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Effects of environmental illiteracy and environmental awareness among middle school students on environmental behavior

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Abstract This study proposes and employs a structural model to examine the effects of environmental literacy, environmental awareness, environmental attitudes, and environmental behavior among middle school students in Eskişehir on their purchase of environmentally friendly products. In the proposed structural model, environmental illiteracy and environmental awareness were the exogenous latent variables, while pro-environmental attitude, pro-environmental behavior, and the purchase of environmentally friendly products were the endogenous latent variables. The latent variable of environmental illiteracy did not have a statistically significant effect on environmental attitudes and purchase of environmentally friendly products, whereas environmental awareness had a positive effect on pro-environmental attitudes and the purchase of environmentally friendly products. These findings indicate that students with environmental awareness also develop positive attitudes toward the environment, and the presence of a positive attitude toward the environment leads them to display pro-environmental behaviors and adopt a positive attitude toward environmentally friendly products.

Keywords Environmental awareness · Environmental behavior · Environmental attitudes · Purchase of environmentally friendly products

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1 Introduction

In recent years, the increasing visibility of the damage caused by environmental problems has led to a growing concern for the environment, resulting in the more widespread adoption of environmentally friendly behaviors. Environmentally friendly consumption can be defined as minimizing environmental damage and taking environmental consequences into account at every stage of consumption. Environmentally friendly consumption is one among many components of environmentally friendly behavior. Consuming ecological and recyclable products, avoiding over-consumption, buying from firms that do not pollute the environment, supporting environmental projects, and producing environmentally friendly products are examples of environmentally friendly consumption.

Concerned by the worsening of environmental problems, various national civil society organizations have increased their pressure on politicians and administrators, which, together with the increase in consumer awareness, led certain businesses to start producing environmentally friendly products to prevent environmental pollution and to minimize or eliminate hazardous waste (Yılmaz et al. 2009: 2).

As a result of education and training activities on social media, TV programs, and in schools and public education centers to raise environmental awareness, there has been an increase in social awareness and interest in environmentally friendly products in recent years. Consumer interest in organic products arises from the perception that environmentally friendly products are healthier and taste better; from concerns about the living environment, food safety, and animal health; and from the desire to support the local economy and maintain traditional cooking methods (Çelik 2013: 98).

To ensure that environmentally friendly products—which are more natural and healthier—gain widespread acceptance, the public in general as well as the younger generations need to be taught about environmental awareness and to participate in awareness activities. With this goal in mind, a structural equation model (SEM) was developed to examine the effects of environmental knowledge, environmental awareness, pro-environmental attitudes, and pro-environmental behaviors among middle school students on their purchases of environmentally friendly products; model fit was examined using various measures of fit.

2 Literature review

Kaiser et al. (1999) used environmental attitudes as a predictor of environmentally friendly behavior. In the SEM they developed, they determined that environmental knowledge and environmental values explained 40 % of the variation in interest in environmentally friendly behavior, and interest in environmentally friendly behavior was able to explain 75 % of the variation in environmentally friendly behavior in general. Kaiser and Shimoda (1999) used environmental awareness as a predictor of environmentally friendly behavior. In the SEM they developed, they determined that feelings of guilt arising from environmentally damaging behavior explained 44 % of the variation in environmental awareness, and individual environmental awareness explained 55 % of the variation in environmental behavior. Tilikidou and Delistavrou (2006) determined a negative correlation between Greek consumers' environmentally friendly behavior and environmental unconcern and that women with higher levels of education participated in pro-environment activities more frequently. Using a structural equation model, Fraj and Martinez (2007) showed that

environmental attitudes are successful predictors of environmentally friendly behavior. Nakıboğlu (2007) determined that married, middle-aged individuals with a university degree were more willing to pay higher prices for environmentally sensitive products and that they were more likely to purchase environmentally friendly products. In a study on ecologically oriented consumption and how it varies by demographics and level of environmental knowledge, Tilikidou (2007) determined that ecologically oriented consumption had a positive correlation with the level of environmental knowledge and a negative correlation with environmental unconcern. Tilikidiou and Delistavrou (2008) examined the non-purchase of environmentally friendly products and factors that explain this behavior. They found that people with higher levels of education were more interested in recycling, participated in ecologically oriented activities more frequently, and displayed behavior in which environmental concerns took precedence over consumption concerns. In their study on the determinants of pro-environmental consumption, Weisch and Kühling (2009) determined that the frequency of purchasing environmentally friendly food products was higher among people who have been consuming such products for a long time and cognitive and economic factors were also significant covariates of ecologically oriented consumption.

Kaiser and Wilson (2000) examined the cross-cultural validity of the general ecological behavior scale and found that the scale was able to measure ecological behavior among Californian students as well as among Swiss students and that in this sense it had cross-cultural validity. Kaiser et al. (2007) developed a behavior-based attitude scale for adolescents, which is based on people's recall of their past behavior. They determined that people's environmental attitude can be reliably derived from self-reported conservation behaviors by employing Rasch-type model. They predicted environmental attitude can be directly derived from what people claim to do and probably do conservationally. Their new measure, which implies a mathematically formalized link between a person's attitude and his or her behavior record, has extensive application potential as a psychological science-based policy support tool. Uzun and Sağlam (2006) developed an environmental attitude scale for use with high school students and examined the validity of the scale. They used factor analysis to extract further dimensions related to environmental behavior and environmental opinions. The factors extracted were interest in environmental issues, environmental concern, and environmental awareness. Although the scale was developed with the participation of high school students, it is also applicable to middle school students. Shobeiri et al. (2007) conducted a comparative study of environmental awareness among middle school students in Iran and India. The study was conducted with the participation of 476 male and 513 female students from 103 different middle schools in Mysore and Tehran. Levels of environmental awareness among students in Iran and in India were determined to differ significantly. School administration was a very important factor affecting students' environmental awareness. The study did not find any significant differences between male and female students in terms of their levels of environmental awareness. Yılmaz et al. (2009) developed and used a structural equation model to examine the effects of environmental awareness and pro-environmental attitudes and behaviors on the purchase of environmentally friendly food products. They determined that environmental awareness did not have a direct effect on ecological behavior, but that people with ecological attitudes were more likely to purchase environmentally friendly products. Steg and Vlek (2009) argued that pro-environmental behavior needs to be explained with reference to environmental attitudes and that changes in environmental attitudes would be reflected in behavior as well. Dono et al. (2010) determined that there was a significant

relationship between university students' environmental attitudes and environmental behavior.

Abeliotis et al. (2010) aimed to examine methods used by Greek families to improve environmental awareness among their children. Their study was conducted with the participation of the parents of 435 children attending the last year of primary education at schools in the larger Athens urban area, who were asked to fill out a questionnaire consisting of closed-end questions. Greek families agreed that environmental awareness was an important part of children's character development. Participants also stated that they helped their children develop environment awareness with their daily activities. Based on their responses to the items on daily activities, families were divided into five groups using cluster analysis. The results suggested that highly educated young mothers engaged in environmentally friendly activities more frequently compared to other groups.

Kapassa et al. (2013) examined the relationships between the knowledge, beliefs, and attitudes of middle school students regarding renewable raw materials/biomass. They looked into the relationships between knowledge, beliefs, and attitudes toward renewable biomass sources and toward the use of renewable biomass sources with the purpose of facilitating implementation of green chemistry principles in practice, topics that are included in school curricula in Greece. They have found that students had insufficient knowledge of mechanisms of biomass generation and basic principles of green chemistry, and there were significant gaps in their knowledge regarding the relationship between biomass and global food needs. Students were determined to have a positive attitude toward and strong determination regarding the use of biomass.

Studies of parental effects on environmental attitudes report that mothers tend to be more interested in and concerned about environmental issues compared to fathers. This difference is explained with reference to their differing social roles. Mothers were found to be more concerned about the health and welfare of family members (which are closely related to local environmental conditions such as water and air quality and solid waste), while fathers were found to be more concerned about material conditions and economic issues (George and Southwell 1986; Dietz et al. 1998). Studies on the relationship between education and environment find that people with higher levels of education tend to be more knowledgeable and thus more concerned about environmental issues (Kohut and Shriver 1989; Vining and Ebro 1990; Mainieri et al. 1997).

Overall, while there are many studies in the literature investigating the relationship between environmental attitudes, environmental behaviors, and the purchase of environmentally friendly products, there are only a limited number of studies evaluating the relationships between the aforementioned latent environmental variables in middle school students.

3 Method

3.1 Data collection and sampling

According to a survey conducted by CNBC-e Business magazine, Eskişehir, with its population of 750,000, is considered to be Turkey's third most livable city. This study was conducted with the participation of 335 students from four different middle schools, administered by Eskişehir Provincial Directorate of National Education, and located in neighborhoods of different socioeconomic characteristics. Data were collected using the

surveys administered at Atatürk Middle School on March 11, 2015, at Murat Atılgan Middle School on March 12, 2015, at Fahrettin Kerim Gökay Middle School on March 13, 2015, and at Ata Middle School on March 20, 2015, with the permission of Eskişehir Provincial Directorate of National Education.

The data collection instrument used in the study was developed by the authors based on the studies by Uzun and Sağlam (2006), Kaiser and Wilson (2000), Fraj and Martinez (2007), Tilikidiou and Delistavrou (2008), and Yılmaz et al. (2009). The instrument consists of 33 statements designed to measure various attitudes and behaviors; the first part of the questionnaire contains questions on demographics such as gender, grade, mother's education, father's education, and the name of the school attended. The second part of the questionnaire contains statements designed to measure environmental knowledge, environmental attitudes, environmental behaviors, and use of environmentally friendly products. A 5-point Likert scale was used in the study to address statements of attitude (1: strongly disagree; 5: strongly agree) and statements of behavior (1: never; 5: always). A pilot study was conducted with 50 students to establish the reliability of the data collection instrument. Items that were difficult to understand were removed, and some items were amended. The data collection instrument used contained the following five factors: "A: Environmental Illiteracy," "B: Environmental Awareness," "C: Pro-Environmental Attitudes," "D: Pro-Environmental Behaviors," and "E: Purchase of Environmentally friendly Products." The Cronbach's alpha value for the assessment tool's "A: Environmental Illiteracy" was not at a desirable level. This might have been due to the students' lack of experience (students between the ages of 10 and 13) with 5-point Likert type questions, which might have resulted in an insufficient understanding of some of the questionnaire items. However, the Cronbach's alpha coefficient of the overall scale was found to be 0.87. For this reason, the scale was considered suitable for assessing the environmental attitudes and behaviors of middle school students between the ages of 10 and 13. Small children learn various attitudes and values regarding the environment from the schools they attend and their close social environment. Since today's children are also tomorrow's adults, it is known that the attitudes and behaviors children acquire in their early ages will shape their behaviors as adults toward the environment. For this reason, one effective approach would be to increase the level of knowledge and awareness of children on the environment by teaching this subject in schools starting from an early age. In both developed and developing countries, it is particularly pertinent that such courses are included into school curricula.

Of the students who participated in the study, 48.7 % ($n = 163$) were female and 51.3 % ($n = 172$) were male. Of the participants, 9.6 % ($n = 32$) were 5th-graders, 7.2 % ($n = 24$) were 6th-graders, 44.2 % ($n = 148$) were 7th-graders, and 39.1 % ($n = 131$) were 8th-graders. Data on the mothers' level of education show that 5.7 % ($n = 19$) were illiterate, 37.3 % ($n = 125$) were primary school graduates, 23.0 % ($n = 77$) were middle school graduates, 23.6 % ($n = 79$) were high school graduates, and 9.3 % ($n = 31$) were university graduates. Data on the fathers' level of education show that 2.1 % ($n = 7$) were illiterate, 21.5 % ($n = 72$) were primary school graduates, 24.2 % ($n = 81$) were middle school graduates, 34.3 % ($n = 115$) were high school graduates, and 15.8 % ($n = 53$) were university graduates.

3.2 Structural equation modeling

Structural equation modeling (SEM) is a multi-variable statistical technique which uses a linear approach in order to resolve complex theoretical structures containing intangible

facts (Çelik and Yılmaz 2013). Intangible facts mean latent variables which are set forth via observed variables. SEM enables evaluating causal relationships between these latent variables and testing and developing the theoretical model put forward. It is thought that this will shed light on research studies in the social sciences; in particular, since their theory is based on intangible structures, it becomes very difficult to determine intangible concepts such as intelligence, motivation, emotion, attitude, and the relationship between them. Therefore, the researcher must relate the latent variable with the observable variables at the point of default structure in order to define the latent variable functionally. A structural equation model implies a structure of the covariance matrix of the measures. Once the model's parameters have been estimated, the resulting model-implied covariance matrix can then be compared to an empirical or data-based covariance matrix. If the two matrices are consistent with one another, then the structural equation model can be considered a plausible explanation for relations between the measures. The fundamental hypothesis for the covariance analysis method is that the covariance matrix of the measurement variables is a function of a set of parameters as shown: $H_0: S = \sum(\theta)$. Model parameters (θ, which is a generic notation for all unknown parameters in the model) are estimated by minimizing some form of discrepancy between a sample variance–covariance matrix (S) and model-implied variance–covariance matrix $\sum(\theta)$. Different estimation methods or estimators minimize different functions of the discrepancy between S and $\sum(\theta)$, called fit or discrepancy functions (F). A model fit statistic is $T = (N - 1) \times F$, where N is the sample size, and F is the minimum of the fit function when the model converges. T follows a Chi-square distribution with degrees of freedom (df) equal to the number of unique variances and covariance minus the number of estimated model parameters. Therefore, overall fit of the model to data can be assessed using a Chi-square test.

SEM consists of two components: a measurement model and a structural model. The measurement model assesses latent (unobserved) variables as linear functions of indicators (observed variables). The structural model shows the direction and strengths of the relationships of the latent variables. A typical structural equations model is defined:

$$\eta = B\eta + \Gamma\xi + \zeta \tag{1}$$

where η is a column vector of m endogenous variables, ξ is a column vector of n exogenous variables, B is a matrix $(m \times m)$ of coefficients associated with the direct effects of an endogenous variable on another endogenous variable, Γ is a matrix $(m \times n)$ of coefficients associated with the direct effects of an exogenous variable on an endogenous variable, and ζ is a column vector of error terms associated with endogenous variables. Φ represents the covariance matrix $(n \times n)$ of exogenous variable ξ.

The measurement equations relating the latent variables to the measurement variables are

$$y = \Lambda_y\eta + \varepsilon \tag{2}$$

$$x = \Lambda_x\xi + \delta \tag{3}$$

$y_{(p\times 1)}$ and $x_{(q\times 1)}$ are the column vectors of p-measured endogenous variables and q-measured exogenous variables, respectively. Λ_y and Λ_x are the corresponding factor loading (λ_{ij}) matrices. ε and δ are the error terms related to the measured variables and are uncorrelated. In the proposed model, there are three endogenous variables ($m = 3$) and two exogenous variables ($n = 2$). The detailed specified SEM can be laid out in the form of matrices as shown below, based on Eqs. 4–5.

$$\eta = B\eta + \Gamma\xi + \zeta \tag{4}$$

$$\begin{bmatrix} \eta_C \\ \eta_D \\ \eta_E \end{bmatrix} = \begin{bmatrix} 0 & 0 & 0 \\ \beta_{BC} & 0 & 0 \\ 0 & \beta_{ED} & 0 \end{bmatrix} \begin{bmatrix} \eta_C \\ \eta_D \\ \eta_E \end{bmatrix} + \begin{bmatrix} \gamma_{CA} & \gamma_{CB} \\ 0 & 0 \\ \gamma_{EA} & \gamma_{EB} \end{bmatrix} \begin{bmatrix} \xi_A \\ \xi_B \end{bmatrix} + \begin{bmatrix} \zeta_C \\ \zeta_D \\ \zeta_E \end{bmatrix} \tag{5}$$

3.3 The research model and the design of hypotheses

The research model used in the study is illustrated in Fig. 1. In this model, A refers to environmental illiteracy, B refers to environmental awareness, C refers to pro-environmental attitudes, D refers to pro-environmental behaviors, and E refers to the purchase of environmentally friendly products.

The symbols in Fig. 1 are defined below.

ξ_A, environmental illiteracy; ξ_B, environmental awareness; η_C, pro-environmental attitudes; η_D, pro-environmental behaviors; η_E, purchase of environmentally friendly products. ζ_C, error term to pro-environmental attitudes; ζ_D, error term to pro-environmental behaviors; ζ_E, error term to purchase of environmentally friendly products; Φ_{BA}, covariance between environmental illiteracy and environmental awareness.

γ_{CA}, the direct effect impact on pro-environmental attitudes of environmental illiteracy; γ_{CB}, the direct effect impact on pro-environmental attitudes of environmental awareness; γ_{EA}, the direct effect impact on purchase of environmentally friendly products of environmental illiteracy; γ_{EB}, the direct effect impact on purchase of environmentally friendly products of environmental awareness; β_{DC}, the direct effect impact on pro-environmental behaviors of pro-environmental attitudes; β_{ED}, the direct effect impact on purchase of environmentally friendly products of pro-environmental behaviors.

Students who are faced with environmental problems are expected to develop some sort of a response to these problems. The response developed is usually shaped by their level of environmental knowledge and environmental awareness. Kaiser and Shimoda (1999) and

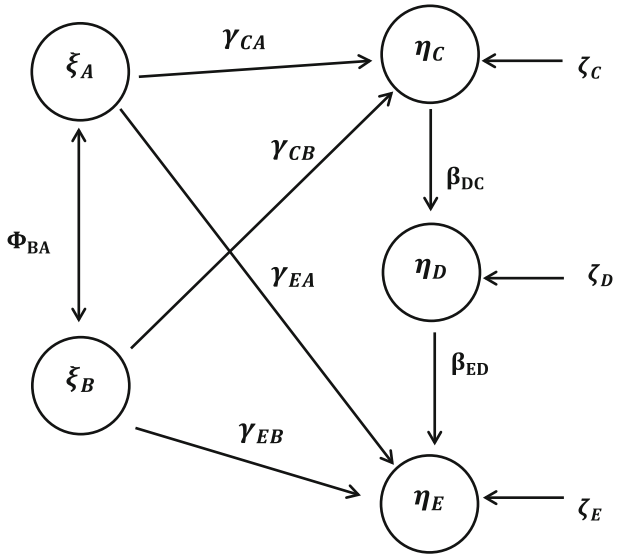

Fig. 1 Proposed research model

Table 1 SEM results for the proposed research model

Factors	Items	Standard loads	*t* value	R^2
Factor A environmental illiteracy Cronbach's alpha = 0.48	S20: It would be better for our country if we spent our money on building luxury roads rather than on historical sites.	0.57	6.07***	0.32
	S24: We no longer have soil erosion in our country.	0.47	5.55***	0.22
	S29: Agricultural pesticides are good for the environment.	0.42	5.19***	0.18
Factor B environmental awareness Cronbach's alpha = 0.65	S31: Global warming may cause catastrophes in the future.	0.57	10.09***	0.32
	S37: Rapid depletion of natural resources threatens our future.	0.68	12.58***	0.47
	S38: I am afraid environmental pollution may endanger life on earth.	0.54	11.63***	0.41
Factor C pro-environmental attitudes Cronbach's alpha = 0.74	S32: Everyone should notice the beauty in nature.	0.68		0.47
	S35: You have to be frugal to help protect nature.	0.72	10.58***	0.51
	S36: I turn off the tap when I brush my teeth to save water.	0.70	10.57***	0.49
Factor D pro-environmental behaviors Cronbach's alpha = 0.69	S7: I watch and listen to environmental shows on TV and radio.	0.67		0.45
	S8: I read non-school-related books and magazines on the environment.	0.61	8.30***	0.37
	S9: I watch documentaries on environmental issues.	0.69	8.82***	0.48
Factor E purchase of environmentally friendly products Cronbach's alpha = 0.55	S6: I would like my family to purchase environmentally friendly products to help protect the environment.	0.54		0.29
	S12: I consume environmentally friendly products with peace of mind.	0.53	6.13***	0.28
	S15: I prefer products that do not damage the environment even if they are more expensive.	0.50	5.95***	0.25
Hypotheses				Conclusion
H_1 : A → C		0.09	1.12NS	Not supported
H_2 : B → C		0.97	10.94***	Supported
H_3 : A → E		0.15	1.51NS	Not supported
H_4 : B → E		0.22	2.35**	Supported
H_5 : C → D		0.42	5.33***	Supported
H_6 : D → E		0.69	5.68***	Supported

NS not significant

** $p < 0.05$; *** $p < 0.01$

Tilikidou (2007) determined that higher levels of environmental knowledge and environmental awareness were associated with pro-environmental attitudes. Thus, the expected relationship between environmental knowledge, environmental awareness, and pro-environmental attitudes is expressed by hypotheses H_1 and H_2:

H_1 Higher levels of environmental illiteracy among students are associated with lower levels of pro-environmental attitudes.

H_2: H_1 Higher levels of environmental awareness among students are associated with higher levels of pro-environmental attitudes.

The relationship between environmental knowledge, environmental awareness, and purchase of environmentally friendly products was examined by Çabuk and Nakıboğlu (2003), Mostafa (2007), and Tilikidiou and Delistavrou (2008). The expected relationship between environmental knowledge, environmental awareness, and pro-environmental attitudes is expressed by hypotheses H_3 and H_4:

H_3 Higher levels of environmental illiteracy among students are associated with a lower frequency of purchasing environmentally friendly products.

H_4 Higher levels of environmental awareness among students are associated with a higher frequency of purchasing environmentally friendly products.

Kaiser et al. (1999); Fraj and Martinez (2007); and Dono et al. (2010) examined the relationship between environmental attitudes and environmental behaviors. These studies determined that positive attitudes toward environment are associated with pro-environmental behaviors. The expected relationship between environmental attitudes and environmental behaviors is expressed by the hypothesis H_5:

H_5 Higher levels of pro-environmental attitudes among students are associated with a higher frequency of pro-environmental behavior.

It is expected that individuals with a positive attitude toward the environment will engage in pro-environmental behavior and develop a positive attitude toward environmentally friendly products, and this will lead to the purchase of environmentally friendly products. To examine the relationship between pro-environmental attitudes and behaviors on the one hand, and attitudes toward and purchase of environmentally friendly products on the other, hypothesis H_6 was formed:

H_6 Higher levels of pro-environmental behavior among students are associated with a higher frequency of purchasing environmentally friendly products.

4 Results

Parameter estimates obtained using the SEM specified above are given in Table 1. The *t* test conducted showed that hypotheses H_1 and H_3 were not supported by the data and hypotheses H_2, H_4, H_5, and H_6 were supported.

The Chi-square value of the SEM was $\chi^2 = 94.44$ ($df = 83$, $p > 0.01$). The χ^2/df ratio was 1.137, which indicated good fit because the ratio is less than two (Hair et al. 2006). The following measures of model fit were calculated: RMSEA = 0.020 (root-mean-square error approximation), NFI = 0.98 (normed fit index), CFI = 0.99 (comparative fit index) and GFI = 0.96 (goodness of fit). An RMSEA value equal to 0.05 or less reflects a perfect fit, values under 0.10 indicate an acceptable fit, while those above 0.10 indicate a poor fit. The other measures of fit vary between 0 and 1, and the closer the measure is to 1, the better the model fit (Byrne 1998; Joreskog and Sorbom 2001). When all fitness criteria are considered together, it is evident that the proposed model has a good fit.

Figure 2 displays the path diagram of the model, and Fig. 3 displays the detailed path diagram.

Structural equations calculated as part of the SEM analysis are shown in Eq. 6:

$$\begin{aligned}
&\eta_C = \gamma_{CA}\,\xi_A + \gamma_{CB}\,\xi_B + \zeta_C = 0.09\,\xi_A + 0.97\,\xi_B + 0.09; && R^2_C = 0.91\\
&\eta_D = \beta_{CA}\,\eta_C + \zeta_D = 0.42\eta_C + 0.82; && R^2_D = 0.18\\
&\eta_E = \gamma_{ED}\,\eta_D + \gamma_{EA}\,\xi_A + \gamma_{EB}\,\xi_B + \zeta_E = 0.69\eta_D + 0.15\,\xi_A + 0.22\,\xi_B + 0.36; && R^2_E = 0.64
\end{aligned} \tag{6}$$

Results reported in Table 1 and Fig. 3 show that the exogenous variable of "environmental illiteracy" has no effect on the endogenous variables of "pro-environmental attitude" and "purchase of environmentally friendly products." The coefficient of the relationship between the exogenous latent variable "environmental awareness" and the endogenous variable of "pro-environmental attitude" is $\gamma_{CB} = 0.97$. Therefore, a one unit increase in students' environmental awareness score results in a 0.97 unit increase in their pro-environmental attitude score. The coefficient of the relationship between the exogenous latent variable "environmental awareness" and the endogenous latent variable "purchase of environmentally friendly" products is $\gamma_{EB} = 0.22$. This signifies that a one unit increase in students' environmental awareness score results in a 0.22 unit increase in their purchase of environmentally friendly products. Similarly, the endogenous latent variable "pro-environmental attitude" has a positive effect on the endogenous variable of "pro-environmental behavior." The coefficient of the relationship between pro-

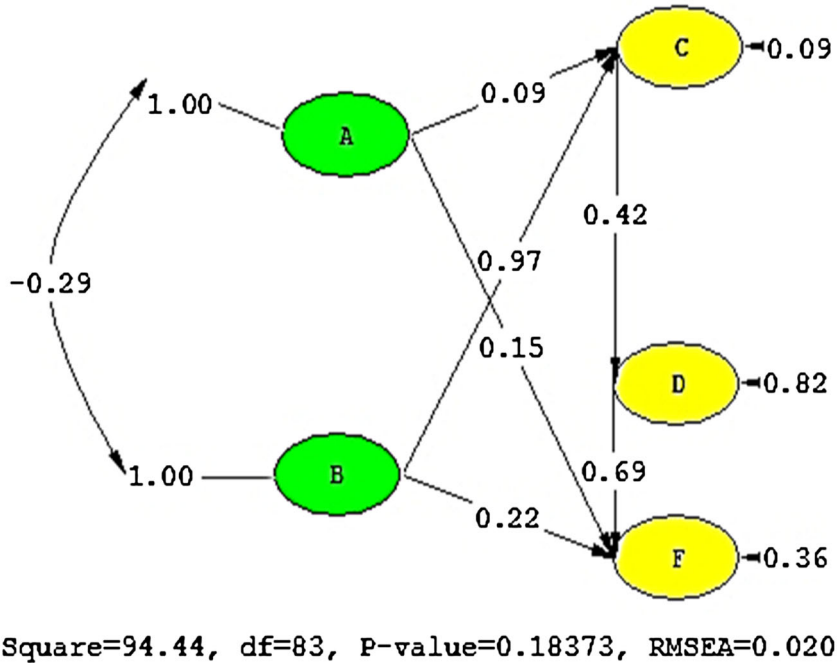

Fig. 2 Empirical structural equation model (LISREL output). A, environmental illiteracy; B, environmental awareness; C, pro-environmental attitude; D, pro-environmental behavior, E, purchase of environmentally friendly products. Goodness of fit measures: $\chi^2/df = 1.137$; NFI = 0.98; GFI = 0.96; CFI = 0.99

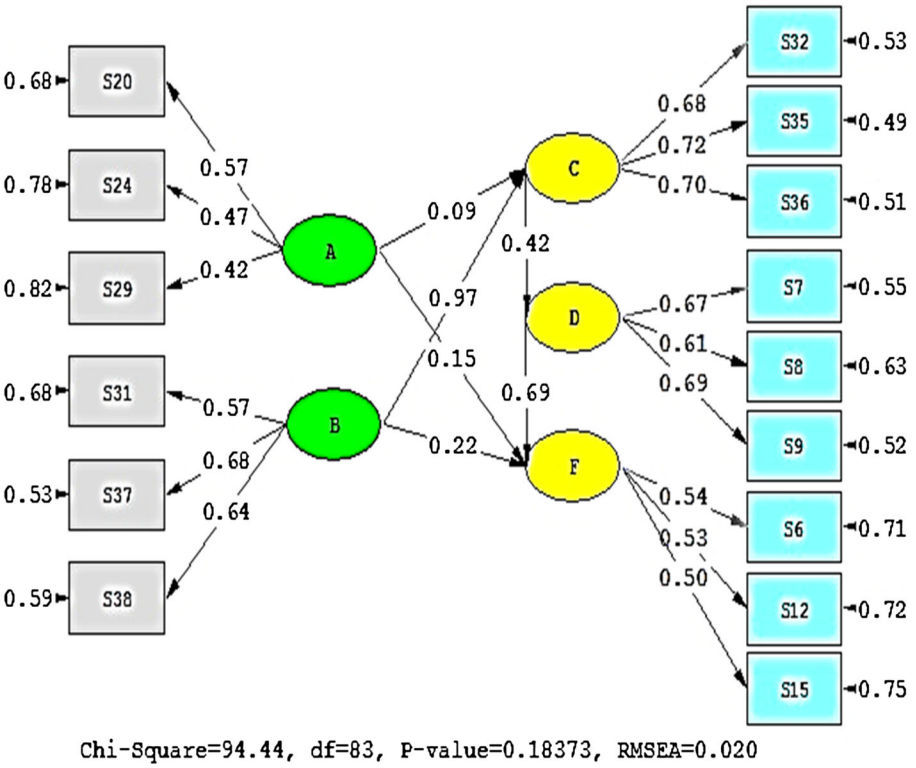

Fig. 3 Detailed path diagram of empirical structural equation model (LISREL output). A, environmental illiteracy; B, environmental awareness; C, pro-environmental attitude; D, pro-environmental behavior; E, purchase of environmentally friendly products

environmental attitude and pro-environmental behavior is $\beta_{DC} = 0.42$. Consequently, a one unit increase in students' pro-environmental attitude score results in a 0.42 unit increase in their pro-environmental behavior score. Finally, the endogenous variable "pro-environmental behavior" has a positive effect on the endogenous variable "purchase of environmentally friendly products," and the coefficient of the relationship between the two variables is $\beta_{ED} = 0.69$. Therefore, a one unit increase in students' pro-environmental behavior score causes a 0.69 unit increase in their purchase of environmentally friendly products. The correlation coefficient of the relationship between the exogenous variables "environmental illiteracy" and "environmental awareness" was $\Phi_{BA} = -0.29$ ($t = -3.12$; $p < 0.001$), and the coefficient of the indirect relationship between "environmental awareness" and "pro-environmental behavior" via "Pro-environmental attitude" was $0.41(t = 5.38;\ p < 0.001)$.

Based on the R^2 determination coefficients in Eq. 6, it was determined that the latent variables environmental illiteracy and environmental awareness accounted for 91 % of the change in environmental attitude, while environmental attitude accounted for 18 % of the change in environmental behavior, and environmental illiteracy, environmental awareness, and environmental behavior accounted for 64 % of the change in the purchase of environmentally friendly behavior.

In this study, ANOVA was also performed between the demographic variables and the latent variables. It was determined that the average scores of the students for "environmental illiteracy," "environmental awareness," "environmental attitude," and "purchase of environmentally friendly products" differed statistically significantly with respect to gender.

The calculated statistics were ($F_{(1;334)} = 19.636$; $F_{(1;334)} = 26.582$; $F_{(1;334)} = 16.501$; $F_{(1;334)} = 4.588; p < 0.05$). The average environmental illiteracy score for males was ($\bar{x} = 2.474$; SD = 0.870), while the average score for females was ($\bar{x} = 2.091$; SD = 0.700). This result indicates that male students have a higher level of environmental illiteracy than female students. The average environmental awareness score of female students was ($\bar{x} = 4.168$; SD = 0.615), while the average score of the male students was ($\bar{x} = 3.769$; SD = 0.786). The average environmental attitude score of the female students was ($\bar{x} = 4.021$; SD = 0.591), while the average score for male students was ($\bar{x} = 3.701$; SD = 0.824). The average score for the purchase of environmentally friendly product behavior was ($\bar{x} = 3.501$; SD = 0.799) for female students and ($\bar{x} = 3.293$; SD = 0.964) for male students.

It was determined that the average "environmental behavior" and the "purchase of environmentally friendly product behavior" scores of the students differed statistically significantly according to the education level of their fathers ($F_{(4;327)} = 4.047$; $F_{(4;327)} = 3.795$; $p < 0.05$). This significant difference stemmed mainly from the difference between students whose fathers had middle school education and students whose fathers had high school education. The average environmental behavior score of students with middle school graduate fathers was ($\bar{x} = 3.345$; SD = 0.866), while the average score for students with high school graduate fathers was ($\bar{x} = 2.824$; SD = 0.906). Similarly, the average score for the purchase of environmentally product behavior was ($\bar{x} = 3.648$; SD = 0.748) for students with middle school graduate fathers and ($\bar{x} = 3.230$; SD = 0.915) for high school graduate fathers.

It was determined that the average "environmental illiteracy" scores of the students differed statistically significantly according to the education level of their mothers ($F_{(4;327)} = 2.824$; $p < 0.05$). This significant difference stemmed mainly from the difference between students whose mothers were illiterate and students whose mothers were elementary school and university graduates. The average environmental illiteracy was ($\bar{x} = 2.754$; SD = 0.727) for students with illiterate mothers, ($\bar{x} = 2.190$; SD = 0.760) for students with elementary school graduate mothers, and ($\bar{x} = 2.091$; SD = 0.812) for students with university graduate mothers.

5 Conclusion

This study determined that environmental awareness, pro-environmental attitudes, and pro-environmental behavior are significant predictors of the purchase of environmentally friendly products. No statistically significant relationship was identified between the exogenous variable of environmental illiteracy on the one hand, and pro-environmental attitudes and purchase of environmentally friendly products on the other. These findings indicate that students with environmental awareness develop pro-environmental attitudes, which then are reflected in pro-environmental behavior, including purchase of environmentally friendly products.

This study establishes that environmental awareness, pro-environmental attitudes, and pro-environmental behavior are all interrelated. Other studies in the literature also report findings that support this relationship. Yılmaz et al. (2009), for example, determined that environmental awareness did not have a direct effect on pro-environmental behavior, but that people with pro-environmental attitudes were more likely to display pro-environmental behaviors and purchase environmentally friendly products. Dono et al. (2010) determined that there was a statistically significant relationship between environmental attitudes and environmental behavior. Similarly, Steg and Vlek (2009) argued that environmental attitudes should be the starting point for any study aiming to explain pro-environmental behavior.

The present study also determined that environmental awareness, pro-environmental attitudes, and pro-environmental behavior were significant predictors of purchase of environmentally friendly products, an observation supported by similar findings from other studies. Using a structural equation model, Fraj and Martinez (2007) showed that environmental attitudes are successful predictors of environmentally friendly behavior. Tilikidou and Delistavrou (2006) determined a negative relationship between Greek consumers' pro-environmental behavior and environmental unconcern, and Çabuk and Nakıboğlu (2003) found a significant relationship between consumers' environmental awareness and purchasing behaviors. In addition, Kaiser, Wölfing and Fuhrer (1999) determined that environmental attitudes could be used as predictors of pro-environmental behavior.

Another finding of this study was that female students have higher environmental awareness, environmental attitudes, and purchase of environmentally friendly products than male students. In parallel with the findings of the present study, various studies in the literature describe that female students are generally more interested in environmental issues than male students and that their attitudes toward the environment are also more positive (Uzun and Sağlam 2006; Yilmaz and Arslan 2011). However, in contrast to our study findings, the study of Shobeiri et al. (2007), which comparatively investigated the level of environmental awareness among middle school students in Iran and India, identified no statistically significant differences between the environmental awareness levels of male and female students.

In addition, it was also determined that the education level of mothers has an effect on environmental illiteracy levels and that a higher level of education for the students' mothers was associated with a higher level of knowledge for the students regarding the environment, which in turn led to more environmentally friendly attitudes and behaviors among the students. In parallel with these findings, the study of Yilmaz and Arslan (2011), which investigated university students' commitment to protect the environment and their environment-friendly consumption habits, determined that a higher education level for the students' mothers was associated with a higher level of environmental awareness, environment-friendly consumption, and commitment to protect the environment among the students. The said study also determined that while the education level of the fathers led to statistically significant differences in the students' mean scores for the "environmental behavior" and "environment-friendly product purchasing behavior" dimensions, it did not have a significant effect on any of the other dimensions. These results indicate that the education level of mothers and fathers have various different effects on the students' knowledge, attitudes, and behaviors regarding the environment. This difference observed in the said study possibly stems from the different roles mothers and fathers assume in social life. Studies generally describe that mothers feel greater concern for the family's well-being and health (concerns that are more closely related to the quality of

environmental conditions, such as water and air quality and wastes), while fathers feel more concerned about the financial and economic status of the family (George and Southwell 1986; Dietz et al. 1998).

Using structural equation modeling, the present study examined the relationship between middle school students' environmental knowledge, environmental awareness, pro-environmental attitudes, and pro-environmental behavior on the one hand, and the purchase of environmentally friendly products. The Cronbach's alpha coefficient of the assessment tool used in this study was determined as 0.87. Based on this value and the goodness of fit measures of the recommended SEM model, the scale was considered suitable for assessing the environmental attitudes and behaviors of middle school students between the ages of 10 and 13. Furthermore, we believe that in addition to assessing the environmental attitudes and behaviors of middle school students between the ages of 10 and 13, the results obtained through this scale might also contribute to the preparation of content for classes/courses on the environment in schools.

The limitations of the study included the fact that it was performed in a single province and that it did not encompass the country overall. The proposed model can be further developed by including other factors that were not considered within the scope of the current study. In addition, the data collection tool used in this study and the recommended SEM can be expanded to include groups with different income levels, high school and university students, and different countries and cultures, such that it would be possible to perform comparisons between different groups.

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