

An Evaluation of Science Teacher Candidates' Energy Saving Behavior Intention Based on the Theory of Planned Behaviour*

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Abstract

Aim of the study is to evaluate science teacher candidates' behaviour of energy saving intention among sustainable behaviours within the frame of the Theory of Planned Behaviour. The study was conducted with 1947 teacher candidates studying in six geographical regions of Turkey (Central Anatolia Region, Black Sea Region, Aegean Region, Marmara Region, Mediterranean Region and Eastern Anatolia Region) in the spring semester of 2015-2016 academic year. Correlational survey model was used in the study. Within the scope of the research, the Energy Saving Scale (ESS) was developed in order to determine the factors and beliefs affecting the sustainable Behaviours of science teacher candidates, in pursuant of the Theory of Planned Behaviour and by taking into account the scale development steps. The Cronbach Alpha reliability coefficient of the dimensions of the Energy Saving Scale (N = 1947) varies between .918 and .952. The Cronbach Alpha reliability coefficient for the entire Energy Saving Scale is .944. The results of the research, indicated that science teacher candidates' attitudes towards energy saving Behaviour are low and the "Subjective Norm" is effective in explaining the "Intention towards Behaviour" and the "Intention towards Behaviour" is most influenced by the factor of the "Perceived Behavioural Control".

Keywords: Science education, sustainability, the theory of planned behaviour, energy saving, structural equation modelling

Introduction

Environment can be defined as the setting in which biotic and abiotic factors interact each other and they are in balance. The factors causing negative effects on the Behaviours and lifestyles of the living things, such as air pollution, water pollution, soil pollution, extinction of animal and plant species, climate change and garbage problems compose environmental problems (Erten, 2003, 2004, 2006). With increasing environmental problems in the industrialized regions, conferences were held nationally and internationally, especially after the 1970s (United Nations, 1972; UNESCO, 1977; WCED, 1987; United Nations, 1992; United Nations, 2002).

Intergovernmental Conference on Environmental Education held in Tbilisi in 1977 is important for environmental education. In this conference, it was emphasized the importance of international cooperation in environmental education and it was accepted

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that UNESCO and UNEP initiatives will be extended to the international dimension. The report of the conference contains topics such as environmental problems, the role of environmental education and environmental education, the aims of environmental education and the strategies recommended for the development of environmental education. (UNESCO, 1977). The concept of sustainable development was used for the first time in the Brundtland Report prepared in 1983 and presented to the General Assembly of the United Nations on 20th March 1987. According to the report, it was defined that sustainable development is to meet today's needs without compromising the potentiality of future generations to meet their own needs (WCED, 1987). 27 principles were approved at the United Nations Conference on Environment and Development (UNCED) held from 3 to 14 June 1995. The first principle of the Rio Declaration is "Human beings exist in the center of the sustainable development. Human beings have the right to a healthy, productive life which is harmonious with nature" (United Nations, 1992). At the end of the conference, it was formed conventions and action plans such as the Rio Declaration on Environment and Development, the Framework Convention on Climate Change, the Convention on Biological Diversity, the Declaration on Forest Principles and Agenda 21.

With the increase of ecological destruction, environmental provisions have begun to take place in the constitution of the countries (Gurseler, 2008). Article 56 in the sections of "Fundamental Rights and Duties" and "Social and Economic Rights and Duties" of the 1982 Constitution of the Republic of Turkey, contains "Everyone has the right to life in a healthy and balanced environment" and "It is the duty of the State and its citizens to improve the environment, protect the environment and prevent environmental pollution" (Turkish Constitution, 1982). Environmental problems are not a simple problem that can only be solved by technology, conferences or law. Prevention of environmental problems is possible by changing the information, attitude and value judgments. This change can be made by means of environmental education. Environmental education, which appeals to the cognitive, emotional and psycho-motor learning areas of students and is an interdisciplinary field of study, is an important process in which ecological information is transferred, positive attitudes towards the environment are developed and these attitudes are converted into behaviour (Erten, 2004). The main objective of environmental education programs, which is an indispensable means of protecting the environment, is to train individuals who can demonstrate environmentally friendly behaviour related to environmental problems or have an environmental awareness (Erten, 2012; Pooley & O'Connor, 2000). Environmental awareness includes attitude towards the environment, environmental knowledge and environmentally friendly behaviour dimensions. Individuals who have attitudes towards the environment but do not exhibit environmentally friendly behaviour do not have environmental awareness (Erten, 2004).

According to the statistics of the TUIK (Turkish Statistical Institute) (2016a) the population of Turkey was 70 586 256 in 2007; 77 695 904 in 2014 and 78 741 053 in 2015. The greenhouse gas emissions inventory includes direct greenhouse gases (CO₂, CH₄, N₂O, F gases), indirect greenhouse gases (NO_x), non-methane volatile organic compounds, CO and SO₂ emissions arising from energy, industrial operations and product use, agricultural activities and waste. According to the results of 2014, greenhouse gas emission was calculated as 467.6 million tonnes (Mt) CO₂ in equivalent of CO₂. In 2014, the greatest emission value is 72.5% for energy-based emissions, 13.4% for industrial operations and product use, 10.6% for agricultural activities and 3.5% for waste. (TUIK, 2016b). The greenhouse gas emission per capita between 1990 and 2014 was indicated in the figure 1.

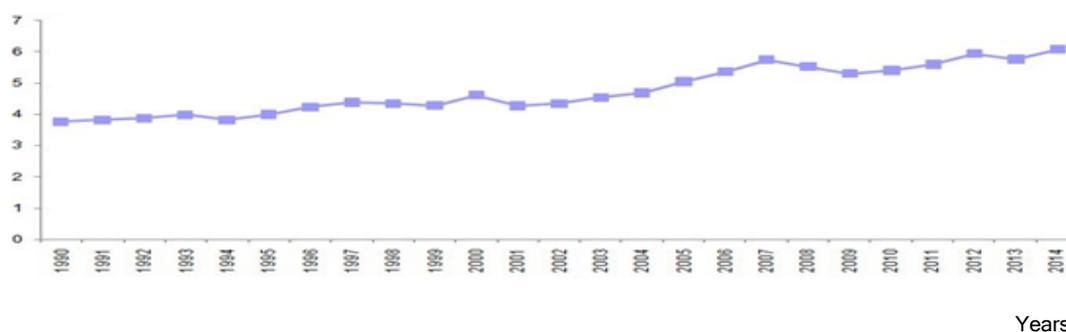
Ton CO₂/ person

Figure 1. Greenhouse Gas Emissions Per Capita Between 1990 and 2014 (TUIK, 2016b)

According to Figure 1, while the CO₂ equivalent emission per capita in 1990 was calculated as 3.77 ton/person, it was calculated as 6.08 ton/person with a 125% increase in 2014. In addition, 85.2% of the total CO₂ emissions for 2014 was stemmed from energy, 14.6% from industrial operations and product use, 0.2% from agricultural activities and waste; 54.3% of total CH₄ emission was stemmed from agricultural activities, 25% from waste, 20.5% from energy, 0.2% from industrial processes and product use; 75.9% of the total N₂O emission was stemmed from agricultural activities, 8.3% from energy, 8% from waste, and 7.8% from industrial operations and product use (TUIK, 2016b).

Science curriculum was updated according to today's expectations and human competences (MEB, 2005a, 2005b, 2013). "Sustainable Development Awareness" is included under the "Science-Technology-Society-Environment" learning area in the curriculum of science education course. According to the curriculum, sustainable development includes "enabling the possibility to meet the needs of future generations by saving natural resources and developing awareness of the individual, social and economic benefits of saving" (MEB, 2013:6). The main objectives of the curriculum of the Science Education are to provide students with basic knowledge of Biology, Physics, Chemistry, Space, Sky and Environmental Sciences, Health and Natural Disasters (12.1) and to understand the interaction between the individual, environment and society, to develop sustainable development awareness related to natural resources (12.4). The unconscious consumption of fossil fuels (coal, natural gas and oil) that are used as an energy source is undoubtedly one of the biggest obstacles for the world. The gases arising from the use of fossil fuels damage to living things and the environment. Therefore, developed countries and scientists have started researching on solving this problem. In researches, it is emphasised the importance of sustainable Behaviours related to saving energy and decreasing of individual car use which forms the basis of sustainability and environmental problems such as global warming, air pollution acid rains (Abeliotis, Koniari & Sardianou, 2010; Erten, 2006; Bamberg, Ajzen & Schmidt, 2003; Erten, 2000, 2002a). It can be predicted to what extend a behaviour will take place by means of the Theory of Planned Behaviour, which is a social-psychological theory (Ajzen, 1991).

Theoretical Basics

The Theory of Reasoned Action

The Theory of Reasoned Action was presented by Ajzen and Fishbein (Fishbein & Ajzen, 1975; Ajzen & Fishbein, 1980). The Theory of Reasoned Action is the basis of the Planned Behaviour Theory (Ajzen, 1985; Schifter & Ajzen, 1985). According to Ajzen (1985), the Theory of Reasoned Action can be expressed as follows:

$$B \sim I \propto [w_1 A_B + w_2 SN]$$

In the equation "B symbolizes behaviour of interest", "I symbolizes person's intention to perform behaviour", "A_B symbolizes Attitude person's attitude toward performing behaviour" "w symbolizes Weighting parameters" "SN symbolizes Subjective Norm". According to the equation, "Behaviour", which can be explained by "Intention", is related to "Behaviour Attitude" and "Subjective Norm". The equations related to "Attitude towards Behaviour" and "Subjective Norm" are shown in Table 1.

Table 1.

Equations Related to Attitude towards Behaviour and Subjective Norm (Ajzen, 1985)

$AB \propto \sum_{i=1}^n b_i e_i$ [D1.1]	$SN \propto \sum_{i=1}^n b_j e_j$ [D1.2]
A _B : Attitude (Attitude toward behaviour)	SN: Subjective norm
B: Behaviour	b _j : Normative Beliefs (Normative belief concerning referent j)
b _i : Belief	b _j : Normative Beliefs (Normative belief concerning referent j)
i: Outcome	m _j : Motivation (Person's motivation to comply with referent j)
n: Normative Beliefs (The number of salient normative beliefs)	n: Normative Beliefs (The number of salient normative beliefs)
e _i : The evaluation of outcome	e _j : The evaluation of outcome

Attitude was first used as a psychological concept by Thomas and Znanieckie (1918) at the beginning of the 20th century. Since attitude is a frequently used term in everyday life, almost everyone has an idea about the meaning of this term. However, it is important to clearly define the concepts used by science educators. For example, the concepts of attitudes based on beliefs and experiences of individuals, learnable and related to behaviours, do not have the same meaning. An attitude which is not a general statement can be defined as a emotion felt towards a person, situation, group, issue or idea. Belief combines some qualifications or features with an object (Koballa, 1988; Koballa ve Crawley, 1985). According to Fishbein and Ajzen (1975), "Attitude towards Behaviour" influences "Intention towards Behaviour". According to Ajzen ve Madden (1986), the relationship between " Attitudes towards Behaviour", "Subjective Norm", "Intention" and "Behaviour" in the model of the Theory of Reasoned Action is shown in Figure 2.

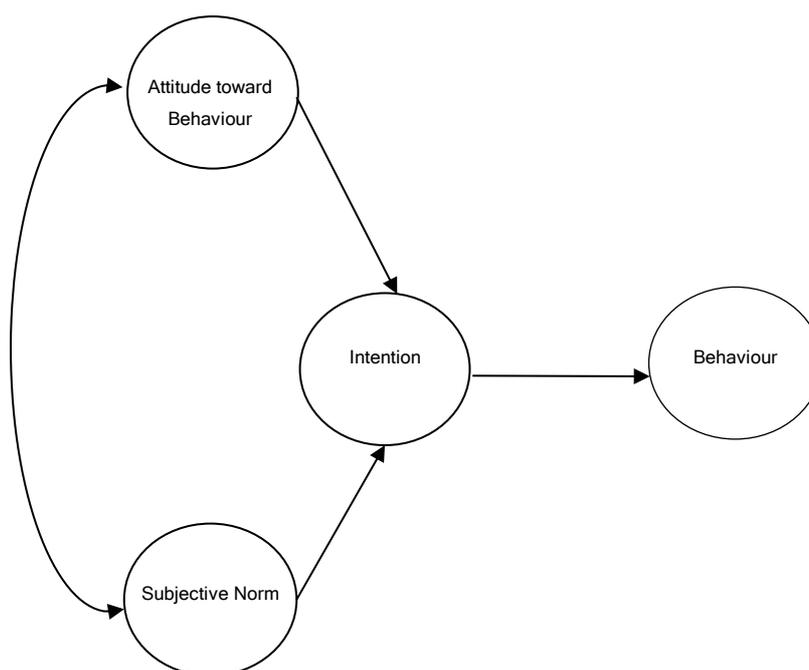


Figure 2. Theory of Reasoned Action (Ajzen & Madden, 1986)

According to Figure 2, it can be said that the more determined intention is the more possibly behaviour happens. Intention can be explained by "Attitude towards Behaviour" and "Subjective Norm" according to the Theory of Reasoned Action (Ajzen & Madden, 1986). On the other hand, the statistical relationship between attitude and Behaviour is high and significant when evaluated according to the correspondence principle. Four factors are important in order to be able to explain the relationship between Behaviour and attitude as a high degree. These factors are "target", "action", "context" and "time" (Ajzen & Fishbein, 1977).

The theory was rearranged by Ajzen in order to eliminate the lack of "Perceived Behaviour Control" in the Theory of Reasoned Action (Ajzen, 1985, 1991, 2005). The "Perceived Behaviour Control" dimension was added to the Theory of Reasoned Action (Ajzen & Madden, 1986). The added dimension and theory in the updated theory (Theory of Reasoned Action) are similar to Bandura's (1977, 1982) theory with regard to "self-efficacy". According to Bandura (1982), self-efficacy is the personal estimations concerning how well an individual can get in the act in order to overcome situations he or she faces with. According to Ajzen (1991), "Perceived Behaviour Control" can be used directly along with the "Intention" dimension in order to estimate "Behaviour".

The Theory of Planned Behaviour

It is very difficult to explain human behaviours. The individual's voluntary and terminal behaviour can be clarified by means of the Theory of Planned Behaviour developed by Fishbein and Ajzen (Ajzen, 1991). The factors in the Theory of Planned Behaviour and beliefs affecting the factors ("Behavioural beliefs", "Normative beliefs", "Control beliefs") are shown in Figure 3 (Hrubes, Ajzen & Daigle, 2010; Erten, 2000; Bamberg, 1996; Bamberg & Schmidt, 1994; Ajzen, 1991).

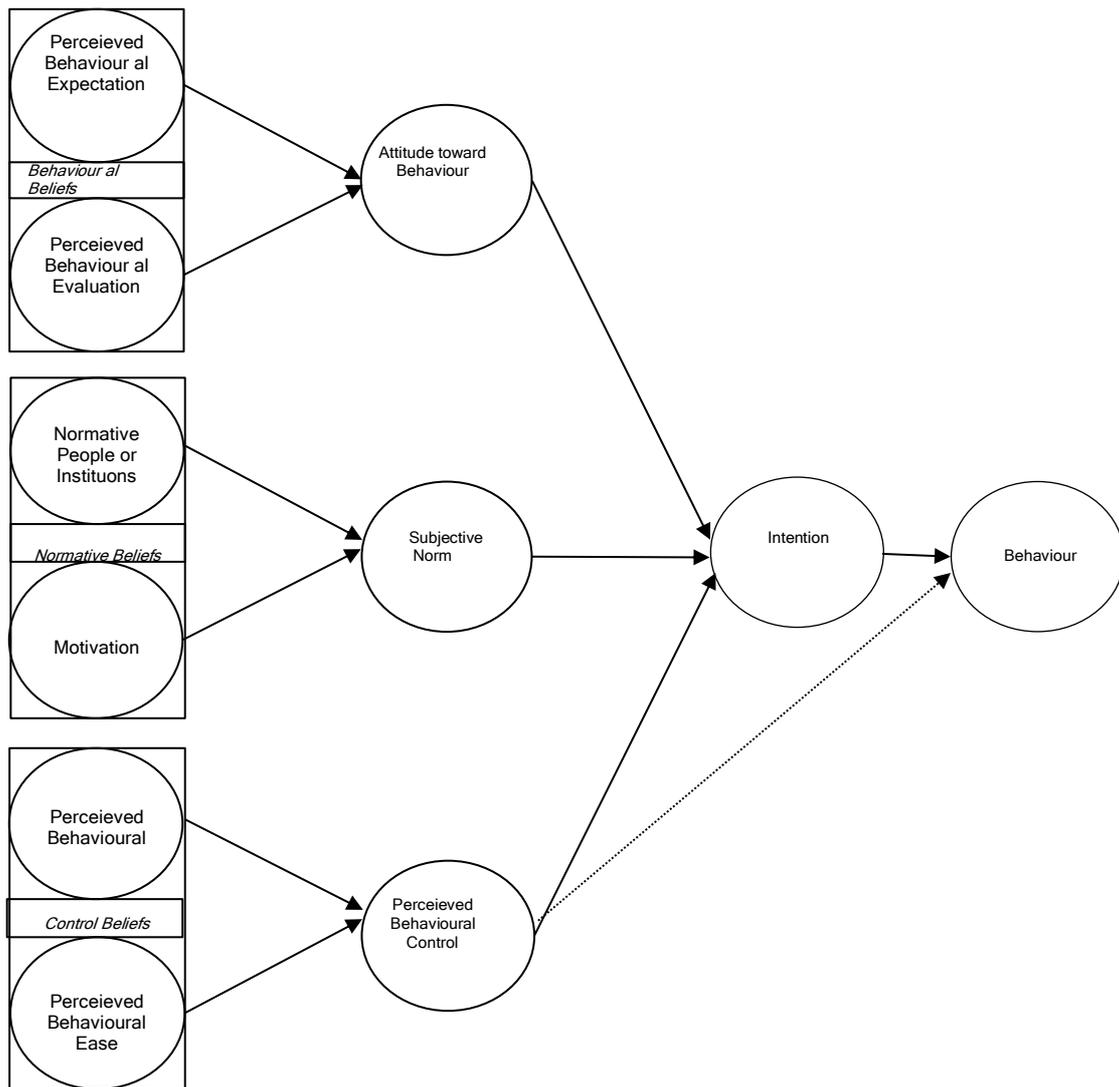


Figure 3. The Model of the Theory of Planned Behaviour (Ajzen, 1991)

People's social behaviours or intentions are under the influence of some factors within the Theory of Planned Behaviour. These factors are "Attitude towards Behaviour", "Subjective Norm" and "Perceived Behaviour Control" (Ajzen, 1985). "Intention towards Behaviour" is the most important factor in the emergence or display of human behaviour. "Intention towards Behaviour" is the factor directly affecting behaviour and indicating the degree of effort the individual spends in showing a certain Behaviour (Ajzen, 1991). According to the Theory of Planned Behaviour, the stronger the individual's intention towards Behaviour is, the more possible he or she shows the behaviour (Ajzen & Madden, 1986).

The factor which expresses the positive or negative evaluations of the individual to show the behaviour is "Attitude towards Behaviour". According to the model of the theory of Planned Behaviour, "Behavioural Beliefs" effects "Attitude towards Behaviour". "Behavioural Beliefs" contains "Perceived Behavioural Expectations" and "Perceived Behavioural Evaluations" (Fishbein & Ajzen, 1975; Ajzen, 1991; Ajzen, 2005; Erten, 2000). While expressions like "I like Science", "I hate Science", "Science is terrible" show attitudes towards sciences (Koballa & Crawley, 1985), expressions like "This behaviour is good if I save energy at home after graduation and at school I will study", "After

graduation if I use public transportation, this behaviour is bad” show “Attitude towards Behaviour”.

The reference which is important for individuals to exhibit behaviour is the factor expressing the expectations of persons, institutions or organizations. "Normative Beliefs" influences "Subjective Norm". Normative beliefs indicate the social pressure on the individual to perform the Behaviour . For example, my family expects me to save energy, and my teacher colleagues expect me to use public transportation. Such beliefs are expressed with the "Normative Beliefs" variable. Normative Beliefs include Normative Persons, Institutions or Organizations and Motivation (Fishbein & Ajzen, 1975; Ajzen, 1991, 2005, 2012; Erten, 2000).

"Perceived Behaviour Control" has an important role in the Theory of Planned Behaviour . "Perceived Behaviour Control" is a factor which can have a direct impact on Behaviour . However, this is not possible at all times or in every case. "Perceived Behaviour Control" refers to the belief in how difficult or easy it is for the individual to show a Behaviour . "Control Beliefs" influences "Perceived Behaviour Control". "Control Beliefs" includes "Perceived Behaviour Difficulties" and "Perceived Behaviour Convenience" (Ajzen & Madden, 1986; Ajzen, 1991; Erten, 2000). Within the scope of the research, science teacher candidates' intention towards the behaviour of energy saving were evaluated through the Theory of Planned Behaviour. The problem statement and sub-problems of the research can be expressed as follows:

Problem Statement

How can the factors and sub-factors affecting science teacher candidates' aims of achieving sustainable Behaviour be explained by the Planned Behaviour Theory?

Sub-Problems

1. In the appropriate model supported by the data, how are science teacher candidates' "attitudes towards behaviour", "subjective norms", "perceived behaviour controls" and "energy saving intention" explained on the basis of the Planned Behaviour Theory?
2. In the appropriate model supported by the data, how are the science teacher candidates' candidates' "attitudes towards behaviour", "subjective norms", "perceived behaviour controls" and "energy saving intention" explained by region on the basis of the Planned Behaviour Theory?

Methodology

Model of the Research

In scientific research, the model refers to the valid process and plan for presenting evidence for the purposes of research or responses to problems. The model that affects the whole process of research is very important for research (McMillan & Schumacher, 2006). In the present study, correlational survey model was used. According to Karasar (2012), correlational survey models aim to determine the presence or the degree of change between two or more variables. The reasons for using the correlational survey model in the research can be expressed as follows:

Determining the factors affecting the science teacher candidates' sustainable behaviour and the relationship between these factors;

- Generalization of this situation for science teacher candidates in Turkey,
- Explanation of the present situation through Structural Equation Modelling.

Population and Sample

The more the results of a scientific research are generalized, the higher the value of researching increases. It is important to try to get generalizable knowledge in science (Karasar, 2012). The population is the larger group which results of research can be generalized. In some cases, the entire population of research can be reached. However, this case is often difficult. Therefore, researches are usually carried out with selected sets of samples chosen to represent the population in accordance with certain rules (Karasar, 2012; Fraenkel, Wallen & Hyun, 2012; Gravetter & Wallnau, 2009). In sampling, it is necessary to determine the population to which the results of the research will be generalized for the purposes of the research (Gay & Airasian, 2000). Statistics related to the science teacher candidates who were studying between 2010 and 2016 were shown in Table 2.

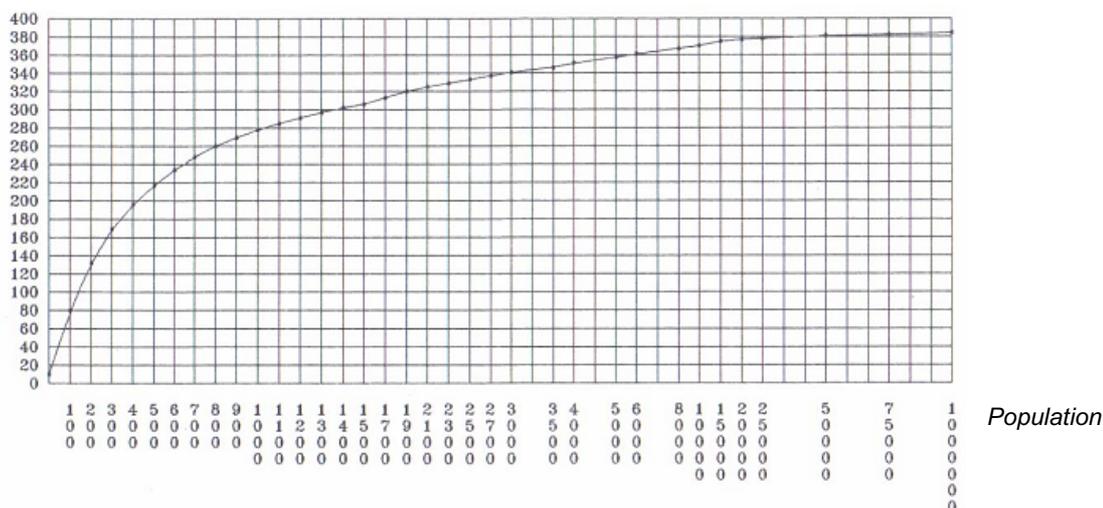
Table 2:

2010-2016 Statistics related to the Science Teacher Candidates (OSYM, 2015)

<i>Academic Year</i>	<i>New Registration</i>			<i>Total Number of Students</i>			<i>Number of Graduated Students</i>		
	<i>Total</i>	<i>Female</i>	<i>Male</i>	<i>Total</i>	<i>Female</i>	<i>Male</i>	<i>Total</i>	<i>Female</i>	<i>Male</i>
<i>2010-2011</i>	6611	4626	1985	19824	12819	7005	3026	1747	1279
<i>2011-2012</i>	6743	4664	2079	23096	15431	7665	2968	1820	1148
<i>2012-2013</i>	4389	3362	1027	23360	16362	6998	3916	2412	1504
<i>2014-2015</i>	4286								
<i>2015-2016</i>	4455								

According to the Table 2, it is predicted that the number of science teacher candidates continuing studying between 2011 and 2016 is 19873. In the research, "stratified sampling method", one of the types of probabilistic sampling, was used. This type of sampling is used in the cases in which there are sub-layers or subunit groups in a bounded population. The important thing is to study on the population starting from the existence of the sub-layers in the population (Arıkan, 2011; Yıldırım & Şimşek, 2011). The graph of the population and sample size is in the Figure 4.

Sample Size



Sampling error .05

Figure 4. The Graph of Population and Sample Size (Krejcie & Morgan, 1970)

Krejcie ve Morgan (1970) explained the following formula for the number of samples

$$s = \frac{\chi^2 NP(1-P)}{d^2(N-1) + \chi^2 P(1-P)}$$

In the formula, “s” refers to sample size, “ χ^2 ” refers to the value of chi square for 1 degree of freedom in expected confidence level (1.96*1.96=3.8416), “N” refers to population size, “d: 0.05” refers to sampling error.

Example 1: 379 persons represent 25,000 persons with 0.05 sampling error in %95 confidence level.

$$s = \frac{(3.8416 \times 25000 \times 0.5 \times 0.5)}{[(0.05^2 \times 24999) + (3.8416 \times 0.5 \times 0.5)]}$$

$$s = 378.361$$

s ~ 379 persons

Example 2: 195 persons represent 25000 persons with 0.07 sampling error in %95 confidence level.

$$s = \frac{(3.8416 \times 25000 \times 0.5 \times 0.5)}{[(0.07^2 \times 24999) + (3.8416 \times 0.5 \times 0.5)]}$$

$$s = 194.483$$

s ~ 195 persons.

The demographic characteristics of the science teacher candidates that constitute the sample of the research are shown in Table 3.

Table 3:

The Demographic Characteristics of the Science Teacher Candidates

<i>Demographic Characteristics</i>	<i>ESS</i>	
	<i>f</i>	<i>%</i>
Gender	Female	1613 82.8
	Male	334 17.2
Class Level	Freshman	621 31.9
	Sophomore	541 27.8
	Junior	429 22.0
	Senior	356 18.3
Regions	1. Central Anatolia Region	611 31.4
	2. Blacksea Region	249 12.8
	3. Egean Region	329 16.9
	4. Marmara Region	199 10.2
	5. Mediterranean Region	267 13.7
	6. Eastern Anatolia Region	292 15.0
Total	1947	100

Data Collection Tools

In the research, Energy Saving Scale (ESS), prepared according to the Theory of Planned Behaviour (Ajzen & Fishbein, 1977; Ajzen, 1991, 2006; Francis ve ark. 2004; Erten, 2000), was used to determine the factors and beliefs that affect science teacher candidates' sustainable behaviours. In the development phase of the scales, literature was firstly searched and open-ended questionnaires based on the Planned Behaviour Theory were prepared. Teacher candidates' opinions were determined through the form and item pool and draft scale forms were created. After making necessary changes in accordance with expert opinions, the pilot study was applied and factor analysis was carried out. For reliability, Cronbach Alpha reliability coefficients were calculated for all dimensions of the scales and for the whole scales. The two major problems of scales used in educational research are whether validity and reliability are provided. The validity of the measuring instrument can be defined as the degree of service of it for the measuring purpose. Reliability is a concept that defines the degree of clearance from accidental mistakes of measurement results. The first condition for scale validity is to ensure reliability. The Cronbach Alpha reliability coefficient value is a measure of the internal consistency between the test scores of the scale (Turgut & Baykul, 2012; Baykul, 2010; Büyüköztürk, 2007; Reid, 2006). Table 4 shows the Cronbach Alpha reliability coefficient values for the Energy Saving Scale.

Table 4:

Dimensions and Reliability Values of the Energy Saving Scale

<i>Dimensions of the Scale</i>	<i>Number of item</i>	<i>Alpha Reliability Coefficient (α)</i>
Perceived Behavioural Expectations	16	.927
<i>Behavioural Beliefs</i>	32	.948
Perceived Behavioural Evaluations	16	.928
Normative Persons, Institutions and Organizations	18	.946
<i>Normative Beliefs</i>	19	.944
Motivation	1	
Perceived Behavioural Difficulties	18	.952
<i>Control Beliefs</i>	36	.924
Perceived Behavioural Conveniences	18	.918
ESS	99	.944

According to Table 4, the Cronbach Alpha reliability coefficients of the dimensions of ESS vary between .918 and .952. The Cronbach Alpha reliability coefficient for the whole of the ESS is .944.

Analysis of Data

PASW Statistics 18 and AMOS 23 (Arbuckle, 2014) programs were used for the analysis of data. The data obtained from the Energy Saving Scale were evaluated by structural equation modelling. In the literature, terms such as covariance structure analysis, covariance structure model or analysis of covariance structures are used instead of structural equality model. The structural equation model is the general name of multiple statistical methods used to test models that explain causal and correlational relationships between observable and non-observable (latent) variables. Examples for

latent variables are self and motivation in psychology, powerlessness and exception in sociology, oral expression skill and teacher expectancy in educational sciences, concepts of capitalism and social class in economy. It can be stated that the structural equation model adopts a confirmatory approach. All of the relationships to be studied in the model are presented in a conceptual way (Kline, 2011; Hoyle, 1995; Byrne, 2010). Figure 4 shows the structural equation model based on the Theory of Planned Behaviour.

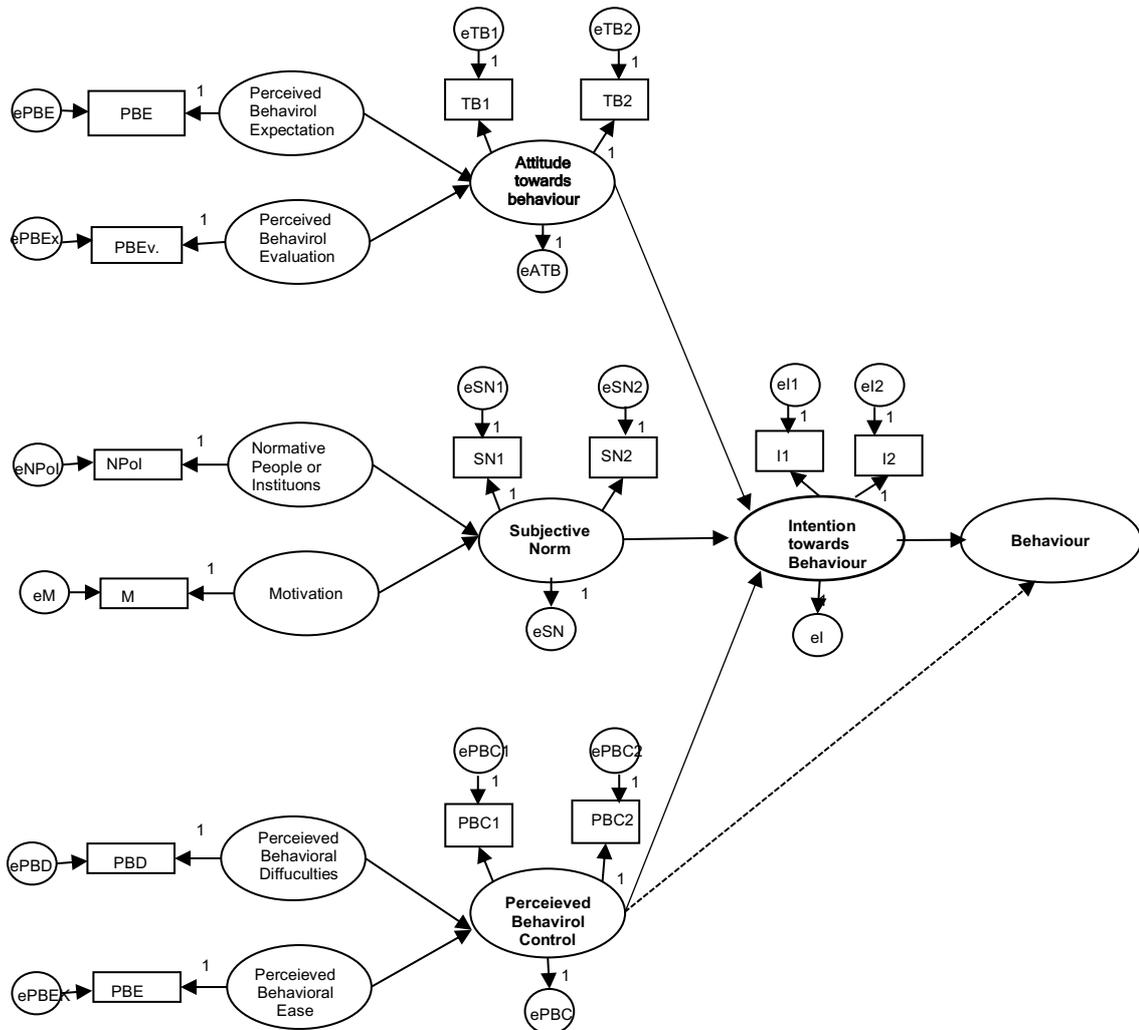


Figure 3. Structural Equation Modelling for the Theory of Planned Behaviour

In structural equality models, the concepts of endogenous and exogenous variables are used instead of dependent and independent variables due to the complexity of relationship patterns. In the model, endogenous variables are used instead of independent exogenous variables are used instead of dependent variables (Byrne, 2010). In this regard, in the model shown in Figure 4, "Normative Beliefs (Perceived Behavioural Expectations and Perceived Behavioural Evaluations)", "Normative Beliefs (Normative Persons, Institutions or Organizations and Motivation)" and "Control Beliefs (Perceived Behavioural Difficulties and Perceived Behavioural Convenience)" are endogenous variables and "Behaviour", "Intention towards Behaviour", "Attitude towards

Behaviour", "Subjective Norm" and "Perceived Behaviour Control" are exogenous variables.

Findings

Findings Related to the First Sub-problem of the Research

The first sub-problem of the research is expressed as follows:

In the appropriate model supported by the data, how are science teacher candidates' "attitudes towards behaviour", "subjective norms", "perceived behavioural controls" and "energy saving intention" explained on the basis of the Theory of Planned Behaviour?

Figure 6 shows the regression relationship of the energy saving intention of science teacher candidates in the framework of the Theory of Planned Behaviour.

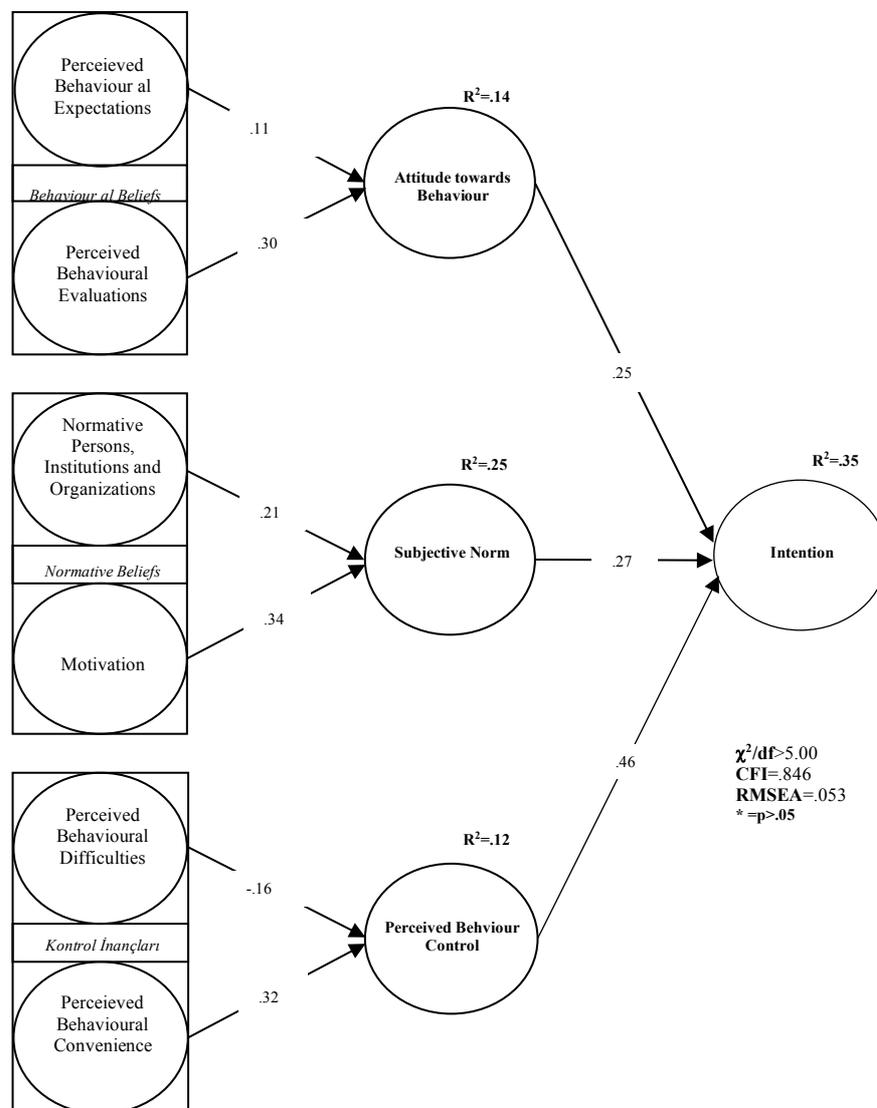


Figure 4. Planned Behaviour Theory Model for Science Teachers Candidates (Turkey-ESS)

In the model explaining the purpose of energy saving behaviours of the science teacher candidates in Figure 6, explaining at the rate 35% of "Intention" is related to the effect of "Attitude Towards Behaviour", "Subjective Norm" and "Perceived Behaviour Control" which have an impact on the intention. The effect of science teacher candidates' "attitudes towards behaviour" on "Intention" for energy saving is .25, The Effect of "Subjective Norms" on "Intention" is .27 and the Effect of "Perceived Behaviour Controls" on "Intention" is .46. The path coefficients are statistically significant. According to the model, "Intention" is most affected by the "Perceived Behaviour Control" factor.

Findings Related to the Second Sub-problem of the Research

In the appropriate model supported by the data, how are the science teacher candidates' "Behavioural Attitudes", "Subjective Norms", "Perceived Behaviour Controls" and "Energy Saving Intention" explained by region on the basis of the Theory of Planned Behaviour?

Table 5 shows the regression relationships and R² values of the science teacher candidates' intention of energy saving

Table 5.

All Regions and Path Coefficients for Energy Saving Behaviour Intention

<i>Model of the Theory of Planned Behaviour</i>	<i>Turkey</i>	<i>Central Anatolia Region</i>	<i>Black Sea Region</i>	<i>Aegean Region</i>	<i>Marmara Region</i>	<i>Mediterranean region</i>	<i>Eastern Anatolia Region</i>
ATB-ITB	.25	.27	.21	.28	.13	.10	.23
PBE1-ATB	.11	.32	.19	.02	.21	.02*	.26
ADD-DYT	.30	.21	.18	.57	.18	.17	.13
SN-ITB	.27	.26	.10	.23	.41	.17	.32
NPIO-SN	.21	.20	.30	.15	.38	.17	.18
Motivation-SN	.34	.38	.33	.38	.19*	.38	.47
PBC-ITB	.46	.43	.71	.59	.34	.67	.35
PBC-PBC	-.16	-.18	-.14	-.28	-.13*	-.23	-.13
PBE2-PBC	.32	.22	.42	.42	.12*	.36	.36
ITB R ² value	.35	.32	.57	.48	.30	.49	.28

*p>.05

ATB: Attitude towards Behaviour ITB: Intention towards Behaviour PBE1: Perceived Behaviour Expectations SN: Subjective Norm NPIO: Normative Persons, Institutions or Organizations PBC: Perceived Behaviour Control PBE2: Perceived Behaviour Ease PBD: Perceived Behaviour Difficulties

Conclusion and Discussion

Results and Discussion on Core Model

In the regression models that explain science teacher candidates' intention towards the behaviour of energy saving, the propositions are "Intention towards Behaviour": "I am going to save energy at school where I will work and at home", "Attitude Towards Behaviour": "if I save energy at school where I will work and at home, this Behaviour ...", "Subjective Norm": "That People and organizations that I value, expect me to save energy at home and at school ..." and "Perceived Behaviour Control": "To save energy

at school where I will work and at home, for me ...". Figure 7 shows the statistical relationship between the dimensions in the "Energy Saving" core model.

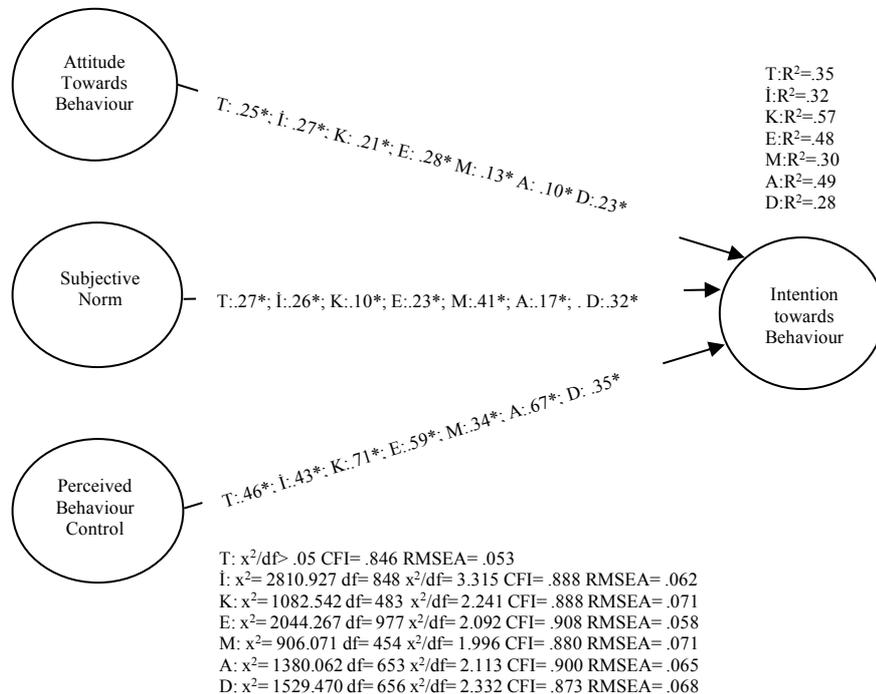


Figure 7. Regression Relationship Between Dimensions in the "Energy Saving" Core Model

(*p<.0.05; T: Turkey, İ: Central Anatolia Region; K: Black Sea Region; E: Aegean Region, M: Marmara Region, A: Mediterranean Region, D: Eastern Anatolia Region)

The model shown in Figure 7 is statistically significant. According to the results of the research, "Attitude Towards Behaviour", "Subjective Norm" and "Perceived Behaviour Control" are effective in explaining science teacher candidates' energy saving intention. However, the effect of "Perceived Behaviour Control" on "Intention" is more than the "Attitude towards Behaviour" and the "Subjective Norm" on "Intention towards Behaviour". "Perceived Behaviour Control", is explained by "Perceived Behaviour Conveniences" and "Perceived Behaviour Difficulties". Therefore, individuals' "Intentions" are related to the Difficulties or conveniences of their behaviour.

Energy has become an indispensable part of modern life. Energy saving and productivity is one of the most important components of our 2023 national strategic goals and energy policies (ETKB, 2017). However, when the percentages of explanation of energy-saving Behaviour al Behaviour are examined, it is seen that science teacher candidates are less likely to exhibit the behaviour in the future. Research results indicate that individuals are less likely to exhibit the behaviour (Erten, 2002a, 2002b; Tonglet, Philips & Read, 2004; Mccullough, 2011).

It is stated that, attitudes in science were not statistically explained sufficiently (Koballa, 1986). In Turkey, intention towards the behaviour of energy-saving was affected approximately equally from "Attitudes Towards Behaviour" and "Subjective Norm". The impact of the proposition of "That the people and institutions that I value expect me to save energy at home and at school." on the proposition of "I aim to save energy at home and at school" is .27. In the Planned Behaviour Theory model, which explains intention towards the behaviour of energy saving, the impact of the proposition of "that science

teacher candidates find energy saving convenient at home and at school after they graduate" on the proposal of "I aim to save energy at home and at school" is .25. When findings related to energy conservation Behaviour are analyzed; It is seen that the attitudes of the science teacher candidates towards energy saving behaviour are in moderate level. It is not a desirable situation that the one-way relationship between "attitude towards behaviour" and "intention towards behaviour" is low or moderate. This finding of the research is similar to the findings of the research conducted by Erten (2002). According to Kanbak (2015), the education of individuals is highly important in determining the environmental attitudes of university students. Especially, the education given in the family has a great contribution to the environmental attitude students have developed. For Erten (2004), environmental research shows students' lack of information about the environment. Individuals, interested in plants and animals in their childhood and within the nature, are more sensitive to environmental problems in their future lives. The research results revealed by Kanbak (2015) and Erten (2004) explain that the statistical relationship between "Attitude towards Behaviour" and "Intention towards Behaviour" is moderate.

When the data obtained from all regions are analyzed; it can be seen that the relationship between "Subjective Norm" and "Intention towards Behaviour" is low and moderate. Findings from the Central Anatolia Region and the Aegean Region; from Black Sea Region and Eastern Anatolia Region; from the Marmara Region and the Mediterranean Region are similar. For the teacher candidates studying in the Marmara and Eastern Anatolian regions, the "Subjective Norm" is relatively more influential than the other regions. This refers that the proposition of "that the people I value expect me to save energy at home and school when I graduate" has an impact on the proposition of that "I aim to save energy at home and at school when I graduate". This finding is consistent with the findings of Erten's (2000, 2001, 2002b)) and Karademir and Erten's (2013) research.

Conclusions and Discussion on Beliefs Section of the Model

Through the beliefs which form the second part of the model of the Theory of Planned Behaviour, the desired behaviour can be assessed at the cognitive level (Bamberg & Schmidt, 1994; Bamberg, 1996). Figure 8 shows science teachers' candidates' "Behavioural Beliefs" for the purpose of intention towards the behaviour of "Energy Saving".

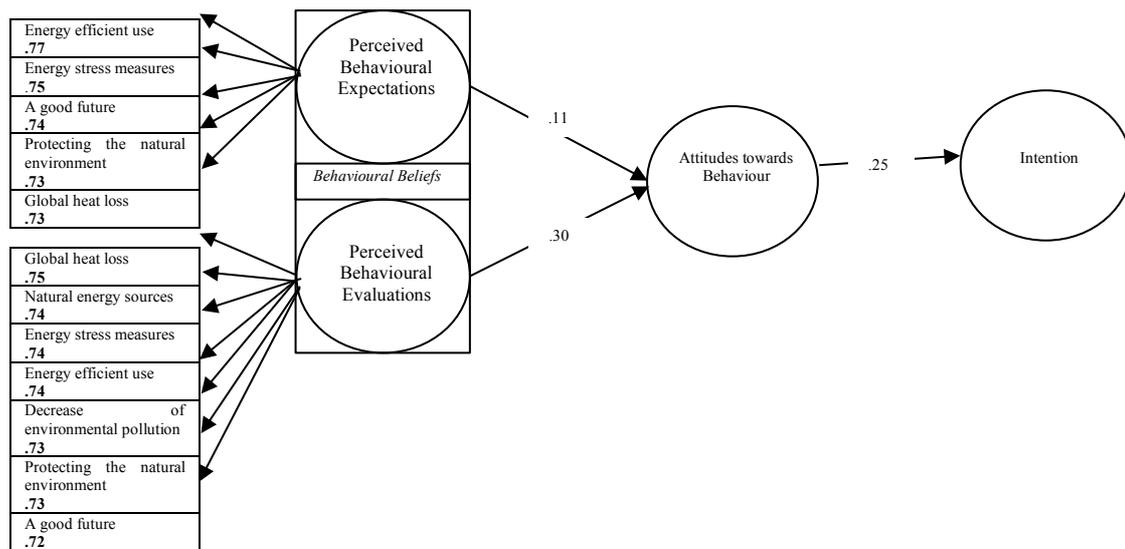


Figure 8. Items in the "Behavioural Beliefs" section of the Model for Intention towards Behaviour of "Energy Saving".

The beliefs seen as (factor weight $\geq .70$) important in the dimension of "Perceived Behavioural Expectations" from "Behavioural Beliefs" in the model explaining science teacher candidates' intention towards behaviour of energy saving are as follows: "Energy is used more efficiently (.77)", "Measures against energy stress are taken (.75)", "A better future is left for future generations (.74)", "Natural environment is protected (.73)" and "Global warming decreases (.73)".

"Perceived Behavioural Evaluations" which considered as important by the teacher candidates are: "It is important to have reduced global warming (.75)", "It is important to preserve natural energy resources (.74)", "It is important to prevent energy stress (.74)", "It is important that energy use is more efficient (.74)", "It is important to have reduced environmental pollution (.73)", "It is important to preserve the natural environment (.73)", "It is important to have a better future for future generations (.72)".

"Normative Beliefs" are shown in Figure 9.

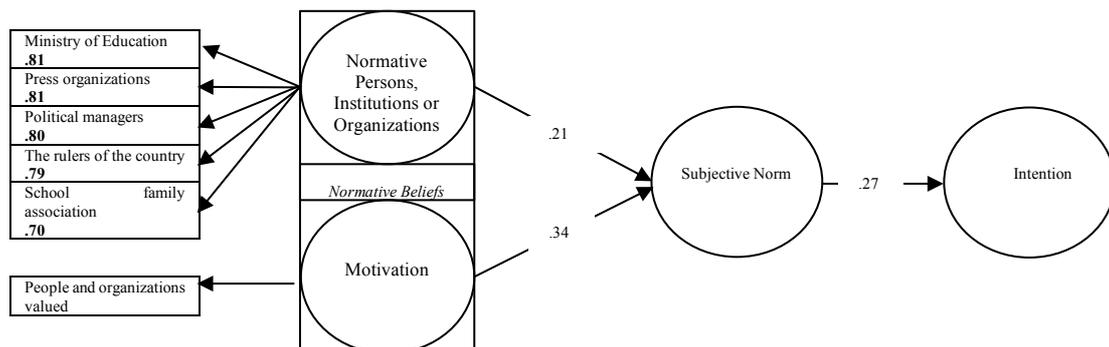


Figure 9. Items in the "Normative Beliefs" section of the Model for the Intention towards Behaviour of "Energy Saving".

Reference persons and institutions which best represent "normative beliefs" are: "Ministry of National Education (.81)", "Press Organizations (.81)", "Political Managers (.80)", "Rulers of the Country" and "School family association (.70)". This finding of the

research is similar to the findings which Erten (2001) found in his research analysing "Applied lessons" and "trips in lessons" in environment education that Turkish teachers aim to behave in the case of the demands of the members of the Ministry of National Education" and the findings of Erten's (2002a) research analyzed male and female students' energy-saving behaviour aims at home. Erten (2002a) stated that the items which were found meaningful under the roof of "Normative Beliefs" are "Recommendations of Biology books", "expectations of local governments" and "Recommendations of the media". According to Erten'e (2000), the actions of individuals in democratic societies should be based not on the impact of reference persons and institutions but on the impact of the positive attitudes. Figure 10 shows the "Control Beliefs".

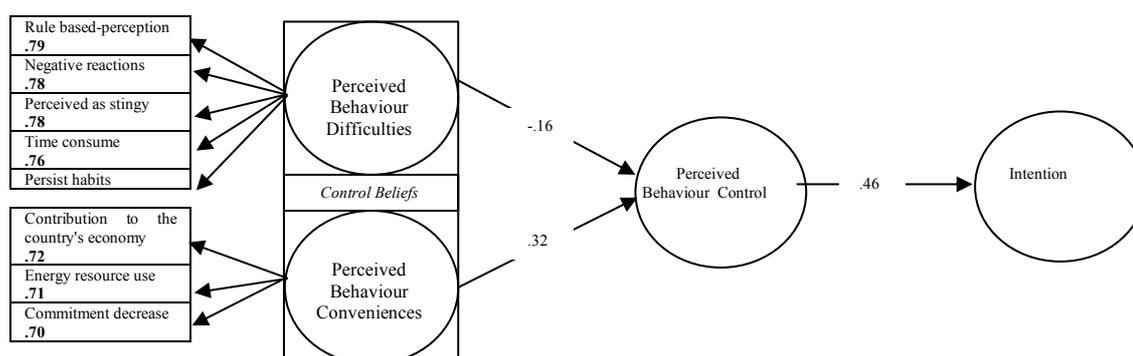


Figure 10. Items in the "Control Beliefs" section of the Model for intention towards the behaviour of "Energy Saving"

"Perceived Behaviour Difficulties" which teacher candidates consider as important are: "It is difficult because I will be perceived as overruling (.79)", "It is difficult because of people's negative reactions (.78)", "It is difficult because I will be perceived as stingy", "It is difficult because I can lose time for control (.76)", "It is difficult for me to leave my habits (.73)". "Perceived Behaviour Conveniences" which teacher candidates consider as important are: "It is easy because it contributes to the country's economy (.72)", "It is easy because the energy resources can be used for a long time (.71)", "It is easy because the dependency to other countries is reduced (.70)".

The results obtained from the research can be explained by the "Low-cost / High-cost" theory of Diekmann ve Preisendörfer (1992). According to the theory, the individuals evaluate the "cost-benefit" factor from their own perspective while fulfilling environmentally friendly Behaviours. A Behaviour is considered as "low-cost" Behaviour if it does not require the individual to sacrifice his or her comfort or to pay money and if it is easy to do; while the opposite behaviours are considered as "high-cost" behaviours. From this perspective; Behaviours such as closing of buttons of electric tools, closing of tap, disposal of garbage are examples of "low-cost" behaviours and behaviours such as reduction of individual car usage are examples of "high-cost" behaviours".

It is arguable whether the science teacher candidates' sustainable behaviours are really aimed at protecting the environment in the past years. The determination of the factors that explain behaviour within the framework of the Theory of Planned Behaviour makes this situation clear. In the models of the Theory of Planned Behaviour, the more positive the "Attitude towards Behaviour" is, the more acceptable the "Subjective Norm" is, and the stronger the "Perceived Behaviour Control" is, the higher the individual's intention

towards behaviour is. A higher intention towards behaviour means that the individual is more likely to exhibit that Behaviour (Ajzen, 1991; Erten, 2000).

The most important feature of environmental problems is that they are global problems. The continuation of the insensitivity in the protection of the environment threatens humanity, creatures and future generations. The important thing in terms of environmental awareness education is to make the individuals love the environment and to provide them for environment friendly behaviours. Many people know why they should do sustainable behaviours, but they can not turn it into behaviour because of reasons such as "it is difficult because of people's negative reactions", "it is difficult because I will be perceived as stingy", "it is difficult because I can lose time for control", "it is difficult for me to leave my habits". For that reason, it is considered as beneficial that beneficial the number of research explaining the behaviour and behaviour improving studies should increase.

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Fen Bilimleri Öğretmen Adaylarının Enerji Tasarrufu Yapma Davranış Amaçlarının Planlanmış Davranış Teorisi Temelinde Değerlendirilmesi

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Özet

Bu araştırmanın amacı fen bilimleri öğretmen adaylarının sürdürülebilir davranışlardan enerji tasarrufu yapma davranış amaçlarını Planlanmış Davranış Teorisi çerçevesinde değerlendirmektir. Araştırma 2015-2016 eğitim öğretim yılı bahar döneminde Türkiye'nin altı coğrafi bölgesinde (İç Anadolu Bölgesi, Karadeniz Bölgesi, Ege Bölgesi, Marmara Bölgesi, Akdeniz Bölgesi ve Doğu Anadolu Bölgesi) öğrenim gören 1947 öğretmen adayı ile gerçekleştirilmiştir. Araştırmada ilişkisel tarama modeli kullanılmıştır. Araştırma kapsamında fen bilimleri öğretmen adaylarının sürdürülebilir davranışlarına etki eden faktörleri ve inançları belirlemek amacıyla Planlanmış Davranış Teorisi'nin öngördüğü şekilde ve ölçek geliştirme basamakları dikkate alınarak Enerji Tasarrufu Ölçeği (ETÖ) geliştirilmiştir. Enerji Tasarrufu Ölçeği'nin (N=1947) alt boyutlarının Cronbach Alpha güvenirlik katsayısı .918 ve .952 aralığında değişmektedir. Enerji Tasarrufu Ölçeği'nin bütününe ait Cronbach Alpha güvenirlik katsayısı ise .944'tür. Araştırma sonucunda, fen bilimleri öğretmen adaylarının enerji tasarrufu davranışına yönelik tutumlarının düşük olduğu; "Öznel Norm"un "Davranış Amacı"nı açıklamada etkili olduğu, "Davranış Amacı"nın en fazla "Algılanan Davranış Kontrolü" faktöründen etkilendiğini sonucuna ulaşılmıştır.

Anahtar Kelimeler: Fen eğitimi, sürdürülebilirlik, planlanmış davranış teorisi, enerji tasarrufu, yapısal eşitlik modellemesi

ENERGY SAVING SCALE (ESS)

Dear Teacher Candidate,

In this study, it is aimed to reveal the factors which affect teacher candidates' energy saving behaviours. You should carefully read each item and write the number of the best rating for you to right column. Please answer all the items by reading. It is important to be sincere for being scientific of this study. I thank you for your contribution.

Gender: Man Woman

Grade: 1st 2nd 3rd 4th

Ahmet Volkan YÜZÜAK

E1. If you save energy at home and at school in six months, after you graduate,

Not at all possible	Not possible	Somewhat not possible	It may or may not be possible	Somewhat possible	Possible	Quite possible
1	2	3	4	5	6	7

1.	It is contributed to home and school budget	
2.	Environmental pollution decreases.	
3.	Natural energy sources are protected.	
4.	Contribution to the country's economy is provided.	
5.	It is a model for people.	
6.	Global warming decreases.	
7.	Society becomes conscious.	
8.	Future generations have a better future.	
9.	Precautions against energy shortage are taken.	
10.	Dependency on foreign countries decreases.	
11.	Energy cuts decreases.	
12.	Energy is used more efficiently.	
13.	The natural environment is protected.	
14.	People becomes healthier.	
15.	The lifespan of electrical devices (TV, radio, refrigerator ...) increases.	
16.	School's fuel costs are reduced.	

E2. If you save energy at home and at school in six months, after you graduate, how important do you find the following conclusions which may arise in this case?

Very unimportant	Unimportant	Somewhat unimportant	Neither important nor unimportant	I find it somewhat important	I find it important	I find it very important
1	2	3	4	5	6	7

1.	Contributing to home and school budget	
2.	Increasing environmental pollution	
3.	Protecting natural energy sources	
4.	Contributing the country's economy	
5.	Being a model for people	
6.	Increasing global warming	
7.	Making the society conscious	
8.	Providing the future generations with a better future	
9.	Stopping energy shortage	
10.	Decrease of dependency on foreign countries	
11.	Stopping energy cuts	
12.	Using energy more efficiently	
13.	Protecting natural environment	
14.	Being more healthy	
15.	Increase of lifespan of electrical devices (TV, radio, refrigerator...)	
16.	Reduction of my school's fuel costs	

E3. How much will the following people and institutions expect you to save energy?

Not at all possible	Not possible	Somewhat not possible	It may or may not be possible	Somewhat possible	Possible	Quite possible
1	2	3	4	5	6	7

1.	That my family expects me to save energy at home and at school	
2.	That my students expect me to save energy at home and at school	
3.	That school administrators expect me to save energy at home	
4.	That my colleagues expect me to save energy at home	
5.	That my friends expect me to save energy at home and at school	
6.	That parents expect me to save energy at home and at school	
7.	That my neighbors expect me to save energy at home and at school	
8.	People who are environmentally sensitive recommend me to save energy at home	
9.	That parent-teacher association expects me to save energy at home and at school	
10.	That politicians expect me to save energy at home and at school	
11.	That media institutions expect me to save energy at home and at school	
12.	That government administrators expect me to save energy at home and at school	
13.	That Ministries (Ministries of Energy and Natural Sources, Environment and Urbanism, Family and Social Policies of Turkish Republic) expect me to save energy at home and at school	
14.	That Ministry of National Education expects me to save energy at home and at school	
15.	That governmental institutions expect me to save energy at home and at school	
16.	That electricity distribution companies expect me to save energy at home and at school	
17.	That municipalities expect me to save energy at home and at school	
18.	That nongovernmental organizations expect me to save energy at home and at school	

E4.	I am generally ready to do the expectations of people and institutions I value.	
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E5. When you graduate and you want to save energy at home and at school in the next six months, is this be difficult because of which of the items below?

Not at all possible	Not possible	Somewhat not possible	It may or may not be possible	Somewhat possible	Possible	Quite possible
1	2	3	4	5	6	7

1.	It is difficult because of my lazy behaviours.	
2.	It is difficult because we do not allocate money for the products to save energy.	
3.	It is difficult because of the small number of products required for saving.	
4.	It is difficult for me because I do not leave my habits.	
5.	It is difficult because some of the economic products emit radiation	
6.	In the case of over-saving, it is difficult because my work goes wrong.	
7.	It is difficult because I can lose time for control.	
8.	It is difficult because I can be perceived as stingy.	
9.	It is difficult because I can be perceived as restrictive.	
10.	It is difficult because of people's negative reactions.	
11.	It is difficult because I am fond of my comfort.	
12.	It is difficult because energy-saving lamps are not aesthetical compared to droplights.	
13.	It is difficult because it creates electromagnetic pollution.	
14.	It is difficult because of my forgetfulness.	
15.	It is difficult because my energy saving is not supported.	
16.	It is difficult because it reduces my life standards.	
17.	It is difficult because I do not know how to do it.	
18.	It is difficult because of errors caused by the heating system.	

E6. When you graduate and you want to save energy at home and at school in the next six months, is this be easy because of which of the items below?

Not at all	Very little	Some	Adequately	A lot
1	2	3	4	5

1.	It is easy because I make an effort for energy saving.	
2.	It is easy because the financial facilities for energy saving are adequate.	
3.	It is easy because it contributes to the subjects in science courses students will learn.	
4.	It is easy because I have made a habit of it.	
5.	It is easy because it provides with talking about productivity within the family.	
6.	It is easy because it will provide financial gain.	
7.	It is easy because it contributes to the country economy the country to contribute to the economy.	
8.	It is easy because energy resources can be used for a long time.	
9.	It is easy because dependency on foreign countries will reduce.	
10.	It is easy because of people's positive reactions	
11.	It is easy for a healthier life	
12.	It is easy because there will not be any energy cut.	
13.	It is easy because energy efficiency will increase.	
14.	It is easy because I continuously think about energy saving.	
15.	It is easy because of the support for my saving.	
16.	It is easy because I think I will win others' appreciation.	
17.	It is easy because I know how to do it.	
18.	It is easy because the heating system works efficiently.	

E7.

Very bad	Bad	Little	Neither good nor bad	Somewhat good	Good	Very good
1	2	3	4	5	6	7

1.	When I graduate, I work at home and I save energy in school, this behaviour...	
2.	When I graduate, I work at home and work at school to save water, this behaviour...	
3.	When I graduate, I work at home and work to reduce garbage at school, this behaviour...	

E8.

Not at all possible	Not possible	Somewhat not possible	It may or may not be possible	Somewhat possible	Possible	Quite possible
1	2	3	4	5	6	7

1.	That the people and institutions that I value expect me to save energy at home and work and school	
2.	That the people and institutions that I value expect me to save water at home and work and school	
3.	That the people and institutions that I value expect me to reduce garbage at home and work and school	

E9.

Not at all possible	Not possible	Somewhat not possible	It may or may not be possible	Somewhat possible	Possible	Quite possible
1	2	3	4	5	6	7

1.	For me, saving energy at home and at school which I will work in	
2.	For me, saving water at home and at school which I will work in	
3.	For me, reducing garbage at home and at school which I will work in	

E10.

Not at all possible	Not possible	Somewhat not possible	It may or may not be possible	Somewhat possible	Possible	Quite possible
1	2	3	4	5	6	7

1.	I aim to save energy at home and at school which I will work in when I graduate.	
2.	I aim to save water at home and at school which I will work in when I graduate.	
3.	I aim to reduce garbage at home and at school which I will work in when I graduate.	

E11.

Never	Very little	Sometimes	Often	Quite often
1	2	3	4	5

1.	Last year I saved energy at home	
2.	Last year I saved water at home	
3.	Last year I reduced garbage at home.	

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