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Developing preservice science teachers' self-determined motivation toward environment through environmental activities

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The aim of this study was to develop pre-service science teachers' self-determined motivation toward environment before, after and five months following the environmental course activities guided by self-determination theory. The sample of the study was 33 pre-service science teachers who participated in an environmental science course. This course included various environmental problems guided by self-determination theory, group discussions and class discussions. Data were gathered by administration of motivation toward environment and amotivation toward environment scaling to pre-service science teachers. The results of the study illustrated that pre-service science teachers' intrinsic motivation increased after the course activities and five months following the course. PSTs' negative capacity beliefs which refer to lack of capacity beliefs causing amotivation toward environment declined after the course activities and in the follow-up measurement. Significant results could not be found regarding other subscales of motivation toward environment and amotivation toward environment scales. These findings suggest that pre-service science teachers' self-determined motivation toward environment was developed throughout the environmental activities guided by self-determination theory. However, there is a need to study with the larger sample and make a long-lasting research to be able to find more significant results.

Keywords: self-determination theory, pre-service science teachers, motivation toward environment

The ultimate goal of environmental education (EE) is to encourage pro-environmental behaviors. However, the early model for behavioral change proposed a linear relationship among knowledge, attitude and action (Hines, Hungerford, & Tomera, 1986-1987; Hungerford & Volk, 1990; Darner, 2009). Nevertheless, it was understood that this linear relationship does not explain responsible environmental behavior (REB) and there is not just one factor affecting REB (Oskamp, 1995). Hines, Hungerford and Tomera (1986-87) introduced a model which indicates several psychological constructs predicting pro-environmental behaviors. These variables include attitude, locus of control, personal responsibility, action skills, knowledge of issues, knowledge of action strategies and intention to act. Intention to act is one of the best predictors of responsible environmental behavior (Hsu & Roth, 1999) and it is a critical construct for behavioral change (Hwang, Kim, & Jeng, 2000). There are lots of environmental education treatments but, it is not completely known why these treatments are effective. That is, individuals' reasons to have intention to act are not questionized by the researchers (Darner, 2009). For instance, two people may contribute to recycling for different reasons. One person may recycle for cash refund and another person may show this behavior to protect the environment (Darner, 2007). That is to say; people may have external or internal reasons to demonstrate pro-environmental behaviors. For this reason, Darner (2009) proposed self-determination theory (SDT) as an alternative theory to understand the reasons of individuals' intention to act and foster motivation toward environment in the classrooms.

Literature Review

Self-Determination Theory and Motivation toward Environment

SDT proposed by Deci and Ryan (1985) is a human motivation theory explaining the process of internalizing goals and values (Deci & Ryan, 2000). SDT classifies behaviors as intentional or motivated. That is, SDT makes a distinction between self-determined and controlled types of behaviors (Deci, Vallerand, Pelletier, & Ryan, 1991). While self-determined behaviors are voluntarily regulated through volitionally, controlled types of behaviors are motivated by interpersonal or external forces. Pelletier, Tuson, Green-Demers, Noels and Beaton (1998) have developed and tested individuals' motivation toward environment. The authors noted that individuals having self-determined motivation act with their personal choice and their behavior continues in the absence of external outcomes. On the other hand, even though many people are concerned with environmental problems, they do not act to protect the environment (De Young, 1989, Pelletier, Dion, Tuson, & Green-Demers, 1999). Although people' reasons to protect the environment has been examined, their reasons not to engage in environmental activities (amotivation toward environment) has needed more attention (Pelletier et al., 1999). According to Pelletier et al. (1999) people' reasons to engage in environmental activities may be different than the reasons not to engage in environmental activities. Therefore, they developed amotivation toward environment scale and investigated the reasons causing lack of motivation toward pro-environmental behaviors. These reasons are amotivation because of capacity, strategy, effort and helplessness beliefs. Capacity beliefs refer to believing that people do not have the capacity to implement environmental strategies. Effort beliefs are about making the necessary effort to perform the pro-environmental behaviors. Although people believe their capacity, they may not be able to indicate necessary effort to perform the pro-environmental behaviors. Strategy beliefs refer to believing that strategies developed to protect the environment will not be effective. The last one is helplessness belief. People who have helplessness belief cannot see how their contribution will be effective on a large scale. The authors of this study focused on two main themes with motivation and amotivation toward environment.

The Regulation Types of Self-Determined Motivation

In the previous section, the differences between self-determined and controlled actions were explained. Indeed, both controlled and self-determined behaviors are motivated yet their regulatory process is different (Deci et al., 1991). In order to foster self-determined motivation, SDT suggests that one should feel free and autonomous (Legault, Green-Demers, Grant, & Chung, 2007). According to SDT, there are six types of regulation which are: intrinsic motivation, integrated regulation, identified regulation, introjected regulation, external regulation and amotivation placed in a continuum of self-determination (Legault et al., 2007). In this paper, these types of regulation from most to least self-determined are presented.

Intrinsic motivation, which is the most self-determined type of motivation, refers to an innate tendency to engage in a behavior (Deci & Ryan, 1990). Intrinsically motivated behaviors are maintained freely and within a sense of satisfaction and competence (Legault et al., 2007). Intrinsically motivated behaviors that are fully derived from self represent the prototype of self-determination (Deci et al., 1991).

In terms of extrinsic motivation, the goal of behavior is to obtain positive outcomes or avoid negative ones (Pelletier et al., 1998). Extrinsically motivated behaviors are regulated by internal or external forces (Darner, 2009). Therefore, extrinsic motivation is classified in four different classes of motivation which are: integrated regulation, identified regulation, introjected regulation and external regulation. Figure 1 shows these different types of regulations, type of motivation and quality of behavior as self-determined and non-self-determined. According to figure 1, amotivation and three styles regulation of extrinsic motivation (external, introjected and identified) are classified as non-self-determined and intrinsic motivation together with integrated regulation are classified as self-determined.

Type of Motivation	Amotivation	Extrinsic Motivation				Intrinsic Motivation
Type of Regulation		External Regulation	Introjected Regulation	Identified Regulation	Integrated Regulation	Intrinsic Motivation
Quality of Behavior		Non-Self-Determined			Self-Determined	

Figure 1. Self-determination Continuum with Types of Motivation and Types of Regulation. Darner (2009) (modified version of Deci and Ryan (2004)' figure)

Integrated regulation is the most self-determined form of extrinsic motivation which is integrated to the person's sense of self (Deci, Vallerand, Pelletier, & Ryan, 1991). Even if the person who does not feel the pleasure of performing the behavior, he or she becomes happy to illustrate the behavior (Ryan, 1995). Both Integrated regulation and intrinsic motivation include feelings such as free of choice and autonomy (Deci et al., 1991). However, integrated regulation is still considered to be extrinsic because the behavior is regulated by the person's value system. (Deci et al., 1991). According to Osbaldiston and Sheldon (2003), many pro-environmental behaviors are integratedly regulated. For instance, although recycling is not seen as an enjoyable environmental activity, many people feel pleasure for doing recycling because it is related to their value system (Darner, 2009).

Identified regulation occurs when the behavior is considered as valuable and important (Deci & Ryan, 1990; Ryan & Deci, 2000a). As compared to external regulation and introjected regulation, identified regulation is more autonomous or self-determined type of motivation

because the behavior is performed for personal reasons, rather than external pressure (Deci et al., 1991; Deci & Ryan, 2004). The motivation is still extrinsic because the person performs the behavior because it is useful rather than interesting (Deci et al., 1991).

On the other hand, introjected regulation represents the behavior regulated by internal pressure and coercion (Legault et al., 2007). People exhibit introjectedly regulated behaviors not to feel guilty or embarrassed and not to diminish their self-esteem (Deci & Ryan, 1990; Legault et al., 2007). As introjectedly regulated behavior is leaded by internal coercion, it refers to a controlled behavior, not to self-determined behavior (Deci & Ryan, 1990).

External regulation is the least self-determined form of extrinsic motivation (Legault, et al., 2007). Externally regulated behavior is performed to obtain a reward or to avoid punishment (Deci, et al., 1991). The motivation behind behavior is forced and controlling (Legault, et al., 2007). The last type of motivation is amotivation which is the lowest level of self-determined motivation. Amotivation refers to lack of intention to act and leads to the disappearance of the action or behavior (Pelletier et al., 1998; Deci & Ryan, 2000; Deci & Ryan, 2004). For amotivated individuals, it is difficult to see the consequences of the behavior and therefore, they cannot perceive the underlying motives and they probably give up taking action (Pelletier et al., 1999).

According to SDT, in order to foster self-determined motivation, individuals' basic psychological needs should be supported (Ryan & Deci, 2000a). SDT proposed that all humans have three innate basic psychological needs; the need for competence, autonomy (or self-determination) and relatedness (Ryan & Deci, 2000b). The need for competence refers to a sense of confidence and efficacy in action (Deci & Ryan, 2004). Competent individuals believe that they have the capacity to take action and if their need for competence is not fulfilled, they develop negative capacity beliefs and feel amotivated (Pelletier et al., 1999).

The need for relatedness includes developing security and establishing connectivity with other people in a social environment. The last one is the need for autonomy which involves self-initiation and self-regulation of the behaviors (Deci, Vallerand, Pelletier & Ryan, 1991). In order to satisfy need for autonomy, it is crucial to provide choices and supporting feelings that foster self initiation and cause positive outcomes (Deci & Ryan, 2000). Thus, when people initiated their behavior on their own, they feel more autonomous and intrinsically motivated for the activity because their behavior occurs spontaneously, not externally (Deci, Eghrari, Patrick & Leone, 1994).

According to Darner (2012), environmental education should include several elements to foster self-determined pro-environmental behaviors. Darner (2009) mentioned these elements in her study. Individuals' need for autonomy can be supported in an environment where people make their own decisions and not controlled by an authority (Darner, 2009). To support need for competence, individuals should be in an optimally challenging situation (Ryan, 1995; Darner, 2009). Development of problem solving skills leads individuals to think that they can solve the problems effectively (Darner, 2009). Furthermore, co-constructed classroom environments and classroom acitivies connecting students to their own community may satisfy their need for relatedness. For instance, students may learn about environmental resources such as activist groups, environmental organizations and model environmentalists who share similar backgrounds with them. Such activities may support their' need for relatedness in EE classrooms (Darner, 2007).

Briefly, supporting basic psychological needs will promote motivated actions and these actions will be self- determined rather than controlled (Deci et al., 1991). In this study, we tried to create a classroom environment fostering PSTs' basic psychological needs. Environmental problems, assignments, final project, group discussions and whole class discussion were prepared by the researchers to support PSTs' basic psychological needs. Through the following two research questions, we examined PSTs' motivation and amotivation toward environment in an environmental science course supported by SDT guided activities.

1. Is there any change in pre-service science teachers' motivation toward environment through the three time periods -before, after, and five-months following the SDT guided environmental activities?
2. Is there any change in pre-service science teachers' amotivation toward environment through the three time periods -before, after, and five-months following the SDT guided environmental activities?

Significance and Purpose of the Study

In the light of the previous research of Darner (2007) about SDT on EE, it is understood that more research is needed to apply SDT in EE settings. SDT was effectively used by social psychologists to explain the reasons of pro-environmental behaviors in the general public. However, these studies were not conducted in EE settings (Darner, 2009). These studies emphasize that it is necessary to foster students' self-determined motivation to obtain long-lasting pro-environmental behaviors. SDT is a new framework for EE researchers to understand the reasons of individuals' pro-environmental behaviors (Darner, 2007). SDT can be a useful theory to explain pro-environmental behaviors (Pelletier, 2004). Self-determined behaviors can be exhibited more frequently and maintained pertinaciously (Pelletier, 2004). The critical point is to integrate environmentally responsible behaviors into people's lifestyles to protect the environment and create a sustainable world. Therefore, SDT guided environmental activities satisfying students' basic psychological needs should be implemented in environmental courses. In Turkish elementary education, environmental courses are given by elementary science teachers. Hence, pre-service science teachers play an important role in EE as the teachers of the future. If we give an effective environmental education to them, we can educate environmentally responsible citizens, which is the main goal of EE (Culen, 2001). In an EE setting, there is limited research using SDT to promote environmentally responsible behavior, therefore; it is believed that this study may make considerable contributions to the literature by applying SDT into EE to raise environmentally motivated citizens. In line with the literature review, this study aims to develop PST's self-determined motivation toward environment through SDT guided activities in EE setting.

Summary

In the introduction and literature review part, SDT as a theoretical framework of the study was presented in detail. As individuals gain long-lasting pro-environmental behaviors, there is a need to develop their self-determined motivation through supporting their basic psychological needs. In the light of this claim, some SDT guided activities supporting PSTs' basic psychological needs were developed in an environmental science course and PST's motivation and amotivation toward environment were assessed in the same course. In the following section, how these activities were implemented and how the data were collected and analyzed are explained. At the end of the paper, the results are discussed and implications of the study are presented.

Method

Research Design

This study consisted of a survey that was conducted in an environmental science course at one of the large public universities of Turkey. Data were collected from pre-service science teachers (PST) who enrolled in this course in 2009. The course which lasted for 13 weeks included two parts. The course instructor presented the topics in the first part of the course and the second part

was discussion part carried out by the first author who was the research assistant of the course. This second part of the course continued through the six weeks. At the beginning of the semester, PSTs were divided into groups by using of an environmental attitude questionnaire (EAQ) based on the one used by Worsley and Skrzypiec (1998) and originally developed by Herrera (1992) and adapted into Turkish by Tuncer, Ertepınar, Tekkaya and Sungur (2005) to constitute heterogeneous groups who have different environmental attitudes toward environment. This was done not to have groups only including PSTs' who are not interested in environmental issues. The groups of 5-6 people were constituted with regard to their response in the scale. Through the semester, PSTs participated in SDT guided activities and studied with their group friends. These activities included environmental problems, weekly assignments, reflection papers and final project. Environmental problems and weekly assignments were given through the six weeks of the course. Each group discussed environmental problems and found out solutions to them. After each course week, they completed assignments about the environmental issues which they selected.

Participants

A total of 33 volunteer pre-service elementary science teachers (22 females and 11 males) attending at a large public university in Turkey participated in the study. All participants were enrolling in an environmental science course offered by the Department of Elementary Education. The age range of the participants was from 21 to 28 with an average 23 years.

Environmental Activities

The six course weeks were designed in the guidance of the SDT and were intended to support PSTs' basic psychological needs which lead to increased self-determined motivation toward environment. Through the six course weeks, PSTs were given real life problems because real life problems can motivate students to act for the environment (Unal, 2008). The questions in each problem were asking the reasons for the problem and possible solutions to them. While PSTs were discussing the problems, they gave examples from their real life and they tried to relate to problems and their solutions to their local environment. PSTs studied with the same group friends and shared their ideas in the group and later in whole class in order to support their need for relatedness. Moreover, the instructor did not lead the PSTs instead she guided them. That is, the researcher did not give the answers during the discussions and she only answered the questions to clarify the problems. Thus, PSTs had an opportunity of making their own decisions during the problem solving and while completing the assignments. In this way, it was aimed to satisfy PSTs' need for autonomy. After each course week, PSTs were given assignments linked to environmental problems. In table 1, the problems and assignments are presented for each week. Considering the environmental activities, it was aimed to develop PSTs' basic psychological needs – need for competence, relatedness and autonomy by means of real life problems, group discussions, assignments and by encouraging PSTs to share their personal solutions or decisions.

Final Project

After course activities were completed, each group prepared a final project in which they proposed their personal solutions to the environmental problems which they chose from their community. The content of this project was originated from preparing environmental action plans. PSTs first introduced the environmental problem which they planned to study and then, they explained possible reasons for the problem and lastly, they presented their actions or solutions for the problem.

Table 1. Environmental Problems and Assignments of Each Course Week

Course Weeks	Environmental Problems	Assignments
Week 1	Two problems were given. One is the story of Easter Island (Keller and Botkin 2008) and the other one is Environment vs. Economy (Mckinney, Schoch & Yonavjak 2007). In Easter Island problem, PSTs learned about an environmental disaster occured in the past and made a relationship between this problem and today's environmental problems. Considering Environment vs. Economy problem, PSTs discussed environmental and economical concerns of today's world and discussed how a sustainable life could be achieved.	PSTs chose an environmental degradation and examined it crtitically.
	Paper vs. plastic (Mckinney, Schoch and Yonavjak 2007). This problem helped PSTs think about their everyday decisions which are environmentally friendly or not. They also prepared a group assignment in this week.	PSTs prepared a video or presentation about how to change people' attitudes toward environment and encourage environmentally friendly behaviors by choosing an environmental topic.
Week 3	Why worried about extinction? (National Geographic July 2009). This problem helped them understand human can solve environmental problems even they cause these problems	PSTs examined a problem about biodiversity loss and they investigated the reasons and solutions of the problem
Week 4	Reducing ozone depletion (Mckinney, Schoch and Yonavjak 2007). PSTs learnt that harmful effects of ozone depletion could be eliminated with an international treaty. PSTs also discussed their role what they could do to reduce ozone depletion.	No assignment
Week 5	Ilısu dam project-Hasankeyf. A dam project which was planned to establish in Hasankeyf in the south east of Turkey. PSTs discussed about ecological, social and economic effects of dams and they found out alternative solutions to the dam construction.	PSTs chose and investigated one of the questions related to water problems which were prepared by the researcher
Week 6	Ankara Mamak Garbage Dump. PSTs discussed the effects of landfills to the environment and what they could do as an individual to produce less waste in daily life	PSTs investigated solid waste management so that they could realize waste problems in their community

Each group prepared their projects about the problems which are respectively "Waste Problem at the METU (Middle *East Technical University), Food Problem at METU, Pollution in Mogan Lake in Ankara, Energy Consumption at METU, Water Consumption at METU and Waste Problem in Eymir Lake in Ankara".*Subsequently, they presented their projects in the classsroom. In terms of this project, PSTs obtained an opportunity to produce their personal solutions for the problem which they chose from their community. At the end of the presentation, each person from the groups wrote a reflection paper about their projects.While writting their reflection papers, PSTs were asked some questions; *Do you think that you could effectively contributed to this project? Why or why not? or Do you feel like your suggestions were taken seriously by your group mates? Why or why not*? PSTs were requested to write reflection papers to be able to understand whether their basic psychological needs were supported or not.

As they made their own choices and decisions, their need for autonomy was supported. They believed that their actions or solutions could be effective to protect the environment, therefore, their need for competence was fullfilled. Thus, it was considered that feeling competent and autonomous supported their self-determined motivation toward environment. Final project was like summary of weekly assignments which PSTs prepared through the semester. Similar to assignments, PSTs investigated an environmental problem in their community and tried to produce solutions to this problem and wrote their actions which were necessary to prevent the problem.

Data Collection

Instruments

Motivation toward Environment Scale (MTES)

Pre-service science teachers' motivation toward environment was assessed by using Motivation toward Environment Scale which originally included 24 item questionnaire developed by Pelletier et al. (1998). The instrument included 6 subscales that are regulation types of self-determined motivation; intrinsic motivation, integrated regulation, identified regulation, introjected regulation, external motivartion and amotivation and each subscale included four items (Pelletier et al. (1998). The scale was further validated by Villacorta, Koestner and Lekes (2003) and they showed that environmental self-determination is separated from self-determination in other domains like academics and politics. The scale was a 7 point likert scale ranging from 1 (doesn't correspond at all), 7 (corresponds exactly). Items in the scale represented possible answers to the question that is "*Why are you doing things for the environment*?" In the present study, MTES was used before, after and five months following the course in order to understand whether participants sustain their motivation or not. In the present study, the scale consists of 22 items with 6 subscales. Before conducting MTES in the classroom, it was translated into Turkish and pilot tested. The items in the scale were evaluated by science educators in order to eliminate ambiguities, and unfamiliar terms.

Amotivation toward Environment Scale (AMTES)

AMTES developed by Pelletier et al. (1999) was used to assess why PSTs are amotivated toward environment. The main question in the scale was "*Why are not you doing things for the environment*?" and the items in the questionnaire included possible reasons of this question. The questionnaire included 16 items with four subscales named strategy beliefs, effort beliefs, capacity beliefs, helplessness beliefs. Confirmatory factor analysis and correlations between four subscales and environmental constructs demonstrated that the scales had a strong validity (Pelletier et.al., 1999). These subscales demonstrated the reasons of individuals' amotivation toward environment such as amotivation due to negative strategy beliefs, effort beliefs, capacity beliefs and helplessness (Pelletier et al., 1999). The participants indicated their reason of

amotivation on a 7 point likert scale ranging from 1 (doesn't correspond at all) to 7 (corresponds exactly). AMTES was also translated into Turkish and pilot tested. Administration of both scales lasted about 15 minutes. In table 2, sample items for both instruments are presented.

Table 2. MTES and AMTES Subscales and Sample Items

MTES subscales	*Sample Items*
Intrinsic motivation	For the pleasure I experience while I am mastering new ways of helping the environment
Integrated regulation	Because being environmentally conscious has become a fundamental part of who I am
Identified regulation	Because it is a reasonable thing to do help the environment
Introjected regulation	I think I would regret not doing something for the environment
External regulation	For the recognition I get from others
Amotivation	Honestly, I do not know; I truly have the impression that I am wasting my time doing things for the environment
AMTES Subscales	
Strategy Beliefs	I don't think that present programs are really going to help the environmental situation
Effort Beliefs	I can't seem to try hard enough
Capacity Beliefs	I don't feel that I have the competence to do these things for the environment.
Helplessness	What little I could do for the environment wouldn't have any impact on a larger scale

Data Collection Procedure

The research was conducted in an environmental science course in the fall semester 2009. These problems were selected from different sources (Keller & Botkin, 2008; Mckinney & Schoch & Yonavyak, 2007) and reviewed by the researchers. The content of the course was announced to the PSTs in the first week of the course and they learnt what they will do throughout the course. Furthermore, the permissions of all participants were taken for data collection in the course. Before the course activities started, MTES and AMTES instruments were administered to the PSTs in order to get information about their environmental motivation and background characteristics**.** At the end of the course, MTES and AMTES questionnaires were administered to PSTs to see whether any change occurred in their environmental motivation. Five months following the end of the course, MTES and AMTES were again administered in order to understand whether PSTs' environmental motivation continued or not**.**

Data Analysis

In order to analyze the data, initially mean and standard deviation scores were calculated through the descriptive statistics. Furthermore, one way repeated measure ANOVA and Friedman test were used in order to examine PSTs' motivation and amotivation toward environment through three times (before, after and five months after the course activities). Descriptive and inferential statistics were conducted by using the data collected from 33 pre-service science teachers.

Results

Pre-Service Science Teachers' Motivation toward Environment

Pilot Test

At pilot testing, MTES included 27 items which were adapted from Darner (2007)'s study and Pelletier et al. (1998)' study. MTES was administered to 134 pre-service science teachers and 5 items which had low reliability and low factor loadings were deleted. Afterwards, confirmatory factor analysis (CFA) using Lisrel 8.30 was conducted to validate 6 factor structures with remaining 22 items. The results of both pilot test and main study showed that items in the Turkish-adapted scale loaded on 6 factor structure. According to the results of CFA intrinsic motivation, integrated regulation, identified regulation and amotivation subscale included four items while external motivation and introjected regulation included 3 items. Cronbach's alpha coefficient was calculated as measures of reliability and showed a good reliability as .76. Table 3 shows CFA and Cronbach's alpha results of the MTES subscales.

Table 3. CFA and Cronbach Alpha Results of MTES subscales

MTES Subscales	Cronbach Alpha	Good Fit Index (GFI)	Comparative Fit Index (CFI)	Standardized RMR
Intrinsic Motivation	.90	0.94	0.96	0.03
Integrated Regulation	.87	0.99	0.99	0.01
Identified Regulation	.85	0.93	0.94	0.04
Introjected Regulation	.76	perfect	perfect	perfect
External Motivation	.79	0.98	0.98	0.04
Amotivation	.70	0.96	0.94	0.05

Descriptive Statistics

Students' pre, post and follow-up motivation toward environment i.e., intrinsic motivation, integrated regulation, identified regulation, introjected regulation, external regulation, amotivation and amotivation because of strategy beliefs, capacity beliefs, effort beliefs and helplessness were examined descriptively. While the level of pre-service science teachers' identified regulation (*M*= 6.19, *SD*= .71) was the highest, the level of amotivation (*M*= 1.95, *SD*= .97) was the lowest. However, there was a decline in the level of pre-service science teachers' identified regulation from pre (*M*= 6.19, *SD*= .71) to follow-up measures (*M*=6.00, *SD*=.97). Concerning amotivation level, although there was an increase from pre (*M*=1.87, *SD*= .97) to post measurement (*M*= 2.18, *SD*=1.34), follow-up measure (*M*=1.92, *SD*= 1.01) was comparable to pre-measure. There was a decline in pre-service science teachers' amotivation toward environment scores after five months following the course. This finding showed that there was a decline in the sense of unwillingness to take action for the environment after the course. Examination of other subscales of MTES displayed that the level of pre-service science teachers'

intrinsic motivation increased after the course activities. Even there was a decline in intrinsic motivation scores from post to follow-up measure; follow-up intrinsic motivation score (*M*=5.57, *SD*= 1.06) was still higher than pre-intrinsic score (*M*=5.43, *SD*=.72). Moreover, integrated regulation scores increased after the course activities and it did not change after the course. Furthermore, while the level of introjected regulation of students decreased from pre to follow-up measurements, there was an increase in external regulation level of students from pre to post measurement yet, there was a decline in the external regulation scores from post to follow up measurement. Table 4 shows means and standard deviations of pre, post and follow up measurement of MTES subscales. In order to determine whether these observed changes in the mean scores were statistically significant, repeated measures ANOVA and Friedman test were conducted as detailed in the following sections.

Table 4. Means and Standard Deviations of MTES Sub-Scales

	Mean	SD
Pre-intrinsic	5.43	.72
Post-intrinsic	5.66	.94
F-intrinsic	5.57	1.06
Pre-integrated	5.22	1.07
Post-integrated	5.31	1.02
F-integrated	5.31	1.21
Pre-identified	6.19	.71
Post-identified	6.02	.87
F-identified	6.00	.97
Pre-introjected	5.63	.96
Post-introjected	5.27	1.05
F-introjected	5.21	1.27
Pre-external	1.87	.95
Post-external	2.19	1.20
F-external	2.01	.94
Pre-amotivation	1.95	.97
Post-amotivation	2.18	1.34
F-amotivation	1.92	1.01

Pre-service Teachers' Amotivation toward Environment

Pilot Test

AMTES was also translated into Turkish and administered to 67 pre-service science teachers for pilot testing. Before conducting the pilot test, the items in AMTES were examined by science educators to eliminate unfamiliar items. In order to validate four subscales with 16 items, CFA using lisrel 8.30 was carried out. According to CFA results, each subscale which is namely strategy beliefs, effort beliefs, capacity beliefs and helplessness included four items. Cronbach's alpha coefficient was calculated as measures of reliability and showed a good reliability as .89. Table 5 illustrates CFA and Cronbach alpha results for each AMTES subscale.

Table 5. CFA and Cronbach Alpha Results of AMTES Subscales

AMTES Subscales	Cronbach Alpha	Good Fit Index (GFI)	Comparative Fit Index (CFI)	Standardized RMR
Strategy Beliefs	.77	0.91	0.89	0.08
Effort Beliefs	.88	0.96	0.99	0.03
Capacity Beliefs	.85	0.92	0.95	0.05
Helplessness	.89	0.99	1.00	0.01

Descriptive Statistics

Examination of the mean scores on the AMTES revealed that pre-service science teachers showed amotivation toward environment for different reasons. While the level of negative effort beliefs of students was the highest, the level of helplessness was the lowest. Students' effort beliefs (not showing necessary effort to perform the behavior) increased after the course activities (*M*= 3.40, *SD*= 1.20) but it decreased five months later (*M*= 3.08, *SD*= 1.56) and the follow-up effort mean was lower than pre-effort mean (*M*= 3.16, *SD*= 1.51). Helplessness beliefs (could not perceive how individuals' contributions for the environment might be effective on a larger scale) increased after the course activities (*M*= 2.43, *SD*= 1.27) and then again declined five months after the course (*M*= 1.96, *SD*= .96). It may be interpreted that when they learn about the environmental problems during the course, they may feel helpless but, the mean scores were really lower than the highest mean value (7 point). Moreover, their negative strategy beliefs (believing the certain strategies are ineffective in producing some solutions) decreased after the course activities (*M*= 2.99, *SD*= 1.20) and five months later increased again (*M*= 3.34, *SD*= 1.49). Their negative capacity beliefs (not believing in themselves to carry out the certain behaviors successfully) for environmental behaviors declined after the course activities (*M*=2.45, *SD*= 1.00) and in the follow-up measurement (*M*= 2.13, *SD*= 1.02). Students believed that they had the capacity to perform pro-environmental behaviors successfully. As detailed in the following sections, repeated measures ANOVA and Friedman test were conducted to determine whether the changes in the mean scores were statistically significant. Table 6 shows the mean and standard deviation results of pre, post and follow-up measurement of subscales of AMTES.

Table 6. Means and Standard Deviations of AMTES Sub-Scales

	M	SD
Pre-strategy	3.22	1.63
Post-strategy	2.99	1.20
F-strategy	3.34	1.49
Pre-effort	3.16	1.51
Post-effort	3.40	1.20
F-effort	3.08	1.56
Pre-capacity	2.53	1.30
Post-capacity	2.45	1.00
F-capacity	2.13	1.02
Pre-helplessness	2.30	1.44
Post-helplessness	2.43	1.27
F-helplessness	1.96	.96

Inferential Statistics

Research Question 1: "Is there any change in pre-service science teachers' motivation toward environment through the three time periods -before, after, and five-months following the SDT guided environmental activities? "

In order to compare PSTs' motivation toward environment (i.e. intrinsic motivation, integrated regulation, identified regulation, introjected regulation, external regulation and amotivation) before , after and five months following the course activities one way repeated measures ANOVA was conducted. Before the conduction of analysis, assumptions of one way repeated measure ANOVA were tested. Only the assumptions of intrinsic motivation were violated therefore, the Friedman test as the non-parametric alternative to the one way repeated ANOVA was used. For other MTES subscales one way repeated measures ANOVA was utilized.

For intrinsic motivation scores, the results indicated that there was a statistically significant difference in intrinsic motivation scores before, after and five months following the course, X^2 (2, n=30) = 10.42, p <0.05). Inspection of median values showed an increase from pre-intrinsic motivation (*Md*= 5.25) to post-intrinsic motivation (*Md*= 5.88) and a further increase in follow-up (*Md*= 6.00). A Wilcoxon Signed Rank Test revealed a statistically significant increase in intrinsic motivation scores after the course, z= -2.210, p <.0.05 with medium effect size (r=.27) and five months following the course, z= -2.173, p <0.05 with medium effect size (r=.28).

For integrated, introjected, identified , external regulation and amotivation scores, results showed that there was not statistically significant difference before, after and five months following the course activities: Wilks Lambda= .88, F (2,28)= 1.86, p > 0.05; on identified regulation : Wilks Lambda= .95, F (2,28)= .751, p>0.05; on introjected regulation: Wilks Lambda= .93, F (2,28)= 1.056, p>0.05; on external regulation: Wilks Lambda= .951, F (2,28)= .715, p >0.05; on amotivation: Wilks lambda= .945, F (2,28)= .809, p>0.05. As there was not statistically significant difference in above mentioned variables, pairwise comparisons were not checked.

Research Question 2:"Is there any change in pre-service science teachers' amotivation toward environment through the three time periods -before, after, and five-months following the SDT guided environmental activities"?

In order to compare PSTs' amotivation toward environment (i.e. amotivation because of strategy beliefs, capacity beliefs, effort beliefs and helplessness beliefs) before, after and five months following the course activities one way repeated measures ANOVA was conducted. Only the assumptions of helplessness beliefs were violated therefore, the Friedman test as the non-parametric alternative to the one way repeated ANOVA was carried out, as well.

Statistically significant interactions were only explored in capacity beliefs before, after and five months following the course (Wilks Lambda= .80, F (2, 28) = 3.406, p<0.05, multivariate partial eta squared =. 19). PSTs' negative beliefs in their capacity to act for the environment decreased after the course activities and this decline continued five months later (Figure 2).

On the other hand, there were not statistically significant differences in strategy beliefs, effort beliefs and helplessness before, after and five months following the course. On strategy beliefs, Wilks lambda= .883, F (2, 28) = 1.857, p >0.05; on effort beliefs, Wilks lambda= .95, F (2, 28) = .751, p>0.05 and on helplessness beliefs X^2 (2, n=30) = 4.701, p>0.05. As there was not statistically significant difference in above mentioned variables, pairwise comparisons were not checked.

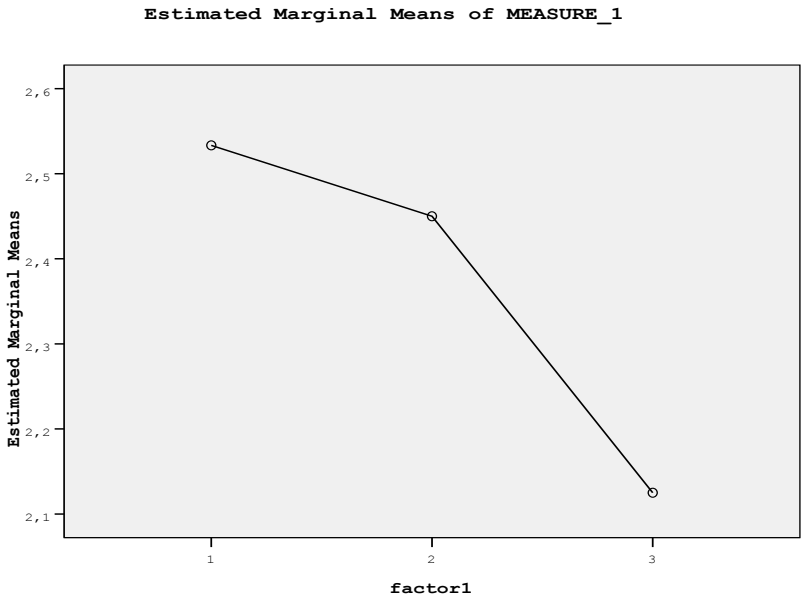

Figure 2. Capacity beliefs scores in three different times (pre-course activities, post-course activities and five months follow-up)

In summary, among subscales of motivation toward environment, there was only statistically significant increase on intrinsic motivation at the three times periods before, after and five months later. Moreover, for subscales of amotivation toward environment, it was found that there was only statistically significant decrease on capacity beliefs causing amotivation at the three times periods.

Discussion

PSTs' Motivation toward Environment

This study mainly focused on whether PSTs' self-determined motivation toward environment can be fostered or not in the light of SDT guided environmental activities. Considering MTES results, only statistically significant difference was found in PST's intrinsic motivation before and after the course activities and also before and five months following the course. This finding implied that, as a result of the course activities, PSTs may feel the pleasure while engaging in pro-environmental behaviors to improve the quality of the environment and protect the environment (Pelletier et al., 1998). Indeed, these are the intrinsic reasons why people exhibit pro-environmental behaviors. To be more specific, intrinsically motivated individuals more likely engage in environmentally responsible behaviors since they volunteer to take action and want to protect the environment for intrinsic reasons not for instrumental reasons (obtaining rewards or avoiding to feel guilty) (Pelletier et al., 1998). Environmental problems and assignments which were given to students during the course motivated them to act with their personal choice and interest and supported their need for autonomy and competence to take action for the environment. For instance, the Easter Island problem may have promoted them to consider the relationship between today and the past. Thus, this problem may have helped them realize how lessons can be learned without making the same mistakes again. Similary, in terms of the Paper

vs. Plastic problem which was closer to the real life, PSTs may have realized that they can protect the environment by making small changes in their daily lives. However, these explanations are speculative; therefore, they should be supported by qualitative data from the analysis of class discussions and assignments.

For Integrated regulation which is the most related to environmental motivation (Darner, 2012), insignificantly raised after the course activities and remained the same five months later. Darner (2007) also found that students' integrated regulation increased in a SDT guided instruction and remained the same six months later following the course.

In addition, identified regulation, introjected regulation, external regulation and amotivation insignificantly decreased after the course activities and continued to decrease five months following the course. As self-determined individuals are dissatisfied with the environmental problems and they are more willing to act for the environment and they feel more competent to be active for preserving the environment (Pelletier et al., 1998). On the other hand, non-self determined individuals are satisfied with the current situation of the environment and they don't want to act to solve the environmental problems (Pelletier et al., 1998). The results of this study indicated limited significant results due to small sample size. Darner (2012) and Legault and Pelletier (2000) also found limited significant findings. Darner (2012) explained the reason of this may be that there is lack of knowledge about students' development toward environmental self-determination. Therefore, it is necessary to make more detailed observations about the effects of curricular activities and classroom aspects on supporting students' basic psychological needs (Darner, 2012).

PSTs' Amotivation toward Environment

The present study also examined the reasons for PSTs' amotivation toward environment. There were four proposed reasons (subscales) contributing to amotivation toward environment in the AMTES. One of the proposed reasons is capacity beliefs. In the present study, only statistically significant difference was found in capacity beliefs of PSTs. PSTs' negative capacity beliefs which refer to individuals' expectations with regard to their efficacy to perform a behavior declined after the course activities and in follow-up measurement. Pelletier et al (1999) claimed that negative feelings about one's own self with regard to environment are positively related to amotivation because of capacity or effort beliefs. As PSTs' intrinsic motivation and integrated regulation increased after and five months following the course activities, their negative capacity beliefs decreased because they may have believed that they could be effective to perform the pro-environmental behaviors and they felt more competent to take action. Bandura (1977) proposed the concept of self efficacy which means "people's beliefs in their capacity to perform a certain behavior". Capacity beliefs were also derived from Bandura (1977)'s self efficacy concept (Pelletier et al., 1999). If people do not believe their capacity to perform a task successfully, they feel amotivated (Pelletier et al., 1999). Other proposed reasons causing amotivation were helplessnes, effort and strategy beliefs. PST's amotivation because of effort beliefs and helplessness beliefs a little increased after the course activities and decreased five months following the course; however, the results were not statistically significant. In environmental psychology context, people who have negative effort beliefs may believe that they couldn't make any effort to change their habits or to make necessary sacrifices (Pelletier et al., 1999).

Indeed, the environmental problems and assignments asking what they can do to protect the environment may have encouraged PSTs to believe that they could change current situation by making more effort. The last reason causing amotivation is strategy beliefs. Strategy beliefs insignifcantly declined after the course activities and raised again five months following the course. Through the course, PSTs discussed environmental programs, organizations and actions with regard to sets of problem. Discussing these environmental organizations may be the reason influencing their belief that these organizations are effective.

The results of this study were also consistent with the relevant literature (Darner, 2012; Legault & Pelletier, 2000). For instance, Darner (2011) compared college students' development of environmental motivation in a SDT guided course and non-SDT guided course. She found that SDT guided instruction was useful to reduce students' amotivation toward environment. Furthermore, in a study conducted by Legault and Pelletier (2000), it was found that students and their parents who participated in a year-long environmental education program showed less extrinsic motivation than students and their parents in the control group.

We did not compare a SDT guided course with non-SDT guided course. Therefore, we couldn't directly imply that SDT guided environmental activities were more effective than non-SDT guided environmental activities to improve PSTs' self-determined motivation toward environment and decline their amotivation toward environment. However, we can say that an improvement occurred in PSTs' intrinsic motivation and a decline in negative capacity beliefs when they engaged in SDT guided environmental activities.

Conclusion

In this study, we utilized Darner (2007)'s study, however, we studied with pre-service science teachers and conducted our research with a single group by using SDT guided environmental activities. We found that SDT guided environmental activities can develop PST's intrinsic motivation and decrease their negative capacity beliefs. We could not find significant results in terms of other sub-scales of MTES and AMTES. The reason of this may be due to small sample size and short term research. Therefore, there is a need to study with larger sample and make long-running research.

Implications and Recommendations

The results of this study have some contributions to curriculum developers, environmental education and teacher education researchers. It is difficult to explain pro-environmental behaviors in one framework or diagram. What shapes pro-environmental behaviors is still considered a complex process (Kollmus & Agyeman, 2002). In the present study, we dealt with an internal factor affecting pro-environmental behavior that is environmental motivation. More specifically, we focused on how self-determined motivation toward environment may be fostered in an environmental science course. Finding ways to solve an environmental problem was a challenging process in the course. This challenging process fostered individuals' intrinsic motivation. In the course, while participants tried to find solutions to the problems, they realized their role both in the problems and solutions, thus they wanted to initiate some actions to protect the environment.

Governments mostly promote non-self-determined pro-environmental behaviors to carry out the environmental policies. Nonetheless, people (especially children) in our community have the main influence on individuals' motivation toward pro-environmental behaviors (Pelletier, 2004). As children become a critical source of information for their family members, it is important to educate them to develop pro-environmental behaviors and create pro-environmentalists or activists (Pelletier, 2004). For this reason, teachers play a critical role to shape and increase children's interest in environmental issues (Tuncer, Sungur, Tekkaya, & Ertepınar, 2007). It is crucial to prepare pre-service science teachers who are able to provide effective environmental education and motivate their students toward pro-environmental behaviors.

Self-determined pro-environmental behaviors can be developed by applying SDT in environmental education. These pro-environmental behaviors are more integrated to individuals' self-system, more persistent and more long lasting (Green-Demers, Pelletier & Menard, 1997). For example, using carpooling regularly in daily life will be a more self-determined and long-

term pro-environmental behavior (Osbaldiston & Sheldon, 2003). For more difficult pro-environmental behaviors, more self-determination to achieve the behavior is needed. For instance, a lower level of self determination may be sufficient to recycle at home whereas more self- determination is required for a person who lives away from recycling bins to contribute to recycling (Pelletier et al., 1998).

Based on the findings of the present study, some recommendations may be proposed for further researches. This study was conducted in an environmental science course lasting one semester with a small sample size group of students. Therefore, a similar study may be undertaken with a larger sample size including pre-service teachers from different areas such as early childhood education, chemistry education in order to assess the usefulness of SDT framework in an environmental course. Moreover, experimental studies with larger sample may be carried out so as to compare a SDT guided course with a non-SDT guided course. Also, it may take more than one semester to perceive the relationship between self-determined motivation and pro-environmental behaviors.

In the present study, the course was supported with some local and non-local environmental problems and thus, a discussion environment was created among the student groups and in the whole class. In addition to these problems, some field trips related to the problems may be organized in the course because field trips help students understand the issue better and foster their sense of confidence and motivation toward environment. Darner (2007) asserted that by virtue of field trips, out of school context is integrated to the courses and thus, students perceive the environmental problems better. All these sources may increase the connection of individuals to the social groups who deal with environmental problems. Furthermore, place based education which refers to community based effort focusing on local environment and using local environment as learning source (Sobel, 2004) may be effective to satisfy students' basic psychological needs and foster environmental motivation.

One of the ultimate goals of environmental educators is to raise environmentally motivated citizens. However, environmental motivation is a neglected area in environmental education. More empirical applications are needed to investigate the effectiveness of SDT in environmental education (Darner, 2009). Therefore, this kind of studies may shed light for the researchers who are studying EE and they may create SDT guided environmental courses in their classrooms.

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