

Can project-based learning close the gap? Turkish student teachers and proenvironmental behaviours

Ahmet Kılınc

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According to environmental education scholars, most people do not use their environmental awareness to behave proenvironmentally. Scholars therefore believe that there is a gap between humans' cognitive and behavioural patterns. On one hand, a plethora of factors, such as religion, culture, self-efficacy, emotions, and so on, may be responsible for this gap. On the other hand, the ways we try to create environmental awareness may be problematic. The present study addresses the latter issue. Instead of conveying shallow environmental information, we foresaw that an action-oriented program would provide fruitful conclusions. To this end, the aim of this study was to examine the effectiveness of a project-based learning environment as an action-oriented method for developing proenvironmental behaviours. 33 student teachers, who took project-based Environmental Science course, in the 3rd year of Elementary Science Teacher Training Program at Ahi Evran University, Turkey, voluntarily participated in the present study and responded the questionnaires. A mixed design with quantitative and qualitative methods was used for the data analysis. The qualitative part consisted of a questionnaire including two open-ended questions. Content analysis was employed to examine these data. In the quantitative analyses, descriptive statistics, t-tests, and ANOVA were used. The findings of present study suggest that the project-based learning environment caused positive changes in student teachers' behaviours regarding environmental protection. The paper concludes with a discussion about the relationships between environmental education and science, socio-cultural issues, and educational implications.

Keywords: proenvironmental behaviours, project-based learning, behavioural change

Introduction

Technological developments, globalisation, and the increasing needs of the human population threaten the natural environment more than ever before. In addition to local problems, humans face impinging global environmental problems, such as global warming and ozone depletion. Currently, a major body of scientists from different disciplines agree that the environmental crisis is, to a significant extent, based on people's behaviours and patterns of thought (Tikka, Kuituren,

& Tynys, 2000). It is therefore necessary to create new environments in order to encourage people to develop more proenvironmental behaviours.

However, changing behavioural patterns to ones that are more responsible is a difficult task (Hines, Hungerford, & Tomera, 1987; Kollmuss & Agyeman, 2002). Early models of behavioural change in an environmental context were based on the assumption that if one becomes more knowledgeable about the environment and its associated topics, one, in turn, will become more aware of the environment and its problems. This will result in increased motivation to act in environmentally friendly ways (Burgess, Harrison, & Filius, 1998; Cottrell, 2003). Such 'information deficit models' assume that there is a comparatively direct, positive relationship between a people's knowledge about environmental problems and their behaviours to reduce these problems. Some studies have demonstrated that knowledge and behaviour are essentially linked (Mogensen & Nielsen, 2001; Yencken, 2000). In many other cases, however, it seems that there is not a robust relationship between knowledge and appropriate action (Hungerford & Volk, 1990; Kollmuss & Agyeman, 2002; Rajecki, 1982). Thus, there exists what has been termed a 'gap' between knowledge and action (Kollmuss & Agyeman, 2002).

A number of factors, such as social norms (Corraliza & Berenguer, 2000), perceived self-efficacy (Devine-Wright, Devine-Wright, & Flemming, 2004), pre-experiences (Mainteny, 2002), religion (Adelekan & Gradegesin, 2005), cultural traditions (Aytülkasapoğlu & Ecevit, 2002), risk perception (Sunblad, Biel, & Garling, 2007), locus of control (Alp, Ertepinar, Tekkaya, & Yılmaz, 2008), and anticipated emotions (Carrus, Passafaro, & Bonnes, 2008) are considered to be responsible for this gap. In addition, this gap may be apparent because our definition of knowledge has been too restricted, and our educational goals have therefore been too narrow. According to Jensen (2002), there are two reasons why knowledge *per se* does not lead to action and behavioural change. One reason is that traditional knowledge about the environment, as taught in school, is not action-oriented, whereas the other is that environmental education at school has traditionally focused on conveying knowledge to students who have not been afforded the possibility of actively appropriating and internalising that knowledge (Kılınç, Boyes, & Stanisstreet, in review a)

In addition to these reasons, the teachers' effects on students in the learning process are inevitable. When it comes to the behavioural gap, the gaps that teachers possess will cause automatic relative gaps in their students. Accordingly, interventions in teacher education are crucial in order to educate environmentally friendly generations. Accepting Jensen's (2002) assumption, it is likely that an intervention based on action is useful in closing these gaps. To this end, the aim of this study is to examine the effectiveness of a project-based learning environment, as an action-oriented intervention, in changing Turkish student teachers' behaviours related to environmental protection or the closing of gaps between their cognitive and behavioural patterns (if any exist). In order to reach this purpose, the research questions raised in this study were two-fold:

1. Are project-based learning environments influential in directing student teachers to more proenvironmental behaviours?
2. Which types of projects can be used in environmental education in order to create robust behavioural change?

Methods

Questionnaire Design

A questionnaire composed of two open-ended questions was developed by the author. On the coversheet, participants were informed about the purposes of the study and were assured that the results would be anonymous. In addition, the student teachers were asked not to write their names on the questionnaire. In the main part of the questionnaire, the following two questions were raised and blank areas were left so that participants could write their responses:

1. Which project did you do in your Environmental Science course? Could you please tell us about your responsibility in this project?
2. If you compare your behaviours before and after the project, do you believe that there are changes in your proenvironmental behaviours? What are probable impacts of your project in incurring these changes?

Sample

72 student teachers in the 3rd year of the Elementary Science Teacher Training Program at Ahi Evran University, Turkey, constituted the sample. These student teachers took the Environmental Sciences course during the 2008-2009 academic period. Of the 72 student teachers, 33 voluntarily participated in the present study and responded to the questionnaires. Ten were male and 23 were female.

Intervention

The intervention was carried out in the Environmental Science course. In Turkey, this course is given in different programs of study with similar curricula. It is part of teacher education programs, such as elementary school teacher training, geography teacher training, and biology teacher training. The main subject areas covered in the course design are environmental concepts, energy, pollution, ecosystems, environmental protection, biodiversity, and environmental education. The course is offered three hours each week for 14 weeks. First, the author developed twenty preliminary ideas about possible projects to be used in the Environmental Science course. After that, these ideas were discussed by a panel consisting of two scholars from environmental sciences and three from educational sciences. Six projects were selected according to the results of these discussions. The projects and the instructions are given below:

1. Literature search: In this project, student teachers were asked to search the literature about environmental pollution and protection. It was imperative that they collect at least 50 manuscripts. Student teachers collected these manuscripts by using the Internet, libraries, and printed journals, or with the help of the lecturers in different programs of study at the university. They then shared the manuscripts and summarised the substantial parts. Initially, each member prepared a PowerPoint presentation about his/her manuscripts and presented this material to the remaining members of the project group. In these presentations, students not only had opportunities to learn more about environmental problems and education, but were also able to criticise the presentations of their counterparts in terms of layout. Finally, they presented their findings in front of the other student teachers in the classroom.

2. Problem-based learning (PBL) in environmental education: Student teachers were asked to prepare a two-hour lesson on an environmental subject from the elementary science education curriculum that is employed in grades four through eight in Turkey. They used PBL as a teaching method. Firstly, they investigated the literature concerning PBL and discussed the appropriate subjects from which they could choose. After that, group members shared the tasks and began to

prepare learning tools and scenarios. Upon designing a plan for the course, the papers including the scenarios about some scientific conceptions were handed out and the other student teachers in the classroom were asked to discuss the main problem in the scenarios and to find plausible solutions.

3. *Local newspaper:* Student teachers were asked to complete a research project about the news in local newspapers from the sample city of Kırşehir. They visited the newspapers' managers and obtained permission to investigate their archives. It was expected that the student teachers would collect salient news items from the past year. They photocopied the newspapers issued in the past year and outlined the news. They then prepared PowerPoint slides and presented the main points in front of the other student teachers in the classroom.

4. *Environmentally friendly design:* The instructions of this project were very flexible so as not to restrict the creativity of the student teachers. The expectation was that group members would develop creative conceptions, designs, or materials to diminish environmental degradation (e.g, a tap mechanism to reduce the water usage). Upon finishing the design, they demonstrated the results in the classroom.

5. *Autopsy of the city in terms of environmental pollution:* The members of this group were expected to investigate the sample city's environmental problems. The group members arranged interviews with the representatives of local authorities, such as the governorship of the city, the mayoralty, the ministry of the environment and forests, and the ministry of national education. In addition, a few members interviewed with residents in the city and their friends at university. Using this data, they prepared slides and presented them in the classroom.

6. *Administering the questionnaire and data analyses:* The student teachers administered a questionnaire pertaining to nuclear power and its effects on the environment at six different schools. Their sample consisted of 500 students in grades six through ten. After administering the questionnaire, they numerically coded the responses of the students into SPSS with the help of their lecturer. In the analyses, they made use of descriptive statistics and prepared cross-tab graphs in order to compare different grades in terms of their responses. Finally, like the other groups, they produced PowerPoint slides and presented the results of their study.

During first week of semester, the projects and their instructions were introduced by the lecturer of the Environmental Science course. In addition, student teachers independently determined their research teams. The teams then selected their projects. It was expected that project groups would present their results during one of the last six weeks of the semester. Until that period, the lecturer of the course gave lessons about environmental subjects such as population, ecosystems, food chains, biodiversity, environmental pollution, local and global environmental problems, sustainable development, and environmental education. In these lectures, didactic and inquiry-based methods were the main teaching techniques utilised. Furthermore, student teachers were informed that they would be marked in terms of their project design, and that these scores would affect their final grade for the course.

Administration of the Questionnaire and Analyses of the Data

The questionnaires were handed out during the last week of the intervention. The questionnaires were completed individually under the supervision of the lecturer in normal classroom conditions. In the data analysis, the exploratory mixed methods design was utilised. The purpose of this design is to first gather qualitative data to explore a phenomenon, and then to collect quanti-

tative data to explain relationships found in the qualitative data. A popular application of this design is to explore a phenomenon, identify themes, design an instrument, and subsequently test it. Additionally, the emphasis was placed on the qualitative data more than quantitative data (Creswell, 2008).

Construction of Indices

In qualitative part of the design, content analysis was used. For this purpose, the compositions of the student teachers were organised, typed into Excel, and transcribed again (The average numbers of the words used by student teachers for first and second questions were 42 and 156 respectively). The researchers then strived to ascertain the segments (or profiles) of people in terms of the proenvironmental behaviours reported by student teachers in their compositions. In this analysis, three lecturers who were experts on environmental education independently cross-checked the data. The results of these analyses were discussed in a panel consisting of the author and three other lecturers. Overlapping segments were determined cooperatively. These major segments are identified in Figure 1.

In constructing these segments, the research team that made the content analyses produced the criteria for each segment. The map of the distribution of these criteria according to the segments is given in Table 1. The research team constructed the segments from less proenvironmental profiles to more proenvironmental profiles. In other words, segment 4 (ignorant but open to learning), for example, is more environmentally friendly than segment 3 (materialistic). These segments were used in order to determine the student teachers' profiles in terms of their proenvironmental behaviours. To achieve this goal, another research team, including eight educators and seven psychologists, investigated the behaviours reported by student teachers according to the newly developed segmentation and marked students' behaviours. The mean scores of research members' points for each student teacher were then quantified. It was determined that team members agreed on the coding of behaviours 74 % of the time.

Segment 1: I am completely harmful to the environment (**Harmful**).

Segment 2: I do not deal with the environment or do extra to protect the environment (**Apathetic**).

Segment 3: Sometimes I am an environmentalist and sometimes I am not. It depends on my convenience (**Materialist**).

Segment 4: I do not have enough information pertaining to the importance and the extent of environmental pollution. If I knew more, I could do more (**Ignorant but open to learning**).

Segment 5: I am well-informed and sensitive in terms of environmental pollution, but when it comes to action I cannot say that I am active. (**Well-informed-sensitive-inactive**).

Segment 6: I am well-informed and sensitive with respect to environmental pollution, and I try to behave in environmentally friendly ways (**Adequate**).

Segment 7: I am a complete environmentalist (**Environmentalist**).

Segment 8: I wish to become an environmentalist teacher or model (**Environmentalist model**).

Figure 1. Segments of student teachers in terms of their proenvironmental behaviours

Table 1. Segments and related criteria

Segment 1 (Harmful)	Segment 2 (Apathetic)	Segment 3 (Materialist)	Segment 4 (Ignorant but open to learning)
<p>He/she does not exhibit proenvironmental behaviours.</p> <p>He/she has negative attitudes towards environmental protection.</p> <p>His/her personal life and self-interests are the most important things.</p> <p>He/she has little environmental awareness or does not have any awareness at all.</p> <p>He/she does not believe that environmental problems can influence him/her or his/her country.</p>	<p>He/she either behaves in an environmentally friendly way or does not do so at all.</p> <p>He/she does not have certain attitudes towards environmental protection.</p> <p>His/her personal life and self-interests are important.</p> <p>He/she has little environmental awareness and is not willing to use this awareness while acting.</p> <p>He/she does not believe that environmental problems can influence him/her or his/her country.</p>	<p>He/she chooses proenvironmental behaviours that have low costs (those that are economic and require little time or energy).</p> <p>He/she has changeable attitudes towards environmental protection in accordance with the situation.</p> <p>His/her personal life and self-interests are the most important things.</p> <p>He/she has environmental awareness but is not willing to use this awareness while behaving.</p> <p>He/she does not believe that environmental problems can influence him/her or his/her country.</p>	<p>He/she is keen to realise proenvironmental behaviours but does not have sufficient information to do so.</p> <p>He/she has relatively positive attitudes towards environmental protection.</p> <p>He/she is neutral about the importance of his/her personal life and self-interests.</p> <p>He/she either has little environmental awareness or does not have any at all but is willing to learn more.</p> <p>He/she is undecided about the fact that environmental problems can influence him/her or his/her country.</p>
Segment 5 (Wellinf.-sens.-inactive)	Segment 6 (Adequate)	Segment 7 (Environmentalist)	Segment 8 (Environmentalist model)
<p>He/she exhibits few proenvironmental behaviours.</p> <p>He/she has positive attitudes towards environmental protection.</p> <p>His/her personal life and self-interests are of little importance.</p> <p>He/she has high environmental awareness but does not use this to change his/her personal behaviours.</p> <p>He/she believes that environmental problems can influence him/her or his/her country.</p>	<p>He/she adequately exhibits proenvironmental behaviours.</p> <p>He/she has fairly positive attitudes towards environmental protection.</p> <p>His/her personal life and self-interests are generally not in the foreground.</p> <p>He/she has high environmental awareness and can use this in his/her actions.</p> <p>He/she believes that environmental degradation can affect him/her or his/her country.</p>	<p>Apart from common proenvironmental behaviours, he/she engages in particular behaviours that require more self-sacrifice.</p> <p>He/she is concerned about environmental pollution and has fairly positive attitudes towards environmental conservation.</p> <p>Instead of personal interests, the well-being of others or the country comes first.</p> <p>He/she has high environmental awareness and uses this in his/her actions.</p> <p>He/she believes that environmental degradation can affect both living things and the inorganic environment.</p>	<p>Apart from common proenvironmental behaviours, he/she is willing to be a model for the others.</p> <p>He/she is concerned about environmental pollution and has fairly positive attitudes towards environmental conservation.</p> <p>Instead of personal interests, the well-being of others and future generations comes first.</p> <p>He/she has high environmental awareness and uses this in his/her actions as well as in affecting others.</p> <p>He/she believes that environmental degradation can affect both living things and the inorganic environment. He/she strives to disseminate this belief.</p>

Table 2. Two sample measurements in marking behaviours in accordance with the segments

Pre-behaviours (before the project)	Score	Post-behaviours (after the project)	Score	Gain score
I was a member of an NGO called TEMA (Turkish foundation for combating soil erosion and encouraging the restoration and protection of natural habitats). However, I never participated in their conferences. In addition, I was not informed about recycling and I used to keep the tap open while brushing my teeth.	3	I now attend all the conferences and collect recyclable waste as much as possible. In addition, the number of the recycling containers in the town was limited, so I wrote a letter to the town authority to draw their attention to this issue. I am now more careful when using tap water.	7	4
I was not interested in environmental pollution.	2	Once I began to observe the environment, I considered the fact that the situation was not as good as I thought. I try to collect the waste around me, and I try not to use resources as much as I once did.	6	4

This means the fact that the measure we used has a relatively high inter-rater reliability (Vanderstoep & Johnston, 2009) Two samples of this measurement are given in Table 2. The approach considered here was designed to use these scores for further quantitative analyses. For this purpose, the student teachers' mean scores were coded into SPSS. At this point, the dependent variables were pre-behaviour, post-behaviour, and gain scores (calculated by subtracting the pre-behaviour score from the post-behaviour score). The independent variables were intervention effect and project type (e.g., local newspaper). Descriptive statistics, t-tests, and ANOVA were utilised in data analysis.

Results

The pre-, post-, and gain scores of student teachers, which were determined by using the compositions in which they assess their own pre and post behaviours following the instruction, are identified in Table 3. When we look at total mean scores of pre- and post-behaviours, we can argue that student teachers were in Segment 4 ($X=3.76$) before the intervention. This means that at the beginning of the intervention, student teachers were ignorant about environmental protection but were keen to learn more. Additionally, they had relatively positive attitudes towards environmental conservation. What is more, because they possessed little environmental awareness, they were undecided about the impact of environmental degradation on their lives or their country. Some responses given by student teachers also address this result:

I think I exhibited some proenvironmental behaviours before the project. At the very least, I was conscious that I should not throw waste on the roads. However, taking the way I was washing the dishes and the time of staying in the bath into consideration, I can say that I over consumed the water before the project (Participant 21).

Prior to the project, I knew that there were some educational materials such as videos and reports, yet I was saying ‘good but it is not my business!’ Especially in the case

Table 3. Participants’ behaviour scores in accordance with segmentation

Participant	Gender	Pre-behaviour score	Post-behaviour score	Gain score	Participant	Gender	Pre-behaviour score	Post-behaviour score	Gain score
1	M	2	7	5	18	F	4	5	1
2	F	5	8	3	19	M	3	7	4
3	F	2	6	4	20	F	5	6	1
4	F	4	8	4	21	F	3	5	2
5	F	5	6	1	22	F	3	6	3
6	M	4	6	2	23	F	2	7	5
7	M	5	6	1	24	F	4	5	1
8	F	4	5	1	25	M	1	7	6
9	F	4	6	2	26	F	6	6	0
10	M	4	6	2	27	M	4	6	2
11	F	5	8	3	28	F	1	7	6
12	F	5	6	1	29	F	1	7	6
13	F	5	5	0	30	M	4	8	4
14	F	3	6	3	31	M	5	5	0
15	F	4	7	3	32	F	4	5	1
16	F	2	8	6	33	F	6	6	0
17	M	5	5	0					

of water consumption, I behaved very unconsciously –You are aware but do not do anything! I like the nature, but I can not say that it (nature) liked me as much as I did before the project (Participant 22).

When it comes to the total mean post-behaviour score, the data indicate that student teachers fell into Segment 6 (X=6.27). As such, they reached an adequate level of environmental conservation after the intervention. They began to exhibit certain proenvironmental behaviours and started to develop positive attitudes towards environmental protection. In addition, they improved their environmental awareness and behaved accordingly. Considering the development between pre- and post-behaviours, we can conclude that the project-based intervention was successful in initiating behavioural change: T-tests revealed a statistically significant difference (p=0.000<0.001) between mean scores of pre- and post-behaviours in favour of post-behaviour scores. This result can be seen clearly by investigating some of the responses by student teachers:

After the project, I understood the exact meaning of recycling and so I now attempt to buy food and other products with minimal packaging. I do not keep the tap running while brushing my teeth. I use limited amount of water while taking a shower. I inform the people around me by using the knowledge I learned about environmental conservation. I am a more conscious person in environmental issues anymore (Participant 15).

After the project, I began to become conscious about many environmental problems I did not care before. I understood that we should be careful in every moments of life such as shopping, washing the dishes, and using deodorants. I do not use the water and electricity extremely anymore. I turn computer off when it will be unused for several hours. I try to constitute environmental awareness for younger people. I did not have enough knowledge about recycling but I now keep such plastics and papers in my room (Participant 29).

As far as the project types are concerned, the mean scores of the projects were $X=3.22$ for 'literature search', $X=2.75$ for 'questionnaire study', $X=2.50$ for 'environmentally friendly design', $X=2.33$ for 'local newspaper', $X=2.2$ for 'autopsy of the city', and $X=1.5$ for 'PBL in environmental education'. One-way ANOVA results revealed no statistically significant differences ($p=0.802 > 0.05$) among the project types in terms of mean gain scores. However, if we take a closer look at these scores, we can see that 'literature search' ($X=3.22$) and 'questionnaire study' ($X=2.75$) have relatively high mean gain scores, whereas the 'problem based learning in environmental education' ($X=1.5$) and 'autopsy of the city' ($X=2.2$) have relatively low scores. There may be different reasons underlining this situation. It is clear, however, that the participants who used more scientific processes, such as searching the literature, administrating questionnaires, analyzing data, and interpreting the results, behaved more pro-environmentally. One possible explanation is that gaining a more scientific viewpoint and a better understanding of the nature of environmental science helped student teachers to close the gap between cognitive and behavioral patterns. At the very least, it is likely that student teachers used the science-based projects to better comprehend the conceptions of environmental issues. In these science-based projects, the student teachers might find opportunities to grasp the development of scientific information about environmental pollution and protection. This healthy development in environmental awareness may have been a starting point for constructing affective and behavioral patterns. The following statements from one of the participants in the present study support this idea:

I had never read a scientific manuscript before. I learned the ways to produce scientific information about the environment. Most of these processes were not included in textbooks. After this project, I began to consider becoming a scientist who would study environmental protection. At the very least, I know how to write manuscripts (Participant 4).

Discussion

Because decision-making is influenced by a plethora of factors, it is unlikely that education alone will result in behavioural change. However, education can still play a role in such change. This may happen directly when increased knowledge may lead, in concert with other factors, to a change in the practices of individuals (Kılınç, Boyes, & Stanisstreet, in review b). The present

study supports this idea by suggesting that project-based activities in environmental education caused student teachers' profiles to become more proactively environmentally friendly.

On the other hand, the findings demonstrate that before the intervention, Turkish student teachers were ignorant about proenvironmental behaviours, though they were keen to learn more. Other studies have also shown that Turkish student teachers possess less environmental knowledge (Erten, 2005; Öztaş & Kalıpçı, 2009; Tuncer et al., 2009), but positive attitudes towards the environment, as well as high degree of concern about environmental degradation (Tuncer et al., 2009). In addition, those who have enough information do not utilise this awareness in their daily actions (Şenel & Güngör, 2008). As expected, a similar situation was also found with school students in Turkey. That is, although school students' attitudes towards the environment were highly positive, they had little information about environmental degradation. Moreover, their proenvironmental behaviours were not at adequate level (Alp et al., 2008; Kasapoğlu & Turan, 2008).

As can be seen, there is a widespread affective support that is independent from cognitive variables, such as knowledge for protecting the environment in Turkey. Though this situation does not allow Turkish people to act in more environmentally friendly ways, this affective nature of Turkish culture deserve attention. The ancient Turkish people regarded fire, soil, sky, stars, mountains, trees, lakes, and some animals as sacred (Anadol, Abbasove, & Abbaslı, 2002; Kalafat, 1995; Ögel, 2006). These ancient beliefs retained their influence even after Islam was adopted. Even today, for example, people in some parts of Anatolia plant trees in front of tombs, and some visit sacred trees and make wishes by tying something to the branches. After the adoption of Islam, the Turkish people encountered some environmental values with which they were already acquainted (Kılınç, Boyes, & Stanisstreet, in review a). In Islam, human beings are at the top of the creation. Nonetheless, they are only members of the nature and therefore do not have the right to abuse, misuse, distort, or exploit natural resources unwisely (Al Damkhi, 2008). Because the Turkish culture gives much importance to spiritual (Bodur & Sarigönuöllü, 2005) and traditional values (Inglehart & Welzel, 2005), it seems that these kinds of affective variables are more influential in creating highly positive attitudes towards the environment. Consequently, a greater emphasis may be placed on the environment in Turkey when compared with other nations. At this point, another phenomenon raised in this study is the fact that environmental education strategies should be planned with respect to the society's cultural and traditional values (Özden, 2008). As discussed above, Turkish culture naturally includes many environmental ethics. Some people are likely to behave in accordance with these ethics, even if they are unaware that they are doing so. Therefore, national characteristics and customs can be placed into the other subjects in environmental education courses at different levels of education. In this way, students will associate some common beliefs or traditional values in the society with environmental protection. These connections, in turn, may feed the cognitive and affective constructs about environmental conservation.

After the project-based intervention, Turkish student teachers improved their environmental awareness and behaved accordingly. Similarly, Nation (2008) expressed that project-based learning deserves a place in the suite of pedagogies used in sustainability education. She argues that project-based learning not only develops students' critical thinking and problem-solving skills, but also gives them experience in applying these skills to real world situations. In addition, project-based learning environments are likely to enhance self-efficacy, which may be an important ingredient in environmental literacy "through a connection to a perceived ability to reduce a threat (Value-Belief Norm theory), or through locus of control (Environmental Citizenship Behavior Model)" (Monroe, 2003, p.122). At first glance, it is likely that Turkish student teachers in the present study enhanced their environmental literacy through the projects and used their in-

creased self-efficacies in behaving in an environmentally friendly manner. However, this assumption requires further analysis.

When it comes to the project types in the present study, we found that there were no statistically significant differences among the project types in terms of gain scores. The fact that the number of participants in the study was low may be responsible for this situation. However, looking to the mean gain scores, we can say that science-based projects such as the 'literature search' and 'questionnaire study' produced fruitful conclusions. 'Autopsy of city' and 'PBL in environmental education', on the other hand, did not cause an outstanding change in student teachers' behaviours. We consider that this result is highly associated with practical science's role in environmental education. By understanding how scientific knowledge is formulated and tested, we can rely on this information to ask more questions, make more predictions, and ultimately make informed behavioural decisions (Kapler, 2009). In an environmental context, it is useful for a person to understand the way in which scientific evidence is technically and socially constructed (Cunningham, 1998). If anyone who wishes to engage seriously with an environmental issue that has a scientific and technical dimension (Jenkins, 2003) or to take an action, he/she usually learn the science content required (Ryder, 2001). However, canonical science content encountered in formal educational settings exists in a particular coded form. If it is to be transferred to some other system (the world of action, for example), it has to be translated into a different code. The translation of 'pure science' into 'practical science' (Jenkins, 2003; Layton, 1991) is especially necessary for socio-scientific issues such as global warming (Jenkins, 2003). At this stage, we consider that the students can develop this convert-program by actively participating in practices of science (Moss, Abrams, & Robb, 1998). By science-based projects, we argue that student teachers had opportunities to do practical works (Roberts & Gott, 2008) such as evidence-based research. In doing so, student teachers might enable scientific environmental concepts to enter their individual belief systems (Zeidler & Bryan, 2009). This interrelated improvement among cognitive and affective patterns is likely responsible for informed decision-makings and actions of student teachers in the present study. As we can see, despite being dismissed by many environmental educators, "science has a significant role to play within effective environmental education, through the achievement of scientific literacy and capability, both of which seen fundamental to an understanding of science, environmental issues and interrelationship" (Bishop & Scott, 1998, p.225).

In addition, the segmentation that was developed in the present study may be a starting point for these kinds of studies. Apart from Department for Environment, Food, and Rural Affairs's [DEFRA, 2008] work, there is no similar segmentation in the literature about the profiles of people in terms of proenvironmental behaviours. Though the segmentation in this study includes relative limitations and needs to be developed, it has implications for policy and communications development, as well as implications for identifying areas for further research. In addition, the segmentation used in this study is likely to provide opportunities for collaborative studies among public organisations, the private sector, and NGOs.

On the other hand, we accept some limitations stemming from the research design. We used post-only design in the present study. Even though we considered that student teachers would reason their pre- and post-behaviours after the intervention in more detail and have opportunity to express the changes by comparing their behaviours, some participants might emphasize some changes though they did not exist. A pre and post administration of same behaviour scale might be more influential to see the changes. As a second limitation, we used self-reports of student teachers in this study. The advantage of the self-report strategy was the efficiency of the data collection. However, the main disadvantage of this strategy was the fact that we must rely on the participants' reports of their own attitudes and behaviours. In fact, the participants might not ex-

hibit these behaviours though they expressed that they did. In addition, people most commonly have a self-serving bias, a tendency to report their behaviors and attitudes in a positive light (Vanderstoep & Johnston, 2009).

As a result, universities have a crucial role in dealing with issues of environmental degradation: They must extend their educational programs to encourage sustainability and changing lifestyles (Tuncer, Tekkaya, & Sungur, 2006). However, teacher education programs in Turkey need to incorporate a renewed environmental education program into the curricula (Tuncer et al., 2009) because “this education is still mostly considered by Turkish student teachers as educational extra” (Tuncer et al., 2009, p.435). Based on the results of the present study, we suggest that problem-based learning environments, especially in projects requiring more practical science skills, can be used by lecturers in teacher training programs in order to change student teachers’ beliefs about environmental education and direct them to behave more proenvironmentally. By educating the teachers who exhibit environmental sympatric behaviours, we believe that we can reach the new generations that will make informed decisions about nature.

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Authors

Ahmet Kılınç is an Assistan Professor of Elementary Science Education at Ahi Evran University, Turkey. He recieved his Ph.D. (2008) in Biology Education from Gazi University, Turkey. His main research areas are science education, public understanding of science, socioscientific issues, environmental education, teacher training, environmental psychology and risk psychology. **Correspondence:** Department of Elementary Education, Faculty of Education, Ahi Evran University, Kırsehir, Turkey. E-mail: ahmet_tr@yahoo.com

Projeye dayali öğrenme boşluğu kapatabilir mi? Türk fen öğretmen adaylari ve çevre dostu davranışlar

Çevre eğitimi uzmanlarına göre, insanların çoğu davranışlarında çevre farkındalıklarını kullanmamaktadır. Dolayısıyla uzmanlar insanların bilişsel ve davranışsal boyutları arasında bir boşluk olduğuna inanmaktadırlar. Bu boşluğun nedeni din, kültür, öz yeterlilik ve duygular gibi bir grup faktör olabilir. Öte yandan yaratmaya çalıştığımız çevre farkındalığı da sorunlu olabilir. Bu çalışma bahsedilen ikinci konuya yöneliktir. Çalışmada, yüzeysel çevre bilgileri vermektense, aksiyon odaklı bir programın verimli sonuçlar vereceği öngörülmüştür. Buna göre çalışmanın amacı, bir aksiyon odaklı metod olan projeye dayalı öğrenme ortamlarının çevre dostu davranışların oluşturulmasındaki etkililiğini incelemektir. Ahi Evran Üniversitesi'nde Fen Bilgisi Öğretmenliği Bölümünde okuyan ve projeye dayalı Çevre Bilimi dersi alan toplam 33 öğretmen adayı çalışmaya katılmış ve anketleri yanıtlamıştır. Verilerin analizi için nitel ve nicel metodların bir arada kullanıldığı birleşik desenden faydalanılmıştır. Çalışmanın nitel bölümünde iki adet açık uçlu sorudan oluşan bir anket kullanılmış ve anketten elde edilen veriler içerik analizine tabii tutulmuştur. Çalışmanın nicel bölümünde ise betimsel istatistikler, t testleri ve ANOVA kullanılmıştır. Buna göre projeye dayalı öğrenme ortamı öğrencilerin çevre koruma ile ilgili davranışlarında olumlu değişimlere neden olmuştur. Ayrıca çalışmanın sonunda çevre eğitimi ve fen arasındaki ilişkiler, sosyokültürel konular ve eğitsel uygulamalar ile ilgili tartışmalara yer verilmiştir.

Anahtar Kelimeler: çevre dostu davranışlar, projeye dayalı öğrenme, davranış değişimi