and optimization. We hope that this edited book will provide a unique source of impact and solutions to global warming. The editors of this unique edited book

would like to warmly thank the editorial team of Springer and all contributing authors for their efforts that have made this book a true and unique source of information.

Oshawa, Canada — Dr. Ibrahim Dincer
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Environmental Problems and Solution Proposals from the Perspective of Secondary School Students

Ebru Güller, Ayça Tokuç, Gülden Köktürk and Kutluğ Savaşır

Abstract The problems we face today such as climate change are a product of the society's current outlook on the environment. Therefore, finding and implementing a solution requires a different outlook. One approach can be a systematic change in schooling children on these concepts. This paper presents the preliminary results of a project that focuses on creating awareness on the concepts of natural and built environment and their interaction with each other. The project involved 130 students, who have different socio-economic backgrounds, academic and art achievements, from six secondary schools. One part of the project involved the determination of the most important natural and built environmental problems and solution proposals according to participants in groups consisting of four–five participants in a group setting. During this study, they discussed their problems and proposals within a wider setting including other participants and supervising academicians. This chapter groups and discusses these problems and solution proposals. The results indicate that most of the children are aware of many problems such as environmental pollution, which was the most discussed topic. Yet, some important problems were not mentioned, and energy management was the least detailed and understood issue in the discussions.

Keywords Children and architecture · Nature · Environmental awareness · Environmental perception · Natural environment · Built environment

1 Introduction

Sustainable development and climate change are interrelated topics that define complex systems with lots of variables. Research shows these problems to be mostly human induced [1, 2]. These problems are the product of the society's current outlook on the environment as a source that can be utilized as necessary. Since the

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efficiency of any system involving humans depends on human behaviour, the solution also requires a different outlook. It is vital to create collective action in society to spread a sustainable lifestyle. Studies to better understand the pro-environmental behaviours of humans are numerous, yet the factors that predict engagement with nature are not universal. Personal factors include childhood experience, knowledge and education, personality and self-construal, sense of control, values, political views and worldviews, goals, felt responsibility, cognitive biases, place attachment, age, gender and chosen activities [3]. Social factors include religion, urban versus rural residence, norms, social class, proximity to problem sites and cultural and ethnic variations [3].

A number of theories and policies to change the interaction of humans with their environment were proposed [4, 5]. In this context, one of the ways to create individual engagement with energy issues is communication through messages and education. Scannel and Gifford [6] interviewed 324 residents living in three regions of British Columbia to learn their perceptions on climate change problem, the strength of their attachment to their local area and their personal engagement with the issue. They found place attachment, receiving the local message and gender (female) as significant predictors of engagement. Bertolotti and Catellani [7] researched the framing of climate-related policies by policy-makers and the media, either in terms of achievement of potential gains or in terms of avoidance of potential losses. They carried out two studies on university students and found that a message is more persuasive when its outcome and the regulatory concerns underlying the policy "fit". More specifically, while a message on "growing" of renewable energy resources was more persuasive when the content emphasized positive "growing", conversely a message on "avoiding" greenhouse gas emissions was more persuasive when it was framed in terms of "avoiding" negative environmental consequences. They also found that the focus of the participant played an important role in persuasiveness. While these studies focus on intentions and self-reported behaviour, Kormos and Gifford [8] did a meta-analysis and found that the correlation between intentions and actual behaviour was 0.45, which corresponded to about 20% of overlap between them. Psychology-based interventions on how to use a building can modify behaviour and cause high reductions in energy consumption, for instance Matthies et al. calculated there can be decreases of 43% electricity and 10% heating energy consumption after such interventions [9].

Education is an effective way to increase pro-environmental human behaviour. The positive interventions can be supported and sustained [10], or critical thinking on climate change issues can be assimilated into the education environment [11] in a structured setting such as a school. Stanford University studied the effects of environmental education on school children all the way from infant school to high school. After researching more than a hundred scientific studies published on the subject from 1994 to 2013 by other institutions, they concluded that 83% of school children improved their ecological behaviour and 98% scored better in other subjects such as maths and science [12]. However, when we look at Turkey's conditions, neither the living environment nor the present education system encourages more ecological behaviour [13, 14]. Since an educational environment that will enable children

to experience sustainability is lacking in Turkey, it can be said that the education programme is also insufficient in environmental education [15]. Knowledge transfer, which is restricted to science courses, does not question the relationship between the natural and the built environment. Although the courses on environmental education, which are included in the current primary education programme as an elective course, provide a certain amount of knowledge in this field, unfortunately, they do not fully realize their goals in an education model mainly based on memorization. Therefore, there is a need for interactive, practical studies based on active education to raise environmental awareness amongst children [14, 16]. Many actors including Children Universities, the Chambers of Architects, and people studying this field, carry out independent studies in order to establish the relationship between children and the environment. For example, TMMOB Chamber of Architects of Ankara Branch started Child and Architecture studies in 2002. Numerous professional volunteers (architects and volunteers from other professions) have been searching for what can be done in order to instil environmental awareness in various primary and secondary schools through focused workshops [17]. The Scientific and Technological Research Council of Turkey (TUBITAK) supports the projects to be organized in order to raise awareness on nature, science and technology within the 4004 Education in Nature and Science Schools Program since 2007 [18].

Creating awareness by gaining an environmentally sensitive mindset via education would be more efficient beginning from children's age, when a person learns values and behaviours. Knowledge of nature, examination of the interaction between natural and built environment and obtaining environmental consciousness from a young age are significant in terms of internalizing sustainability as a lifestyle [19, 20]. For this purpose, the perception of natural and built environment of secondary school students in terms of environmental education and awareness is the topic of this chapter. Research shows that the individual's current attitudes and knowledge play an important role in framing the message [3]; therefore, this study proposes and presents the results of this project that aims to increase environmental consciousness, gain knowledge about nature and love of nature. "The Nature and Architecture for Little Designers Project" is designed with this consciousness and consists of various activities that complement each other. It is mainly set up as nine activities: "First Meeting", "Pre-test", "Environmental Awareness", "We are Inspired by Nature", "What Kind of a Creature?", "Nature and Architecture", "What Kind of a Nest?", "Presentations of the Groups" and "Post-test". Six workshops realized in 2017–2018 on the relationship between nature and architecture by experimenting with differing design themes in secondary schools. The education took place from 9:00 to 17:00, and the students talked, thought and gained knowledge about the environment; they worked in groups and designed their own living beings and home for these beings during the workshops. The project was supported and continued for the next year, and its results are being evaluated, when this chapter is being written. The context of this chapter is the results of the "Environmental Awareness" activity of the project held in 2017–2018. It details and discusses the results from 130 participants.

2 Environmental Awareness

The environmental awareness activity aimed to create awareness on the concepts of natural and built environment and their interaction with each other in a school setting. It was designed to detect current environmental problems through the eyes of secondary school students and to increase environmental awareness and sensitivity to the environment while developing solution proposals for these problems.

The participants were students in the 5th, 6th and 7th grades of secondary schools, which corresponds to 10–12 years old, within the Konak Municipality of Izmir. In line with the decision of the project team, the six schools in the project were determined by the İzmir Konak District National Education Directorate, three of them in the socio-economically disadvantaged regions and the other three in the advantageous regions. So, the students would be selected from different socio-economic backgrounds. There were seven students from each grade with a balance between genders. The students took permission from their parents to participate in the project. In this context, children with high academic achievements, strong artistic aspects, ability in different fields, cognitive and creative aspects were included in the study. In addition, children, who were dominant or silent or noncompliant in the classroom, who had concentration problems, etc., were also included in the project. The research involved 130 students in total from six secondary schools.

Environmental awareness activity of the Nature and Architecture for Little Designers project is designed as an interactive, participatory and productive programme. The activity was carried out in six schools on different days. In each school, students formed groups of 4–5 people around one desk. The groups consisted of at least one student from each grade with a balance between genders. The activity was done in an interactive workshop format and took about an hour. The students talked, thought and gained knowledge about the environment, and they worked in groups during the activity.

Firstly, the topics of the natural environment, built environment, architecture and sustainability were conversed with the students through questions and answers. Students evaluated the current environmental problems and their solutions in groups. They discussed amongst their groups to identify the most significant five environmental issues and solutions and wrote these issues on coloured post-its—pink for problems and green for solution proposals. The questions discussed included how to ensure harmony and balance between nature and architecture. The comments and suggestions of the children, the main problems that the children decided on as a group and their suggestions for solutions are collected in the panel by means of post-its. Later, the groups talked about the issues they identified and why they thought these were significant in an interactive question–answer session (Fig. 1). Meanwhile, the keywords of the groups were aggregated on the board.

Fig. 1 Pink and green post-its (left); a group discussing their post-its with the other participants (right)

3 Results

Within the scope of this study, perception of natural environment and existing environmental problems were determined from the viewpoint of the students via group studies and conversations. An interactive environment has been created, where the keywords for natural and built environment are discussed by the group. Headings and solutions are combined when sharing between groups. Mutual information sharing is provided.

In the environmental awareness activity, the groups discussed and listed the most significant problems they perceived in the balance between the built and the natural environment and generated solutions for these problems. These problems and solutions are given and grouped in Tables 1, 2, 3, 4, 5, 6, 7, 8 and 9. According to the group discussions, nine main headings of problems are determined. These are environmental pollution, failure to protect the natural environment, harming animals, global warming, energy management, insufficient recycling, problems of built environment, traffic problems and negative effects of technology. There were 43 subheadings of problems in total. A total of 155 solutions were proposed and aggregated into 111 solutions.

Table 1 Problems determined by students: environmental pollution

Problems		Solution proposals	Kazım Karabekir MS.	Misak-ı Milli MS.	Necati Bey MS.	Rıdvan Nafiz Edgüer MS.	Güzelyalı MS.	26 Ağustos MS.
Environmental pollution	Throwing trash to the environment	Surveys should generate awareness				☐		
		People and community should gain awareness	☐				☐	☐
		Children should be made conscious; they should study about environment pollution at school		☐				☐
		Recycling consciousness should be created			☐			
		More garbage containers should be put on the streets	☐				☐	

(continued)

Table 1 (continued)

Problems		Solution proposals	Kazım Karabekir MS.	Misak-ı Milli MS.	Necati Bey MS.	Rıdvan Nafiz Edgüer MS.	Güzelyalı MS.	26 Ağustos MS.
		Increasing recycling containers	☐					
		Waste substances should not be thrown to the nature						☐
		Garbage refinement factories	☐					
		Not leaving trash in picnic areas, putting waste bins in forests to raise consciousness		☐	☐	☐		☐
	Polluted air from factories and waste harm the nature	Mandatory factory audits. This audit aims to make sure that factory waste is not disposed of in nature					☐	

(continued)

Table 1 (continued)

Problems		Solution proposals	Kazım Karabekir MS.	Misak-ı Milli MS.	Necati Bey MS.	Rıdvan Nafiz Edgüer MS.	Güzelyalı MS.	26 Ağustos MS.
		Giving special education to factories				☐		
		Installing filters on factory chimneys	☐	☐	☐	☐		
	Water pollution	Not spilling oil from ships and factories to pollute water					☐	
		Installing filters to sinks					☐	
		Water treatment plants	☐					
		Dirty water should not flow to lakes and rivers from sewer pipes		☐				☐

(continued)

Table 1 (continued)

Problems		Solution proposals	Kazım Karabekir MS.	Misak-ı Milli MS.	Necati Bey MS.	Rıdvan Nafiz Edgüer MS.	Güzelyalı MS.	26 Ağustos MS.
	Air pollution, ozone layer depletion	Installing filters in factory pipes and building chimneys		☐	☐	☐	☐	☐
		Usage of public transit vehicles instead of cars			☐	☐		
		Hybrid cars			☐			
		Planting trees			☐			
		Using natural gas instead of coal		☐		☐		
		Decreasing the use of stoves		☐				

(continued)

Table 1 (continued)

Problems		Solution proposals	Kazım Karabekir MS.	Misak-ı Milli MS.	Necati Bey MS.	Rıdvan Nafiz Edgüer MS.	Güzelyalı MS.	26 Ağustos MS.
		To inform factory directorships and to work for prevention of smoke damage to the environment						☐
	Sea pollution	Making people conscious about sea pollution				☐		
		Waste reduction; not disposing of waste into the sea			☐	☐		☐
		Waste recycling instead of throwing waste into the sea	☐		☐			

(continued)

Table 1 (continued)

Problems		Solution proposals	Kazım Karabekir MS.	Misak-ı Milli MS.	Necati Bey MS.	Rıdvan Nafiz Edgüer MS.	Güzelyalı MS.	26 Ağustos MS.
		We must not pour oil into sinks			☐			
		Placing waste bins in shores	☐		☐			
		Raising awareness to not pour factory wastes into the sea		☐				
	People being unconscious and insensitive against the environment and nature, polluting nature	Installing filters to factory chimneys			☐			
		Increasing the use of public transport			☐			
		Recycling instead of burying batteries to ground			☐			

(continued)

Table 1 (continued)

Problems		Solution proposals	Kazım Karabekir MS.	Misak-ı Milli MS.	Necati Bey MS.	Rıdvan Nafiz Edgüer MS.	Güzelyalı MS.	26 Ağustos MS.
		Giving conferences in various places					☐	
		Establishing nature education schools to increase awareness in people				☐		
		Being sensitive to nature and not polluting environment	☐					
		Not building homes on forests, not cutting trees, not eliminating oxygen	☐					

(continued)

Table 1 (continued)

Problems		Solution proposals	Kazım Karabekir MS.	Misak-ı Milli MS.	Necati Bey MS.	Rıdvan Nafiz Edgüer MS.	Güzelyalı MS.	26 Ağustos MS.
	Cause fires due to glasses thrown on the floor	Writing articles, preparing posters to educate people				☐		
		We can write survey questions on trash cans so that people can throw into the waste bins according to directions		☐				

Table 2 Problems determined by students: failure to protect the natural environment

Problems		Solution proposals	Kazım Karabekir MS.	Misak-ı Milli MS.	Necati Bey MS.	Rıdvan Nafiz Edgüer MS.	Güzelyalı MS.	26 Ağustos MS.
Failure to protect the natural environment	Lack of adequate forests	Projects to increase forests should be made attractive					☐	
	Trees are inadequate, plants and trees to be insufficient	Trees should be planted instead of buildings that are not in use by anyone or unfinished					☐	
		Plant and tree planting can solve both the air pollution and the lack of greenery					☐	

(continued)

Table 2 (continued)

Problems		Solution proposals	Kazım Karabekir MS.	Misak-ı Milli MS.	Necati Bey MS.	Rıdvan Nafiz Edgüer MS.	Güzelyalı MS.	26 Ağustos MS.
		Project like tree planting in schools at October should be done				☐	☐	
		Two trees should be planted for each new building. There should be more green space instead of buildings						☐
	Unconscious tree cutting	To raise awareness of people to prevent the cutting of trees, especially young trees		☐		☐		

(continued)

Table 2 (continued)

Problems		Solution proposals	Kazım Karabekir MS.	Misak-ı Milli MS.	Necati Bey MS.	Rıdvan Nafiz Edgüer MS.	Güzelyalı MS.	26 Ağustos MS.
		To warn people, to plant seedlings	☐					
		We need to do less damage to natural structures in our environment			☐			
		People should understand the importance of trees, should not either cut or allow others to cut trees			☐			☐
		Plant more trees in place of cut ones	☐	☐	☐	☐		☐
		We should recycle paper or similar materials		☐				

(continued)

Table 2 (continued)

Problems		Solution proposals	Kazım Karabekir MS.	Misak-ı Milli MS.	Necati Bey MS.	Rıdvan Nafiz Edgüer MS.	Güzelyalı MS.	26 Ağustos MS.
		Should prevent the use of natural gas		☐				
		Should use the pens and papers economically, prohibit cutting trees for pleasure and punish persons who cut trees arbitrarily						☐
	Destroying trees cause oxygen deficiency, decreasing of trees and oxygen	Should work on planting trees	☐	☐				
		Renewable energy sources should be increased		☐				

(continued)

Table 2 (continued)

Problems		Solution proposals	Kazım Karabekir MS.	Misak-ı Milli MS.	Necati Bey MS.	Rıdvan Nafiz Edgüer MS.	Güzelyalı MS.	26 Ağustos MS.
	Failure to protect the green areas	Teach people to ensure that they do not harm green areas						☐
	Failure to protect the seas	Should not spill bunker fuel to sea, and rescue of marine animals from garbage			☐			
	Disrespect for natural beauty	Organize congresses in the name of nature and to raise awareness		☐				
	Forest fires	Should teach people in a cautious way				☐		

(continued)