


Preservice Science Teachers' Views of Ways of Reducing Ecological Footprints

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SYNOPSIS

INTRODUCTION

While we are maintaining our lives, at the same time we are rapidly consuming our natural sources and as a result, we produce many wastes. Each of the consumed material and every waste require some bioproductive land and sea area. Bioproductive land and sea area is necessary in order to produce the consumed sources and to absorb the wastes that we create is called ecological footprint (Schaller, 1999). It is necessary to minimize our ecological footprints for the sustainable future of our world. The ways for minimizing our ecological footprints are precautions such as acquiring conscious consuming habits, utilizing our own resources instead of foreign sources and not being wasteful while using the energy (Yeşil Kutu, 2007).

Ecological footprints which is one of the indicators of sustainable life is more effective education device than didactic information which causes a positive change in our attitudes and behaviours about environment since it expresses our negative effects on our world by numerical data (Keleş, 2007). As it is emphasized on the Agenda 21, each of the teachers is potentially an important agent for the change of value judgments and life styles required for sustainable development. Innovative teacher education is necessary to use this potential (UNESCO, 2002). Faculties of Education have this potential to realize this change. When the concerned literature is analyzed, it is seen that many researches are carried out in which ecological footprints are used as an environmental education device in abroad in primary,



secondary and higher education levels. Although there are limited researches about sustainable life in our country, a research is not seen in which ecological footprint is used as an educational device in environmental education.

PURPOSE OF THE STUDY

The objective of this study is to determine the views of the preservice science teachers' ways of reducing the ecological footprints. This study is significant as it helps preservice science teachers who have an important role in adapting sustainable life principles and as they will reflect their knowledge about reducing ecological footprints to our grants of future, that is our students in their work life to understand the negative effects of them on the world first.

METHODOLOGY

a) Sample

The research group is constituted by 49 students in total (31 males, 18 females) who are in their third year of Science Teaching Department from Gazi University, Faculty of Education, and Department of Science Education in 2006-2007 term spring semester.

b) Material

In this study, student centred activities are carried out in order to inform the preservice science teachers about ecological footprints. In the first level of the study, preservice science teachers are divided into groups and each group is given posters and they are asked to draw their own footprints on these posters and predict the area of their footprints on the posters equal to how many square meters mathematically. Some questions such as 'May each step you take in your lives have an effect on the world?' or 'In your opinion, does your life style effect ecological footprint?' are asked to students and the foreknowledge of the preservice science teachers' about what ecological footprints and its components (food, water, energy, transportation and waste) are examined. They are carried out to discuss the effect of each component on the environment they wrote. After the discussion, web-based questionnaire called 'Ecological Footprint Calculating Questionnaire' given to students and their ecological footprints are calculated on computer environment (In this questionnaire, 16 questions take part in total prepared according to components of ecological footprints). The concept of ecological footprint is transferred to preservice science teachers' in power points presentations in which ecological footprints components and calculating procedure take part. Then, by making preservice science teachers watch animations in DVDs and CDs taking part in Green Pack so as to make them feel the principles of sustainable life, they are provided to exchange their opinions in discussion environment. They are asked to express their opinions verbally and written about what they can individually do about reducing their footprints in their own lives.

c) Data Gathering Tool

In this research, data is gathered through negotiation which is one of the data gathering devices in qualitative research. Six open ended negotiation questions are prepared in order to determine preservice science teachers' opinions in order to find what they can do about reducing their own ecological footprints individually.

d) Gathering Data

In order to find out preservice science teachers' opinions about what they can individually do to reduce ecological footprints, semi-structured interview form is prepared. In the interview form, six open ended questions in total are placed. While preparing the questions, five components constituting ecological footprint (food, energy, transportation, water, and waste) and social dimensions are taken into consideration.

e) Analysis of the Data

As a result of the interviews carried out with the preservice science teachers participating in the research, content analysis depending on coding in order to solve qualitative data was made.

FINDINGS

The question of what preservice science teachers individually can do in food, transportation, energy, water consumption, creating less waste and in social dimension to reduce ecological footprints concerning consumption categories constituting ecological footprints is addressed to the preservice science teachers and their views about each category are determined. Through interviewing, the answers gathered from the students are categorized and data of these categories are shown in the following table according to their percent values.

- In the first question of the interview form, preservice science teachers are addressed the question of what they should do about food consuming in order to reduce their ecological footprints. The opinions of the preservice science teachers participating to the research are gathered under common categories (Table 1).

Table 1. *The Categories about Reducing Preservice Science Teachers' Opinions about Ways of Reducing Their Footprints in Food Area*

Categories Concerning Answers	Percent (%)
Nourishing	37
Natural	20
Not packed	15
Avoiding from high consumption	12
Near	6
Preference of herbal food	5
Seasonal	5

*Students gave some answers concerning more than one category.

The views of preservice science teachers about reducing ecological footprints in food consumption are gathered under the categories of foods' being nourishing, natural, not packed, seasonal and near (being grown in the local areas), abstaining from high consumption and preference of herbal food. Owing to the fact that participating preservice science teachers to the study about food consumption gave some answers concerning to more than one category, they made 118 preferences in total. Out of these 128 choices, in 37% of them they stated that thinking about the nourishing values of the food will reduce ecological footprints. Preservice science teachers also indicated that gaining habits of consumption such as not preferring prepared and frozen food, producing their own food if they can and instead of prepared fruit juice preparing their own fruit juice by squeezing fresh fruit and preferring the food containing least additives under the category of foods' being nourishing will reduce ecological footprints.

In the 20% of the preferences of preservice science teachers participating in the research, they stated that consumed food's being natural will reduce ecological footprints in food consuming area. Under this category, preservice science teachers expressed that preferring natural and organic food, buying fresh and little processed food will reduce ecological footprints in food consuming area.

Preservice science teachers stated that their consuming seasonal food will also reduce ecological footprints in 5% of their choices. Under the category of food's being seasonal, they mentioned that consuming and conserving every food in its seasonal time (freezing, drying, conserving, etc) will reduce ecological footprints, too.

Approximately 6% of the preservice science teachers' choices indicate that consuming the food produced regionally or in close areas will reduce ecological footprints. Under the category of 'near', the students indicated their opinions about buying food from the bazaars, buying local foods and growing their own food.

Preservice science teachers stated that their food's being not packed will also reduce their ecological footprints in the 15% of their choices. Under the category of 'Not being packed', preservice science teachers indicated their opinions about not being extremely packed food and not using plastic bags more than once (reducing unnecessary use of nylon bags, preference of cloth or cartoon bags instead of plastic bags).

5% of choices of preservice science teachers participating in the research reflected their opinions about consuming herbal food will reduce ecological footprints. They stated that minimizing animal food consumption, preferring herbal food instead of animal food will reduce ecological footprints in food area.

Preservice science teachers expressed that it is possible to reduce the ecological footprints by avoiding from high food consumption in 12% of their choices.

• In the second question of interview form, preservice science teachers are addressed the question of what they can do to reduce ecological footprints in the area of energy. The opinions of preservice science teachers participating in the research about ways of reducing ecological footprints in energy area are gathered under the categories of lighting system, isolation, the use of alternative energy sources, true and fertile usage, personal preference and technological innovations choice (Table 2).

Table 2. *Categories of Preservice Science Teachers' Views about Reducing Ecological Footprints Concerning Energy*

Categories Concerning Answers	Percent (%)
The Use of Alternative Energy Sources	34
Correct and Productive Use	25
Isolation	15
Lighting System	14
Personal Preference	7
Technological Innovations	5

* Students gave some answers concerning more than one category.

Since participating preservice science teachers gave the answers concerning more than one category about reducing ecological footprints in the area of energy consumption, they made 116 preferences in total. Out of these 116 choices, the students stated that in 14% of them under the category of lighting such as using light bulbs economically, turning off the lights when they are not being used, not going to sleep very late at nights, not using the night lights, using daylight as much as possible will reduce ecological footprints in the area of energy.

It was stated that in 15% of the choices of preservice science teachers participating in the research, with the help of isolation by preventing improper use of energy ecological footprints can be reduced. Under the category of isolation, the students indicated that by acquiring behaviours such as preferring isolation in homes and offices, isolating hot water pipes, not using air conditioning if possible, closing the windows when the air conditioning is working, it is possible to reduce ecological footprints.

34% of the choices of preservice science teachers, it was stated that by preferring alternative energy sources ecological footprints can be reduced. Instead of using fossil fuel solar energy, the use of wind energy, biomass and geothermal energy sources was indicated as one of the most important steps of reducing ecological footprints.

Preservice science teachers, in 25% of the choices, stated that correct and productive use of energy sources will reduce ecological footprints in energy consumption area. The behaviours such as switching of the heating when there is nobody at home, using technological devices (TV, computers, central heating boiler, lights, etc) when they are necessary, unplugging electronic devices when they are not being used, taking the computer to idle mode instead of leaving computer screen open, not leaving the door of the fridge open will also reduce ecological footprints.

Preservice science teachers participating to the research stated that they can reduce ecological footprints by changing their personal choices about energy in 7% of their choices. They indicated that gaining habits like not having blow dry to the hair often (especially ladies), not keeping the phones on charge for a long time, not operating washing machines and dishwashers when they are not completely full and using hot water bags instead of electric blanket will reduce ecological footprints.

In 5% of the choices of participating preservice science teachers stated that manufacturing new technological products may reduce ecological footprints. They indicated that the products consuming little energy and the choice of using these products and also technology's producing little energy consuming devices will reduce ecological footprints.

• In the third question of the interview form, preservice science teachers are addressed the question of what they can do to reduce ecological footprints in the transportation area. The opinions of preservice science teachers about transportation area to reduce ecological footprints are gathered under the titles of walking, riding bicycles, using public transportation, sharing private cars, properties of private cars and personal preferences (Table 3).

Table 3. *Categories of Preservice Science Teachers' Views about Reducing Ecological Footprints Concerning Transportation*

Categories Concerning Answers	Percent (%)
Using Public Transportation	32
Walking	26
The Properties of Private Cars	19
Personal Preferences	9
Riding Bicycles	8
Sharing Private Cars	6

*Students gave some answers concerning more than one category.

Due to the fact participating preservice science teachers' gave the answers concerning more than one category about transportation in order to reduce ecological footprints, they made 77 choices in total. Out of the total participating preservice science teachers' choices, 32% of them stated that using public transportation, 26% of them stated walking and 8% of them stated riding bicycles will reduce ecological footprints in transportation. It is stated that

it is possible to reduce ecological footprints by acquiring some habits and expressed these in their choices. Mentioning the behaviours in their choices, 6% of the choices of the preservice science teachers participating in the research using the private cars as school bus while going to school or work, 19% of them paying attention to buying or using properties of private cars (friendly with the environment, working by the alternative energy sources, with a little oil consumption, low speed, periodic service of which is done regularly), %9 of them giving up using private cars, selecting the house the live in that are close to the school, finishing all the work that necessiate private cars and not go and return for the second time will all help to reduce ecological footprints concerning with the transportation.

- In the fourth question of the interview form, preservice science teachers are addressed the question of what they can do about creating less waste in order to reduce ecological footprints. Preservice science teachers' views about creating less waste in reducing ecological footprints are gathered under the categories of recycling, changing consuming habits and projects (Table 4).

Table 4. *Categories of Preservice Science Teachers' Views about Reducing Ecological Footprints Concerning Creating Less Waste*

Categories Concerning Answers	Percent (%)
Recycling	46
Changing Consuming Habits	35
Projects	19

*Students gave some answers concerning more than one category.

Since participating preservice science teachers gave some answers concerning more than one category, they made 86 choices in total about creating less waste. In 46% of their choices, they stated that by behaviours like putting paper and plastic boxes into recycling boxes, preferring recycled equipments, sharing the stuff and the clothes they use with others in order to create less waste, it is possible to reduce ecological footprints.

Furthermore, preservice science teachers, under the category of recycling, indicated that ecological footprints can be reduced by using rotten food in producing organic fertilizer, cooking the meals according to the need, sharing the extra food with others instead of putting them into wastebaskets. They stressed that by acquiring behaviours such as preferring their alternatives instead of over packed food, using cloth bags more than plastic ones, using returnable products rather than plastic bottles, while shopping not buying plastic covered and garnished things and if they are bought before using them for other purposes instead of littering will reduce plastic waste and as a result ecological footprints. Preservice science teachers also indicated that using the waste papers again, using paper napkins instead of cloth handkerchiefs, using both sides of the papers will also reduce ecological footprints in creating less waste.

35% of the choices of participating preservice science teachers, they expressed that by the behaviours like preventing from over shopping and preferring the clothes that can be used for a long time and of course by changing their consuming habits, it is possible to reduce ecological footprints.

Preservice science teachers, in 19% of their choices stated that projects such as gathering waste in different places, providing recycling and reuse of the wastes will reduce ecological footprints.

- In the fifth question of the interview form, preservice science teachers are addressed the question of what they can do in order to reduce ecological footprints in water consumption.

Owing to the fact that participating preservice science teachers gave some answers concerning more than one category, about water consumption, they made 116 choices in total (Table 5).

Table 5. *Categories of Preservice Science Teachers' Views about Reducing Ecological Footprints Concerning Water Consumption*

Categories Concerning Answers	Percent (%)
Preventing wastage	75
Repairing	11
Evaluation of waste water	7
Preferring technological devices making saving	4
Chemical materials	3

*Students gave some answers concerning more than one category.

Participating preservice science teachers to the research in the 7% of their choices, under the category of evaluation waste water stated that gaining behaviours like refining dirty water and using it for various purposes, storing rain or waste for watering plants ecological footprints concerning water consumption can be reduced. In 11% of their choices, they stated that to reduce to ecological footprints concerning water all the repairing activities should be carried out. Informing the authorities about water pipe defects, repairing broken sinks and closing the main valve in the meantime should help the reducing ecological footprints concerning water consumption.

Under the category of lessening using chemical materials, in the 3% of their choices they expressed that taking precautions such as reducing the use of cleaning materials and preventing the detergents or poisonous materials mixing with the water will reduce ecological footprints.

Participating preservice science teachers to the research emphasized the importance of preventing waste in water consumption in 75% of their choices. They indicated that behaviours like not leaving the sinks open when they are not being used; not operating dishwasher if they are not full, not using culvert in toilets when it is unnecessary will reduce ecological footprints. By reducing individual water consumption such as limiting the shower time, closing the sink while shaving and brushing teeth, not washing the cars by hosepipes, not washing our hair daily, lessening washing the carpets in the houses will also reduce ecological footprints.

In 4% of their choices, preservice science teachers stated that ecological footprints can be reduced by preferring technological devices making savings. They also stated that the use of automatic sinks and preferring new technology toilets which lessens water waste will be effective in reducing ecological footprints.

•In the last question of the interview form, the question of what the preservice science teachers can do in social dimension to reduce ecological footprints is addressed to teacher candidates.

Since the participating preservice science teachers to the research gave answers concerning more than one category about the ways of reducing ecological footprints, they made 83 choices in total about what to do in social dimension. 26% of these choices are under the category of knowledge sharing, 25% of them are under creating environmental consciousness, 5% of them is under producing individual, 16% of them are under participating, 2% of them are under encouragement, 18% are under the category of setting rules and these categories are all said to be effective in reducing ecological footprints (Table 6).

Table 6. *Categories of Preservice Science Teachers' Views about Reducing Ecological Footprints Concerning Social Dimension*

Categories Concerning Answers	Percent (%)
Knowledge sharing	26
Creating Environmental Consciousness	25
Setting rules	18
Participation	16
Application	8
Producing Individual	5
Encouragement	2

*Students gave some answers concerning more than one category.

Preservice science teachers emphasized the importance of sharing the knowledge of environment protection with others in their families, making the people who live in their areas conscious about ecological footprints and distributing interesting brochures to people under the category of sharing knowledge. As it is thought that the majority of the society know nothing about this, they stressed the importance of gathering knowledge first themselves and then society by arranging conferences.

Under the category of creating environmental consciousness, the importance of developing social environmental conscious is stressed. They also expressed that accepting being producing individuals instead of being consuming individuals is accepted as the main objective and acquiring the behaviours supporting this will be effective in reducing ecological footprints under the category of producing individual.

In the participating category, they indicated that taking part in non-governmental organizations aiming environmental protection will be effective in reducing ecological footprints in social dimension.

They stressed the significance of encouraging municipalities and executives about carrying out the studies to reduce ecological footprints under the category of encouragement. Accordingly, it is also emphasized that making local authorities conscious about ecological footprints by trainings. In local authorities, it is stated that the most important usage area of ecological footprint is making public conscious about resource consumption (George, 2007).

Under the title of application, the importance of the behaviours like preferring recycled materials, separating the waste by collecting them in recycling boxes, protecting natural sources, participating in forestation studies, making students develop projects of environment, arranging applied training in schools about ecological footprints and sustainable life is emphasized.

Under the title of setting rules, they stressed that having behaviours such as warning those who pollute environment, preventing unconscious hunting, hindering harming to animals and plant for joy, not throwing rubbish to the floors and protecting our cultural heritage will also be effective in reducing ecological footprints in social dimension.

DISCUSSIONS, CONCLUSION and RECOMMENDATIONS

The views of participating preservice science teachers to the study are received about what can be done about reducing ecological footprints and its components like food, energy, transportation, water consumption and creating less waste and social dimension. To reduce ecological footprints concerning food consumption preservice science teachers participating in the research stated that buying the food bearing in the mind of their nourishing values, abstaining from high food consumption, concentrating on consuming herbal food, buying not packed food and the foods' growing in near areas and being seasonal will be effective. They

stated that ecological footprints would reduce by behaviours under the categories of isolation, lighting system, and technological innovations making energy use more fertile, the correct and productive use of energy sources and usage of alternative energy sources. The views of preservice science teachers in reducing ecological footprints about transportation are stated under the titles of walking, using public transport, sharing private cars, the properties of private cars and personal preferences. Most of the choices of preservice science teachers show that it is possible to reduce ecological footprints about transportation by walking and using public transport. Preservice science teachers stated that they can reduce ecological footprints in creating less waste by behaviours under the titles of recycling, changing their consumption habits and projects. In water consumption area, preservice science teachers' views about reducing ecological footprints are gathered under the categories of evaluating waste water, repairing, minimizing the use of chemical materials, preventing from the waste and preference of saving up technological devices. It is stressed that waste should be prevented in the 75% of the choices of preservice science teachers to reduce ecological footprints in water consumption. Moving from the concept of ecological footprints, they indicate that behaviours such as sharing knowledge about environment and sustainable life, creating environmental consciousness, being producing individuals instead of consuming ones, participating, encouragement, applications and setting rules are significant in social dimension in reducing ecological footprints. Preservice science teachers focus on the importance of sharing knowledge about sustainable life and ecological footprints in social dimension. It is seen that ecological footprints as an educational device being used environmental education is effective in preservice science teachers' developing consciousness, attitudes and behaviours directed to sustainable life. Moreover, preservice science teachers are found to develop their abilities about critical thinking to find ways for reducing ecological footprints and their consciousness, attitudes and behaviours about what to do changed positively.

Data gathered by the various studies in literature support the research results. Wackernagel & Rees (1996) state that the concept of ecological footprint should be combined with the activities inside and outside the school. They indicate that ecological footprints can be used in the studies of energy and material flow in the nature, carrying out experiments about the sustainable life style, in providing concrete and local applications for concurrent mathematics, biology and physics courses, games and projects.

Science education for sustainable life requires active participation of students in creating processes and models for closing the space between the real world and the class. It is important for the students to study of conditions of sustainable life on the local scale. Educationalists should always activate and motivate the schools so as to learn environmental problems, to understand and to propose solutions (Herremans & Reid, 2002).

It is necessary for the environmental education to go forward to daily environmental problems and this education should be supported by different educational devices such as ecological footprints. Ecological footprint is a significant environmental education device in the minds of teachers who lecture about environmental education in constructing sustainable life principles and thus taking this into consideration to gain required consciousness, attitudes and behaviours in order to take action in environmental matters. Ecological footprints provide us to determine our negative effects on environment by giving us numerical data about environmental problems. Ecological footprint application directed to sustainable life in which students' active participation to education process will be effective in teachers' lectures about environmental courses being more fertile by supporting preservice science teachers' development of critical and creative thinking abilities.

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