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Towards a Profound Ecological Understanding: Statistical Attempts to Measure our Ecological Intelligence

By

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Abstract

Ecological intelligence that is a new type of conscience is defined as an ecological awareness and sensitivity of modern human beings regarding the negative natural mutations on a global scale and the ability to react against these changes. In this study we aim to develop a reliable and valid scale that would enable us to measure individuals' ecological intelligence level based on their consumption behavior. The ecological intelligence scale (EIS) was developed in six different steps: (a) forming an item pool, (b) resorting to expert opinion, (c) pilot testing, (d) application process, (e) construct validity and (f) reliability. A sample of 940 undergraduate students responded to a 95-item questionnaireregarding ecological intelligence. As we examined the results of item analyses of the EIS we observed that 64 items were positive and higher than the value of correlation coefficient .30. For the construct validity we utilized the strategy of dividing the sample into two groups. First group was formed of randomly selected participants(n= 470) used for the EFA and second group (n= 470) for the CFA. Subsequently, we inspected the results and we concluded that the scale had a four-factor structure and consisted of 41 items. Furthermore, we identified that the factors of EIS were ecologically conscious purchasing behavior (ECPB),hidden ecological impact of products(HEIP), ecological sensitivity (ES) and ecological knowledge sharing (EKS). We specified the Cronbach's alpha reliability coefficient as .90 for the whole scale and for the factors it ranged from .70 to .86. The EIS obtained in this research may be considered to be the first step towards determining how consumers behave in order to ensure sustainability.

Keywords: *Ecological intelligence, scale development, factor analysis, ecologically conscious purchasing behavior, hidden ecological impact of products.*

1. Introduction

Our natural resources are being consumed rapidly due to the expeditious population growth, industrialization and urbanization in the world. In addition to the decrease in natural resources, many other problems arise on a global scale such as environmental pollution, climate change, desertification, diminution in biological diversity and deterioration of human health (Dunlap & Scarce, 1991; Goleman, 2009; Koehler, Bennett, Norris,& Spengler, 2005).These problems affect the entire ecosystem including living and non-living things and corrupt the ecological balance. The disruption of ecological balance threatens the sustainability of humans and other living creatures. Several studies in the literature demonstrate that the major factor behind these problems is human beings' unconscious behavior of consumption (Goleman, 2009; Spaargaren & van Vliet, 2000; Tukker & Jansen, 2006; Yılmaz, Çelik,& Yağızer, 2009). Yam-Tang and Chan (1998) note that individuals as consumers neglect environmental concern and do not pay attention to the features of products. When purchasing products, individuals make their choices without considering the damage to the environment and human health caused in the process from production to waste (Spaargaren & van Vliet, 2000). Therefore, it can be stated that we human beings as consumers are the principal responsible of the global threat posed by ecological problems. Goleman (2009) maintains that unless we change our consumption choices the delicate balance of the nature will irretrievably collapse. McCallum (2008) notes that everything that constitutes the life is connected and continue to exist within the ecological balance. He indicates that we should take responsibility in the face of ecological problems and change our consumption habits that harm sustainable ecosystems. This can only be possible by incorporating an ecological perspective that would lead us to a global awareness. In adopting such a perspective certain researchers emphasize the importance of having

an ecological intelligence in this perspective (Bowers, 2010; Gigerenzer, 1998; Goleman, 2009; McCallum, 2008; Sterling, 2009). Departing from this approach which bears a critical importance for the preservation of ecological balance, the present research aims to develop a valid and reliable scale to measure individuals' ecological intelligence which is directly related to their purchasing behavior.

Ecological intelligence that is a new type of conscience is defined as an environmental awareness and sensitivity of human beings regarding the negative natural mutations on a global scale and the ability to react against these changes (Goleman, 2009; McCallum, 2008). Ecological intelligence is a comprehensive understanding that aims to create awareness concerning how human activities affect ecosystems and to promote purchasing behavior that would lead to a sustainable life (Goleman, 2009). This understanding enables us to see what dangers we confront as a community, to comprehend the reasons behind these dangers. Moreover, it teaches us how to overcome these dangers and how to come up with solutions collectively. While expanding on his concept ecological intelligence, Goleman (2009) emphasizes that individuals may become conscious producers and consumers by knowing the impacts of their activities, supporting improvements and sharing their knowledge. On the other hand, McCallum (2008) notes that individuals must explore their position in the ecological balance in order to understand the hidden effects of their activities on the nature and how to improve themselves in this regard which is only possible by virtue of ecological intelligence. Sterling (2009, p.77) expresses the importance of approaching ecological problems through the perspective of relational thinking (which the ecological intelligence entails) by asserting: "*If we want the chance of a sustainable future, we need to think relationally*". The ecological intelligence urges individuals to tackle against global ecological problems by high level thinking skills which involves holistic, critical, collective and creative aspects. Individuals will be able to continue their daily activities more consciously by means of ecological intelligence which includes these high level thinking skills. This study is important in that it aims to develop an Ecological Intelligence Scale (EIS) which constitutes the first step of establishing how individuals act in accordance with ecological intelligence.

As we examined preliminary studies on ecological intelligence, we observed that they mostly focus on how this type of intelligence is formed within the frameworks of ecological consciousness and ecological literacy and how this type of intelligence can be developed in future (Bateson, 1972; Bowers, 2010; McCallum, 2008; Sterling, 2009; Stone & Barlow, 2005). In addition, Wedding (2010) mentions the importance of ecological intelligence that leads consumers to act consciously in his study on ecolabels which causes global problems. As we peruse the above mentioned studies on ecological intelligence (which is a global search for solution for environmental problems) in today's world where we constantly confront ecological problems as actual global issues, one can easily notice how important is to develop a scale measuring this type of intelligence. We can find a work in the preliminary studies by Nayal and Bhatt (2014) on developing a scale to measure the ecological intelligence. However, in their study they examined exclusively the item analysis for construct validity; subsequently they executed the reliability testing. They employed neither exploratory factor analysis nor confirmatory factor analysis in statistically confirming the construct validity of determined factors. Nonetheless, Brown (2006) states that these analysis methods which test whether the defined and limited factor model is confirmed or not, must be used in the scale development process. Taking all these issues into account, to develop a scale measuring individuals' ecological intelligence level based on their consumption behavior was determined as the main purpose of this study. Our study is important since it would be the first study of scale whose validity and reliability is proven aiming to unearth individuals' ecological intelligence through observable behavior; thus it would definitely fill a major gap in the literature.

Purpose of the study

The purpose of this study is to create a reliable and valid scale that measures the ecological intelligence of individuals on a quantitative level. In this respect, the following research questions are explored:

- Does the scale that is designed to measure the ecological intelligence haveconstruct validity?

- Do the scale and its factors that are designed to measure the ecological intelligence meet the acceptable standards of reliability?

2. Method

Participants

Research participants consisted of 940 students studying in different departments of the Faculty of Education of a state university in Turkey. Maximum variation sampling which is one of the purposeful sampling methods was used in determining the accuracy of the measurement tool used for the selection of the participants.This method enables the researcherto select a diversepopulation of students (Patton, 1990).Beinga heterogeneous sampling method, it provides the researcher a wide range of perspectives in respect to the subject of his/her study. As we scrutinized the gender distribution of the university students participating toour research, we observed that 67.7% (*n*=636) of the participant group consisted of female students while the percentage of male students was 32.3% (*n*=304).The average age of the participants was 22.01. The descriptive analysis for the demographic characteristics such as gender, study year and department of these undergraduate students is presented in Table 1. For ethical reasons, we obtained necessary permissionsfrom the academics,as well as students' consents for voluntary participation prior to the execution of this research. Additionally, the students were informed that all data would be used exclusivelyfor research purposes and safely stored. In order to ensure their confidentiality, the participants were kept anonymous and no information regarding their ethnicity, class or academic achievements was taken into account by the researcher.

Table 1. Demographic characteristics of the students

Students	Group	Number of students *(n)*	Percentage of students (%)
Gender	Female	636	67.7
	Male	304	32.3
Study year	1st grade	114	12.1
	2nd grade	163	17.3
	3rd grade	332	35.3
	4th grade	239	25.4
	5th grade	92	9.4
Department	Chemistry	76	8.1
	Mathematics	60	6.4
	Physics	24	2.6
	Biology	56	6.0
	Pre-school	56	6.0
	Primary Science	208	22.1
	Primary Mathematics	75	8.0
	Primary Social	68	7.2
	Primary Turkish	117	12.4
	German	128	13.6
	History	72	7.7
Total		940	100.0

Ecological intelligence scale (EIS) development process

Education contains structural theories based onintangible or latent psychological characteristics of individuals such as intelligence, interest, attitude, personality (Nunnally &Bernstein, 1994). These multi-dimensional structural theoriesare patterns composed of components, or relations between those components. Since the psychological characteristics of individuals are intangible and latent rather than

tangible and observable, they can be interpretedvia specificstructures and theories.Suchstructures can only be uncoveredby observingthe behaviors of individuals (Crocker &Algina, 1986; Tavşancıl, 2005). Kant who says that *"thoughts without content are empty, intuitions (perceptions) without concepts are blind"* articulated the relationship between the structures and their indicators; he also stated that the theories gain meaning by their structures (cited in Pedhazur &Schmelkin, 1991). Thus, we may conclude that the structures related to individuals' psychological characteristicscould only be laid bare by measurements,namelyby the scales to be developed. Intelligence which is one of the principal concepts of our research is both a biological and a measurable psychological characteristic.Departing from this point, by virtue of the scale we developed as a result of our research and within the scope of ecological intelligence we aimed to disclose the latent structures which cannot be directly observed.We developed the EIS in six different stages: (a) forming an item pool,(b) resorting to expert opinion,(c) pilot testing, (d) application process, (e) construct validity and (f) reliability.

Forming an item pool

At the beginning of our research, we primarily established the theoretical basis after reviewing the relevant national and international literature (Bateson, 1972; Goleman, 2009; McCallum, 2008). To have a profound and solid knowledge about the theoretical foundation concerning the measurement tool increases its validity (Jöreskog & Sörbom, 1993).In relation with forming the measurement tool items for our research, we asked certain academics who conduct studies on ecology the following questions: "what does 'ecological intelligence' evoke in your mind?", "what sub-themes do you think the ecological intelligence consist of?" Consequently, we combined their answers with the information that we acquired from the relevant literature.In line with all these studies, we established 100 items in total apropos of the ecological intelligence of which 75 are positive and 25 are negative.We preferred to use the 5-point Likert scale for its high convenience. Accordingly, the participation levels and scores of the students regarding the EIS items were categorized as: "Always" (5), "Often" (4), "Sometimes" (3), "Rarely" (2) and "Never" (1). In scale scoring process, we tookthe positive and negative items into account and we recoded the negative items.

Resorting to expert opinion

All of the items contained in a scale that is formed on a specific subject must be within the extent of that subject(Christensen, 2004; Tavşancıl, 2005). Departing from this point, in order to provide the content validity of the EIS three academics who are specialized in ecology and environmental studies were inquired about their opinions.Accordingly, we evaluated the academics' opinions and suggestions on 100 scale items in the context of the subject and we decided to remove 5 items that do not comply with its extent from the scale.Furthermore, we consulted two academics specialized in grammar in order to verify the grammatical adequacy and comprehensibility of the expressions used in the scale items. In regard to this point, we demanded the expertsto confirm particularly whether or not the statements are explicit and clear, they bear single meaning and exclude a double negation.Besides, we also paid particular attention in order for the items correspond to the cognitive levels ofthe students.On account of all these evaluations, the statements of the items were reconstructed.Following our final assessment on the content validity, we decided to compose the EISof 95 items in total, of which 70 were positive and 25 negative.Additionally, we selected the adequate name and demographic characteristics (i.e. gender, department of education, age and class level) of, and commentaries on the measurement tool for the face validity of the scale.

Pilot testing

The scale was initially applied to a pilot group consisted of 24 senior students enrolled in the Department of Chemistry Teaching for the purpose of determining the appropriateness of the response time and the comprehensibility of the statements contained in the EIS items.As a result of this application, we judged that the response time varied between 20-25 minutes and all the scale items were comprehensible.As a means to prevent the students from giving clichéd and predictable answers, which could leave the internal

consistency of the scale items vulnerable; we were also especially careful to set the positive and negative items in the scale at random.

Application process

The EIS was applied to 974 students studying in eleven different departments of a Turkish state university's Faculty of Education.Because 16 students did not respond to some of the scale items and 18 students selected more than one option, their answers were dismissed and we took the data obtained from the remaining 940 students into account (See Table 1).The data collection process lasted approximately for two months during the 2014 spring academic term.

Data analysis

Subsequent to the application of the EIS to the students the collected data was subjected to a statistical analysis for verifying the construct validity and reliability of the scale.First of all, we resorted to construct validity analyses with the objective of establishing which structures or dimensions corresponded to which scale items. There are many different types of methods referred in the literature regarding the determination of the construct validity of a measurement tool (Anastasi, 1988; Pedhazur &Schmelkin, 1991; Urbina, 2004). We applied item total analysis and exploratory factor analysis (EFA) respectively to the obtained data with the aim of discovering the latent structure(s). For these analyses, SPSS 15.00 statistical software package was used. As a means to evaluate the correspondence of the data to the structural or factor model that was obtained as a consequence of EFA we executed confirmatory factor analysis (CFA) and we utilized LISREL 8.71 statistical software package.We used the strategy of dividing the data into two and randomly selected for the EFA (n= 470) and the remaining data (n= 470) for the CFA (Revicki et al., 2014).The reason why we adopted this strategy was to avoid using the data we had used for explaining factor structure, once more in CFA for verifying the factor model.Finally, we calculated the Cronbach alphacoefficients to verify the reliability of the EIS whose construct validity we had discovered and the scale factors.We presented the stages of the EISdevelopment process in the Figure 1.

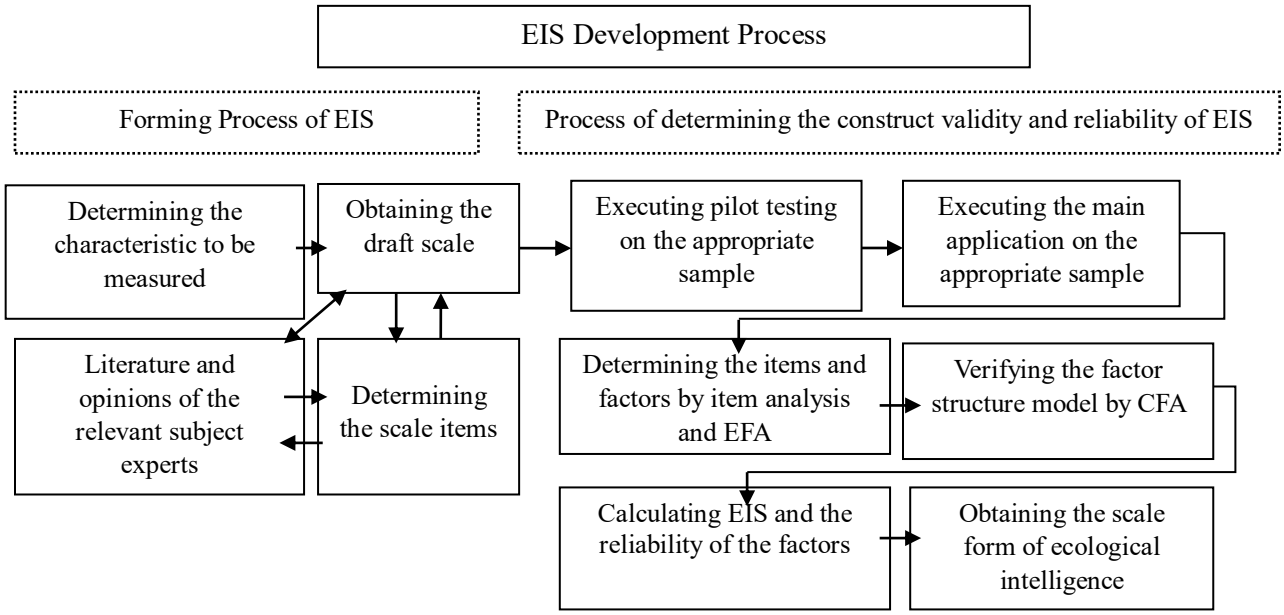

Fig. 1. Flowchart of the basic steps of EIS development process

3. Results

Construct validity of EIS

Structure is a pattern composed either of specific elements which are considered to be related to each other or the relations between these elements (Tekin, 2000). In this sense, in order to determine which structure or structures a scale is composed of, the construct validity should be studied. Researchers such as Gorsuch (1997) and Şencan (2007) state that there is not a single and absolute way of putting forward the empirical evidences related to construct validity in a scale. Item analysis, which is a method to develop a scale, gives us a clue regarding the construct validity.

Results of item analysis of the EIS

Item analysis demonstrates how well the items categorize individuals in terms of their measured behaviors (Büyüköztürk, 2007; Cunningham, 2005). In an item analysis, all items that have a high correlation with the scale scores are included in the scale on the condition that they are able to measure the characteristic that the scale intends to measure while the rest are excluded (Büyüköztürk, 2007; Wood, 1988). Based on this information and taking the fact that there are an excess number of items into account; initially an item analysis was applied to the scale items. In order to obtain reliable results, two different item analyses, one based on item-total score correlation and the other on upper-lower group averages difference were utilized.

- ***Item analysis based on the correlations***

Item-total score correlation explains the relation between the scores obtained from scale items and total score of the scale (Büyüköztürk, 2007). As a result of the analysis that was performed based on the item-total score correlation, we established that the correlation coefficients corresponding to total item scores of 31 out of 95 items composing the entire scale was lower than .30 and unlikely to be at the acceptable level. In this regard, Nunnally and Bernstein (1994) point out that item-total score correlation should be positive and higher than .30 in order for a scale to have a high internal consistency and indicate that it measures a certain characteristic or structure.

- ***Item analysis based on the difference in the upper and lower group means***

The second method adopted in item analysis is the calculation of discrimination indices of the items by taking into account differences between the upper and lower group means (Huck, 2012). In line with this, the differences between the item mean scores of the upper 27% (n=254) and lower 27% (n=254) groups created according to the total score of the items in the scale were tested by using independent t-test. Any significant difference between the groups observed in the desired direction is considered as an indicator of the internal consistency of the scale (Büyüköztürk, 2007). As an outcome of our examination on the results of the independent t-test analysis we determined that 6 items (13^{th}, 23^{rd}, 45^{th}, 65^{th}, 74^{th} and 88^{th} items) did not meet the significance value ($p<.05$). However, since the possibility that some items with low correlation may also turn out to be significant in large samples was often the case in relevant literature; $p<.001$ significance level was chosen as the absolute criterion (Büyüköztürk, 2007). When we applied this criterion we found that 7 items (6^{th}, 18^{th}, 19^{th}, 28^{th}, 34^{th}, 52^{nd} and 93^{rd}items) were not meeting the significance value thus 13 items in total required to be excluded. Apart from this, we reexamined the correlation coefficients of these 13 items andwe observed that they were lower than .30 and took place among the 31 items intended to be excluded. Additionally, in the light of the opinions of the experts in relevant areas we decided to exclude the items that met the significance value and had correlation coefficients between .20-.30 due to their low discrimination indexes and excess in the number of items.

With reference to the results of the item analysis performed based on both methods; a total of 31 items were excluded from the scale. When the item total correlations of the remaining 64 items were examined; it was observed that they vary between .30 and .64 and the item discrimination indices corresponding to total score correlation values of the items were high. Item discrimination indices (r) of each item along with the items that remained after EFA are presented on Table 3. The remaining 64 items were re-numbered for EFA and all analyses were presented according to this new numbering.

Results of exploratory factor analysis(EFA) of the EIS

The purpose of the EFA is to describe lower-level dimensions which represent the theoretical structures of the measurement tools that are developed in line with a specific theory (Costello & Osborne, 2005; Floyd & Wideman, 1995). The exploratory factor analysis is a technique used to identify whether items of a scale cluster under a specific structure or factor or not (Gable & Wolf, 2001). Thus, the EFA, which is based on correlation matrix, focuses on discovering the latent variables (also known as factors) that constitute the basis of the scale. Since our main purpose in using EFA was to decrease the excess number of items (observed variables) and collect them under less number of components (latent variables); in this study we employed principal component analysis which is one of the most frequently used factoring techniques. Before starting the analysis, for an EFA based on multivariate statistical techniques, the sampling adequacy and normality assumptions should be verified(Çokluk, Şekercioğlu, & Büyüköztürk, 2010). In order to test the suitability of the data structure for the factor analysis in terms of sampling adequacy; Kaiser-Meyer-Olkin (KMO) coefficient was calculated and found to be .92 (see Table 2). KMO value being higher than .70 indicates that the data is suitable for the factor analysis (Dalgety, Coll, & Jones, 2003; Field, 2009; Leech, Barret, & Morgan, 2005). Another important assumption for EFA is the normality assumption which verifies whether the data has a normal distribution or not. For the EFA used to reveal the number of factors, the assumption of that there is multivariate normality is accepted (Tabachnick & Fidell, 2001). Accordingly, we implemented Bartlett's Test of Sphericity in order to determine if the data come from a multivariate normal distribution or not, consequently we found that the results were statistically significant (χ^2 = 10782.341; df: 2016; p=.000<.001) (see Table 2). This result proved that EFA can be applied to the data obtained from 64 items and therefore we can extract factors from the correlation matrix of these data.

Table 2. KMO and Bartlett's test of sphericity results for the EIS

KMO Measure of Sampling Adequacy Test		.918
Bartlett's Test of Sphericity	Chi-square value (χ^2)	10782.341
	Degree of freedom (df)	2016
	Sig. (p)	.000

In ascertaining the number of the factors in EFA, eigenvalue of the factor should be equal to 1.0 or higher than 1.0 (Hair, Black, Babin, Anderson, & Tatham, 2006). In addition to this, we utilized scree plot in deciding the number of factors (Thompson, 2004). We examined the analysis results, consequently we established that there were 14 factors which have eigenvalues higher than 1.0. The graphic in Figure 2 indicates an "elbow" beginning with factor two and continuing through factor five and then smoothing that each additional factor beyond that accounts for smaller amounts of the total variance.Hence, we can maintain that the scale items are categorized by four factors.

In case more than one factor is revealed in a factor analysis, in order to determine which item is in high correlation with which factor, rotation procedure is applied to the data (Brown, 2006). In the analysis, varimax orthogonal rotation technique which maximizes factor variances and facilitates describing and interpreting the factor was utilized. In this regard, primarily the items were evaluated in terms of whether the factor loadings met the levels of acceptance or not. Field (2009) and Stevens (2002) state that the items with factor loadings lower than .30 are considered to have non-significant impact on a factor, and need to be removed. In scale development, high values of factor loading (λ) of an item increase the homogeneity of the scores obtained from the sample and the variance explained by the factor (Thompson, 2004). In the preliminary studies many researchers stated that if the level of acceptance for the factor loadings is taken as .32 the item is considered as a poor item, therefore factor loading should be equal to or higher than .40 (Harrington, 2009; Thompson, 2004). Taking all these facts into account, the level of acceptance of the factor loadings was taken as λ =.40 in this research. Accordingly, a total number of 9 items between λ = .32 and .40 were excluded from the scale.

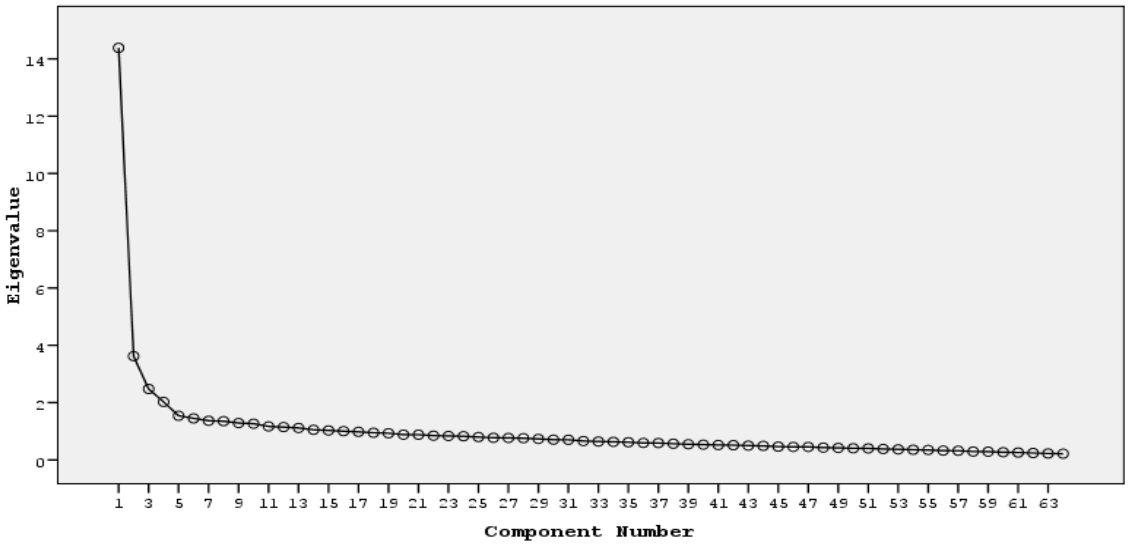

Fig. 2. Scree plot of the EFA of the EIS

Subsequently, we evaluated the overlapping items that were categorized under more than one factor. According to Çokluk et al. (2010) in case an item is classified under more than one factor, the coherence of theoretical structure might get jeopardized; hence, it would be much safer to exclude the overlapping items from the scale.Based on this fact, we excluded all the overlapping items consecutively whose differences between their loadings were lower than 0.1 from the scale and we executed the EFA analysis anew. As a result of the analyses, a total of 11 overlapping items (4^{th}, 9^{th}, 11^{th}, 12^{th}, 13th, 44^{th}, 45^{th}, 54^{th}, 56^{th}, 57^{th} and 62^{nd} items) were excluded from the scale. Furthermore, we excluded three more items (6^{th}, 35^{th}, and 60^{th} items) that could not be categorized under any factor from the scale. As an outcome of the EFA, we established that there were 41 items that are classified under four factors. The factor loadings of the items constituting the EIS range between .414 and .809.The findings regarding the factor loadings of EIS items remained as a result of EFA, are presented in Table 3 along with the item discrimination indices.

Factor Description

In defining each factor,above all we examined in the framework of ecological intelligence which structures are related to the items that belong to that factor. Consequently, we observed that the items found in the first factor were related to the issues that individuals cared about while they purchase products. This factor, which was highly important also in ecological aspect, was named as "Ecologically Conscious Purchasing Behavior (ECPB)". And the rate of variance explained by the first factor consisted of 14 items was 11.989%. As we examined the items that were categorized under the second factor, we noted that 12 items concerned the hidden impacts of the products on the ecosystem that occurred either during the production or consumption. Thus, this factor was named as "Hidden Ecological Impact of Products (HEIP)". The rate of variance explained by this factor was 11.295%. The third factor contains items that determine awareness or sensitivity of individuals towards ecological issues. Therefore it was named as "Ecological Sensitiveness (ES)". The rate of variance explained by this factor consisted of 10 items was 10.465 %. Finally, as we examined the items related to the fourth factor we established that the items emphasized the importance of sharing ecology-related knowledge so the factor was described as "Ecological Knowledge Sharing (EKS)". The rate of variance explained by this factor was 6.324%. As the result of our study on the total variance in EIS explained by all the factors, we concluded that this value was 40.072%. Table 4 summarizes the factor names, eigenvalues, and variance rates of each factor.

Table 3. The results of EFA of the EIS and values regarding item total correlations (r)

Item No	F1	F2	F3	F4	r
I26	.645				.490
I15	.636				.379
I31	.583				.603
I33	.573				.521
I58	.558				.443
I8	.555				.536
I27	.552				.591
I7	.549				.574
I28	.535				.616
I20	.514				.631
I46	.508				.501
I25	.486				.353
I5	.460				.536
I18	.457				.553
I47		.703			.542
I39		.664			.629
I36		.638			.467
I64		.621			.503
I32		.601			.361
I50		.574			.427
I49		.568			.343
I19		.563			.497
I59		.518			.442
I42		.505			.460
I40		.486			.352
I48		.450			.300
I22			.665		.515
I29			.625		.504
I21			.624		.522
I55			.622		.388
I24			.587		.401
I61			.587		.473
I10			.566		.458
I38			.544		.343
I17			.544		.490
I37			.505		.383
I3				.809	.450
I16				.756	.362
I2				.597	.324
I43				.503	.320
I1				.414	.432

Results of confirmatory factor analysis (CFA) of the EIS

CFA is the verification of a theoretical structure or factor model (Brown, 2006). The main purpose in the confirmatory factor analysis based on the covariance matrix is to clarify to what extent the proposed factor model matches with the observed data (Byrne, 2010; Kline, 2011). In the CFA application we employed Maximum Likelihood (ML) method, which is the most resorted estimation process. ML

enables us to obtain universe parameters that maximize the probability of certain sample values. For that reason, ML is the most frequently utilized estimation method that consists of continuous data and corresponds to the normal distribution (Johansen & Juselius, 1990).

Table 4. Factor names, eigenvalues and variance rates of factors

Factor name	Eigenvalue	% of Variance
Ecologically Conscious Purchasing Behavior (ECPB)	4.915	11.989
Hidden Ecological Impact of Products (HEIP)	4.631	11.295
Ecological Sensitiveness (ES)	4.291	10.465
Ecological Knowledge Sharing(EKS)	2.593	6.324

By using this method, primarily we were able to establish whether or not the data has a normal distribution and there were any extreme and lost values. For the data that were proven to have normal distribution, CFA was used on the hold-out sample (n=470) to verify the factorial validity and stability of the four-factor EIS model. In order to evaluate the fitness of the factor model through CFA, we examined the fit indices of the four-factor structure. In order for a model to be acceptable, the required primary conditions for each item are as follows: i) a significant t value, ii) a low error variance and iii) a high explained variance (Jöreskog & Sörbom, 1993; Schumacker & Lomax, 2010; Şimşek, 2007; Tabachnick & Fidell, 2001). Accordingly, in the first stage, we determined that the t values of the items, namely the observed variables were significant ($t \geq 2.576$, $p = .01$). This demonstrates that each latent variable (factor) predicts its own observed variables, in other words, that each item represents its own latent variable. As an outcome of our examinations on the items we noted that the high value was .85 (see Fig. 3). If the error variance does not exceed .90, the item in question could be included in the model (Çokluk et al., 2010). Apart from this, the squared multiple correlations (R^2) ranged from .17 to .77.Based on these facts, we can say that the rate of variance explained by the observed variables of the factors was between 17% and 77%.

The next stage in CFA is examination of fit indices (Albright & Park, 2009; Brown, 2006). In order to evaluate the fitness of the factor model with the observed data, primarily χ^2 and χ^2/df fit indices were checked. Chi-square value (χ^2) tests the difference between the observed data and the estimated data (Jöreskog & Sörbom, 2001). In CFA, no significant difference between these two data is desired (Munro, 2005; Schumacker & Lomax, 2010). As we examined the first CFA results we observed that χ^2 value was 2268.07 and there was a significant difference ($p<.000$, n=470). However, p value of χ^2 statistic is affected by the sample size and usually is significant in samples more than 200 (Byrne, 2010; Tabachnick & Fidell, 2001). Therefore, the rate of the degrees of freedom to χ^2 that is affected less by the sample size (Şimşek, 2007; Waltz, Strickland,& Lenz, 2010). The χ^2/df value was calculated as 2.93 which is almost a perfect fit. For this criterion, rates equal to or lower than 3 in large samples are considered as perfect fit, while the rates equal to or lower than 5 are accepted as adequate fit (Hooper, Coughlan,& Mullen, 2008; Kline, 2011; Munro, 2005).

Furthermore, in order to verify the measurement model, we studied such alternative fit indices asGoodness of Fit Index (GFI), Adjusted Goodness of Fit Index (AGFI), Comparative Fit Index (CFI), Normed Fit Index (NFI), Non-Normed Fit Index (NNFI), Parsimony Normed Fit Index (PNFI), Incremental Fit Index (IFI), Root Mean Square Error of Approximation (RMSEA), and Root Mean Square Residual (RMR). These fit indices that we obtained from the first CFA are given in Table 5. Accordingly, we determined that CFI, NFI, NNFI and IFI goodness-of-fit indices were higher than .95 and these indices verified the model at a perfect level. Apart from this, PNFI value that was established as .90 is also the indicator of a good fit. Many researchers accept that these goodness-of-fit indices range between 0-1 and that as these indices approach1 they indicate a good fit (Hooper et al., 2008; Raykov & Marcoulides, 2006; Tabachnick & Fidell, 2001). According to them, the goodness-of-fit indices that are equal to or higher than .95 indicate that model is perfect, whereas indices being equal to or higher than .90 point to an acceptable fit (Hu & Bentler, 1999; Munro, 2005; Tabachnick & Fidell, 2001; Waltz

et al., 2010). As we examined the analysis results, we observed that GFI and AGFI indices remained below .90. This is because that both values are sensitive to sample size. However, other researchers state that values higher than .85 signify a fit at an acceptable level(Raykov & Marcoulides, 2006; Shevlin & Miles, 1998; Vieira, 2011). Additionally, we established that the RMSEA and RMR indices were lower than .05. Both goodness-of-fit indices that are lower than .05 prove to be a perfect fit (Brown, 2006; Schumacker & Lomax, 2010; Wang & Wang, 2012).

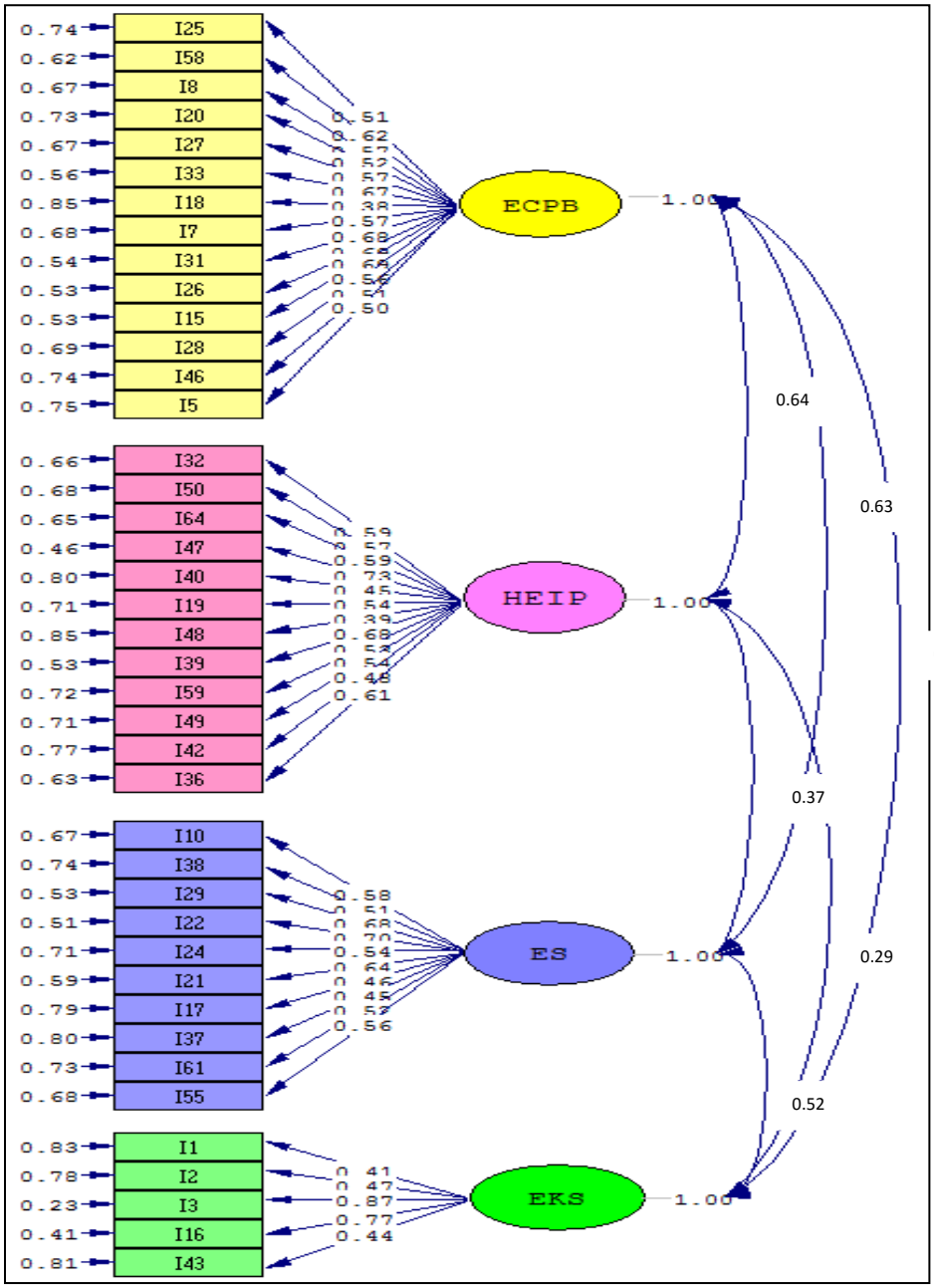

Fig. 3. CFA model output of the EIS

We examined first CFA results by focusing specifically on the modification suggestions, since they can critically modify the χ^2 value and increase the goodness-of-fit indices. Accordingly, we established that

the modification performed between the 27th and 28th items caused a significant decline in χ^2 value of the model (see Table 5). During the modification process, we were particularly careful that the items belong to the same factor and this process does not affect the theoretical framework. Additionally, we observed also an increase in AGFI and GFI indices and a decrease in RMSEA value.

Finally, it is also necessary to inspect the correlations between the factors in CFA results of the four-factor measurement model (Kline, 2011). In order to establish the discriminant validity between the factors, we studied the coefficients of correlations between the factors in EIS. We observed that the relationship among all the factors were positive and statistically significant (see Table 6).

Table 5. CFA goodness-of-fit indices before and after modification

Model	χ^2	df	χ^2/df	GFI	AGFI	CFI	NFI	NNFI	PNFI	IFI	RMSEA	RMR
Before Modification	2268.07	773	2.93	.89	.88	.97	.95	.96	.90	.97	.045	.042
After Modification	2073.45	772	2.68	.90	.89	.97	.95	.97	.90	.97	.042	.042

Consequently, we noted that the coefficient of correlation between the first factor (ECPB) and the second factor (HEIP) obtainedthe highest value of .64. And the coefficient of the correlation between the second factor (HEIP) and the fourth factor (EKS) was .29 which was the minimum value. In order for the factors to be independent, it is ideal that the coefficient of correlation between the factors be lower than .85 (Kline, 2011). Based on the correlation coefficients that we established, we can conclude that each factor measures the ecological intelligence characteristic differently.

Table 6. Correlative relationships among EIS's factors

Factor	ECPB	HEIP	ES	EKS
ECPB	1	.64**	.62**	.50**
HEIP		1	.37	.29**
ES			1	.52**
EKS				1

**p<.01; *n*=470

CFA results clarified that both pre- and post-modification measurement models soundly fitted the data and the items that werecontained in the model corresponded perfectly to the four-factor structure.

Table 7. Names of the factors, number of items, reliability coefficients of the factors and sample items for the factors in the EIS

Factor number	Factor name	Number of items	α	Sample items
1	ECPB	14	.86	Consumers' conscious attitude to choose sustainable products would have companies review their production methods (I26). If I know the hidden impacts of the products, I make more insightful shopping choices (I7).
2	HEIP	12	.82	"Disposable" products (paper cup, paper napkin, etc.) do not wield harmful impacts on the ecosystem (I40). I think that a commercial product has hidden impacts on the environmental, sanitary and social terms (I49).
3	ES	10	.80	The ecological threats that are posed by the commercial products perturb me (I10). That companies do not provide safe working conditions to the labourers who work in the environments that pose ecological risk perturbs me (I24).
4	EKS	5	.70	It is much more important to develop an approach based on collective solidarity than to seek an individual solution for ecological problems that are caused by the commercial products (I1). When I read news concerning the hidden ecological impacts of a commercial product I share it with my friends (I3).

Reliability of the EIS

In order to determine the internal consistency, we conducted a reliability analysis among the items that were classified under the scale factors. For this analysis, Cronbach alpha reliability coefficients (α) of the entire scale and its sub-factors were calculated. As is seen on the Table 7, the reliability coefficients of the scale factors vary between .70 and .86. On the other hand, the Cronbach alpha reliability coefficient of the entire scale was .90. That Cronbach alpha coefficient is equal to or higher than .70 proves that the scale is a highly reliable measurement tool (Domino & Domino, 2006; Fraenkel, Wallen, & Hyun, 2012). From this point of view, we can assert that the items of EIS are highly consistent with each other and consisted of items measuring the characteristic of the latter. In Table 7, factor numbers, names and sample items of EIS for the factors are presented along with the reliability coefficients.

4. Discussion and Conclusion

Individuals need perception capabilities that enable them to think about how their activities affect ecosystems. This is possible only if individuals develop a certain level of ecological intelligence. In order for individuals to develop such kind of intelligence, first of all, it is necessary to explore this type of intelligence which they potentially contain. Then, a measurement tool to establish individuals' ecological intelligence level is needed. Thus, we developed a scale measuring individuals' ecological intelligence which would meet this need. Following scale development steps we applied validity and reliability analyses. In the first step, we created the scale items by reviewing the literature. In determining the scale items, we considered particularly individuals' purchasing behavior and attitudes and behavior related to the effects of commercial products from production to consumption within the framework of ecological intelligence. Subsequently, we consulted expert academics thanks to whose opinions we established scale's scope, ensured its face validity, and eventually confirmed that the scale consisting of 95 items is applicable. After the application, we executed EFA and CFA respectively for construct validity. Following item analysis and EFA, we determined that the scale had a four-factor structure and consisted of 41 items. After CFA that we conducted in order to confirm the factor structure, the resulting factor model was determined to have a firm consistency with the data and it took its final shape. As we verified Cronbach alpha internal consistency coefficients of the scale factors for scale reliability, we noted that they were between .70 and .86, consequently we confirmed that the scale was reliable. Cronbach alpha coefficient as regards to the entire scale was .90 which indicates a high reliability. We examined the factors and their items have been examined with field experts, consequently named the factors as "Ecologically Conscious Purchasing Behavior (ECPB)", "Hidden Ecological Impact of Products (HEIP)", "Ecological Sensitivity (ES)" and "Ecological Knowledge Sharing (EKS)".

ECPB which was one of the factors we obtained in the research refers to individual's learning about hidden impacts of a product from its production to disposal to the ecosystem and determining his purchasing choices in accordance with this knowledge (Goleman, 2009). This factor partly overlaps with the factors of "Environmentally Conscious Purchasing Behavior (ECPB)" and "Product Recovery Awareness (PRA)" of the scale which is adapted from the studies conducted by Fraj and Martinez (2007), Kaiser and Wilson (2000), Tilikidou and Delistabrou (2008). Furthermore, this factor partly overlaps also with some items in the "Ecologically Conscious Consumer Behavior" factor of the three-factor scale named "Socially Responsible Consumer Behavior (SRCB)" contained in Roberts' (1991) doctoral dissertation. Certain researchers assert that an individual with high ecological intelligence is supposed to have a conscious purchasing behavior (Bowers, 2010; Goleman, 2009; MacCallum, 2008; Wedding, 2010). Because, several products that we use, consume or store in our daily lives as consumers have harmful effects on the nature, on all organisms, and particularly on natural resources. For these reasons, some researchers indicated the necessity of using recyclable products that are manufactured with non-toxic raw materials and with low energy consumption in order to ensure sustainability (Gan, Wee, Ozanne, & Kao, 2008;Goleman, 2009; Mannetti, Pierro,& Livi, 2004; Spaargaren & van Vliet, 2000; Yam-Tang & Chan, 1998). Moreover, in purchase not only damages that the products may cause, but also

working conditions of workers in the process of manufacturing the products must be taken into account. In short, the ECPB factor that came by in the research emphasizes the importance of choosing products that harms the nature, humans and social system throughout its life cycle from production to disposal. Roberts and Bacon (1997) and Atasoy (2006) note that individuals must be ecologically conscious consumers in order to solve environmental problems on a global scale. This argument could be confirmed by other experts who suggest that individuals who change their consumption habits in accordance with ecological consciousness will contribute to the reduction of environmental problems and ensuring ecological balance (Anderton & Jack, 2011; Arslan, Yılmaz, & Aksoy, 2012; Boström & Klintman, 2008; Bowers, 2010; Ilgin & Gupta, 2010; Jackson, 2005). The ECPB factor is important in that it enables us to realize how our consumption choices affect the world and social structure and determine to what degree we have an ecological consumption consciousness.

HEIP is another factor that we obtained during our research. The items contained in this factor consist of statements that express what hidden effects our consumption habits cause on the ecosystem. This factor examines what sort of negative effects on the environment and health do all sorts of commercial products cause throughout their life cycle and how do they affect the world and humanity on a global scale. Goleman (2009) expresses how products cause negative effects on the geosphere (soil, air and climate), biosphere (humans, plants and animals) and sociosphere (working conditions) during their production, transportation, use and disposal. Certain studies demonstrate that negative hidden effects of products in the process of production and consumption occur on three different levels being global, regional and local (Collins, Flynn, Wiedmann, & Barrett, 2006; Tukker & Jansen, 2006). As we focus on the subject of the hidden effects of each product that we purchase via a global perspective, we confirmed that the major problems that are discussed in the literature were those which concern climate change, greenhouse effect and reduction of natural resources (Chapagain, Hoekstra, Savenije, & Gautam, 2006; Hertwich, Pease, & Koshland, 1996). Koehler et al. (2005) draw attention to the hidden effects of commercial products on human health throughout their life cycle in their study. Today, products that are manufactured by cheap raw materials due to economic competition and excessive consumption are becoming widespread. They disrupt the ecological balance of the world and also cause problems that negatively affect human psychology and physiology. Goleman (2009) holds that the solution to the problems caused by production and consumption in order to ensure a sustainable world is possible by replacing the “cradle to grave" mentality with the "cradle to cradle" understanding. Our level of knowledge regarding the hidden ecological effects of products plays an important role in creating this understanding. Answers to be given in future studies to items in the HEIP factor which we obtained in the framework of ecological intelligence, will indicate to what degree individuals have this understanding.

Another factor that we acquired in the research is ES. Items in this factor have to do with individual's sensitivity toward and reaction against the negative hidden effects of products on a global scale. McCallum (2008) emphasizes the importance of this factor by suggesting how individuals who can assume responsibility and take action about ecological problems are much needed. Goleman (2009), on the other hand, notes that ecological intelligence directs individuals to behave sensitively and consciously about purchasing products that harm the ecological balance and to react against them if necessary. There are many studies in the literature that deal with the problem of products consumed by individuals and ecological sensitivity (Dunlap & Scarce, 1991; Makower, 2007; Roberts & Bacon, 1997; Yılmaz, Çelik,& Yağızer, 2009). Johnson (2004) articulates that a good life philosophy must involve a life with environmental sustainability, while Özgül (2009) adds that ecological sensitivity is an important component of such a life.

The fourth factor that we came by is EKS. This factor consists of items demonstrating individuals' levels of ecological knowledge related to products that they purchase and to what extent they share knowledge about ecological problems caused by these products with others. Goleman (2009) highlights the importance of collective mentality by stating that it is impossible for a single individual to know all effects of products and we need to think collectively by acting like the insects to acquire this knowledge.

Therefore, the author notes that acquiring the knowledge related to negative effects of products and which products we need to purchase is only possible by sharing knowledge. McCallum (2008), on the other hand, points out the importance of ecological literacy and thus ecological information sharing and states that primarily individuals must enlighten themselves and then spread their consciousness to others. Spreading ecological knowledge will improve individuals' ecological intelligences, as it will ameliorate their interaction with the nature. In this context, answers given to items in the ecological knowledge sharing factor are of great importance in tracking the improvement in individuals' ecological intelligences.

Finally, in order to preserve the ecological balance we need to elucidate how conscious we are in our purchasing choices, how much we know about hidden effects of products on the environment and humans in the processes of production and consumption, how sensitive we are against these effects, by which channels and to what degree we share knowledge about ecological problems caused by these products. This is only possible by changing our consumption habits and ecological intelligence which we would create as a new understanding. The EIS obtained in this study may be thought as the first step toward determining how consumers behave in order to ensure sustainability.

5. Implications

First of all, in order to confirm its construct validity and reliability the EIS developed in the research may be investigated across different populations and settings. Additionally, it may be used in order to determine individuals' ecological intelligence level in four dimensions of ecologically conscious purchasing behavior, hidden ecological impact of products, ecological sensitivity and ecological knowledge sharing. The EIS may be applied to students at all levels who passed the concrete operations period, university students enrolled in different departments and individuals working in different fields. By virtue of EIS, which has a wide application field in terms of sample, individuals' purchasing behavior with regard to ecology, behavior related to hidden effects caused by production and consumption, and their ecological sensitivity and reactions may be determined. Besides, it may also be used to study how individuals' ecological intelligence levels vary according to demographical characteristics. Furthermore, it may be used to investigate relationships among ecological intelligence and components of ecological literacy, ecological attitude and ecological concern for the purpose of elucidating the reasons lying behind ecological problems.

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