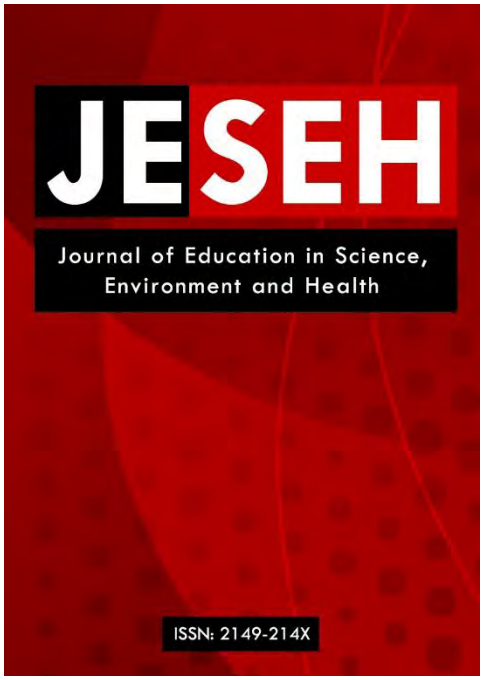

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Abstract

The goal of this study is to create the Zero Waste Attitude Scale, which will be used to determine the zero-waste attitude of social studies teacher candidates and to conduct validity and reliability studies. The data for the study were collected with a 5-point Likert-type form from pre-service teachers studying in the social studies teaching department of some universities in Türkiye. Explanatory factor analysis, confirmatory factor analysis (CFA), and reliability studies were performed on the collected data. Cronbach's alpha and McDonald's Omega methods were used for reliability analysis. As a result of the analysis, it was determined that the scale consisted of 27 items and 3 factors. In total, the factors explained 50.09% of the common variance. As a result of the analysis, the fit index values of the scale $\chi 2/sd$ =1.96, RMSEA=0.06, PGFI=0.70, GFI=0.85, RMR=0.08, SRMR=0.06, NFI=0.95, AGFI=0.81, PNFI=0.84, CFI=0.97, RFI=0.94, NNFI=0.97, IFI=0.97, while GFI, RMR, AGFI, SRMR, and RFI values correspond to acceptable fit; $\chi 2/sd$, RMSEA, IFI, NFI, NNFI , PGFI, PNFI, and CFI seem to correspond to a perfect fit. The reliability coefficient of the scale was 0.90 for both Cronbach Alpha and McDonald's Omega. The scores obtained from the scale are valid and reliable.

Introduction

It is not correct to understand the environmental problem only as environmental pollution, and all degradation events (excessive consumption of natural resources, etc.) occurring in the ecosystem are considered environmental problems (Özkan, 2018). The degradation of the environment because of human production and consumption activities carried out within the context of their essential activities is the root cause of environmental issues (Ertürk, 2018). Today's economic systems, established with the industrial revolution, which is accepted as the beginning of environmental problems, aim at unlimited economic development and an increase in welfare. However, these purposes have led to the unconscious consumption of natural resources and excessive waste generation (Karalar & Kiracı, 2011). To combat environmental issues, which have grown more serious and widespread from the past to the present, societies must create speedy solutions to these issues.

The most important activity to prevent increasing environmental problems is to protect the ecological system. Systems are required in this context to manage production and consumption, segregate wastes, render them harmless, and reuse them whenever possible (Baykal & Baykal, 2008), prevent waste, value material efficiency, and recover resources (Lehmann, 2010). The name of this needed system is zero waste (Zaman & Lehmann, 2013). Zero waste is the protection of all resources by ensuring the recycling and recovery of wastes consisting of goods, materials, and packaging during production and consumption, and disposal in a way that does not threaten the environment or human health (Rathoure, 2020). The zero-waste system has gained importance in the solution of the waste problem, which has been one of the most important problems since the twentieth century, with the effect of the return to natural processes and the circular economy model (Bilgili, 2021).

The term "zero waste" was first used by Palmer in 1973 to reduce the amount of chemical waste (Song et al., 2015). Zero waste is the next stage of recycling and is a policy, path, goal, process, and way of thinking. In addition, "zero waste" refers to the discipline required to create a sustainable interaction with the natural environment (Liss, 2021). Zero waste does not see the waste generated because of human activities as a material to be disposed of or burned, but rather as a resource that needs to be reused (Glavic & Lukman, 2007). Zero waste covers all elements such as producer responsibility, economic design, waste reduction, waste reuse, and recycling (Murray, 2002). Zero waste is a holistic system approach to waste management and elimination (Curran & Williams, 2012).

Zero waste is seen as one of the most rational solutions to solve waste problems (Zaman & Lehmann, 2013; Kabirifar et al., 2020). Zero waste aims to maximize resource recovery by using natural resources at the

minimum level to encourage waste producers to take responsibility and reuse the waste they produce (Khawngern et al., 2021). Zero waste policy protects resources, minimizes environmental pollution, protects public health, contributes to the economy, improves the ability of communities to solve their own problems, and saves energy (TEA, 2021; Zero Waste International Alliance, 2021).

Zero waste is accepted by the governments of many countries. The fact that the zero-waste policy is accepted in many countries is due to the sustainable production and consumption approach, the highest level of waste recycling, and the recovery of vital resources (Zaman, 2015). There is the 5R rule to achieve zero waste on an individual basis (Figure 1). These are: reuse, refuse, reduce, recycle, and rot or replant (Johnson, 2013; Cowles, 2021).

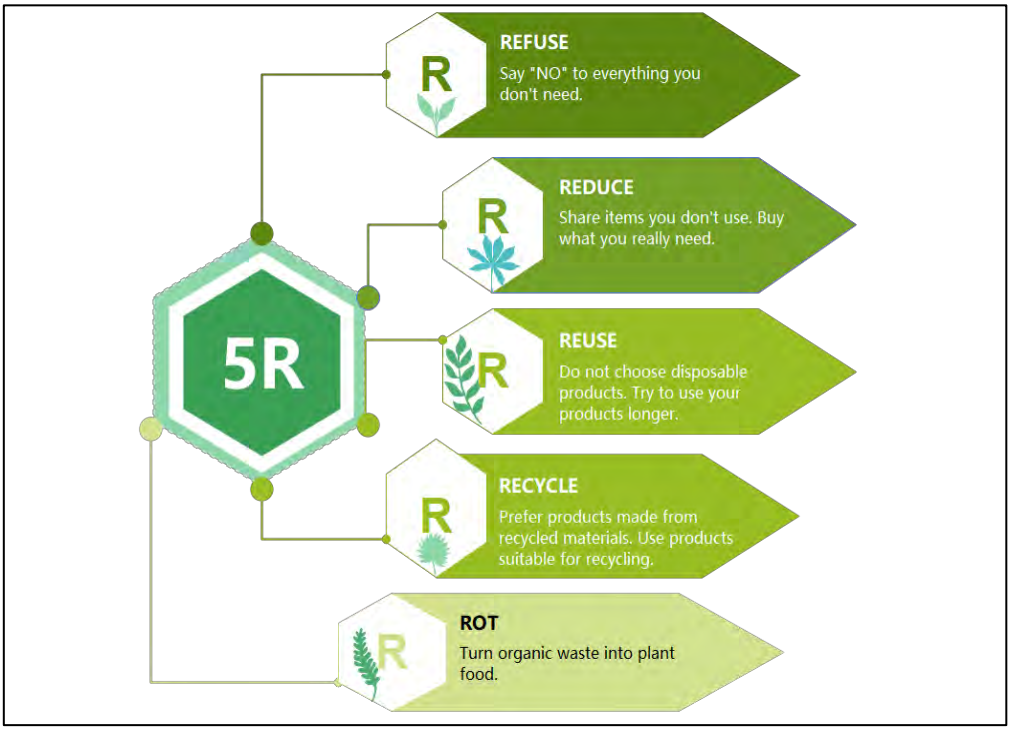

Figure 1. 5R rule

When the literature is examined, no direct scale for zero waste attitude has been found. However, Ugulu (2015) developed high school students' attitudes towards recycling; Paul et al. (2016) developed an environmentally friendly product consumption behavior scale; Kılıç & Kan (2020) middle school students' attitudes a scale towards environmental questions; Maskan et al. (2005) a scale of attitude towards the environment of teacher candidates; Avan et al. (2011) developed secondary school students' attitude scale towards the environment, recycling, plastic, and plastic waste; Karatekin (2013) developed pre-service teachers' attitude scale towards solid waste recycling; Taştepe (2017) developed high school students' attitude scale towards recycling; Coskun (2022) develop a zero waste management behavior scale; Yoldaş (2019) developed a waste and recycling scale for high school students; Gül (2020) developed a scale of waste management and zero waste project; and Coskun (2021) developed a scale to determine the awareness and habit levels of individuals about zero waste. Although individuals' attitudes are the source of environmental problems, individuals' attitudes must change positively to solve these problems. The goal of this study is to develop a scale to detect zero-waste attitudes of social studies teacher candidates. This study is important in terms of contributing to the field because it helps determine the attitudes of individuals towards protecting natural resources, reducing waste, and protecting the economy, and because there are not enough data collection tools for zero waste in the literature.

Method

Research Design

Since it is aimed to develop an attitude scale towards zero waste policy as a research model in this research, the survey model was used. The survey design aims to be a model that aims to reveal the past or existing structure

for what it is, and in this model, it is not aimed to affect or change the event, individual, or object that is the subject of the research. The survey design is a model made within the scope of sampling to be taken from all the elements in the universe or from the universe to reach a judgment about the universe consisting of many elements (Karasar, 2020).

Participants of Study

The participants in the research are students studying in the social studies teaching department of the education faculties of some universities in Türkiye in the 2021–2022 academic year. Table 1 shows the demographic information of the participants.

Table 1. Participants' demographic information

Variables		N	Mean
Class level	1	55	22.0
	2	64	25.6
	3	58	23.2
	4	73	29.2
Gender	F	143	57.2
	M	107	48.2
Total		250	100

Data Collection Tool Development Process

It is necessary to comply with some criteria and standards in the development, adaptation, and implementation of the scale (Karakoç & Dönmez, 2014). Cohen & Swerdlik (2010), Crocker & Algina (2006), DeVellis (2017), Hinkin et al. (1997), Murphy & Davidshofer (2005), and Rust & Golombok (2009) stated stages in their study. These stages were taken into account in the research, and the process of developing the scale consists of 8 stages. The stages followed during the development of the scale are given in Figure 2. The data for this research were collected in accordance with the decision of the Nevşehir Hacı Bektaş Veli University Ethics Committee dated January 25, 2022, and numbered 2022.01.22.

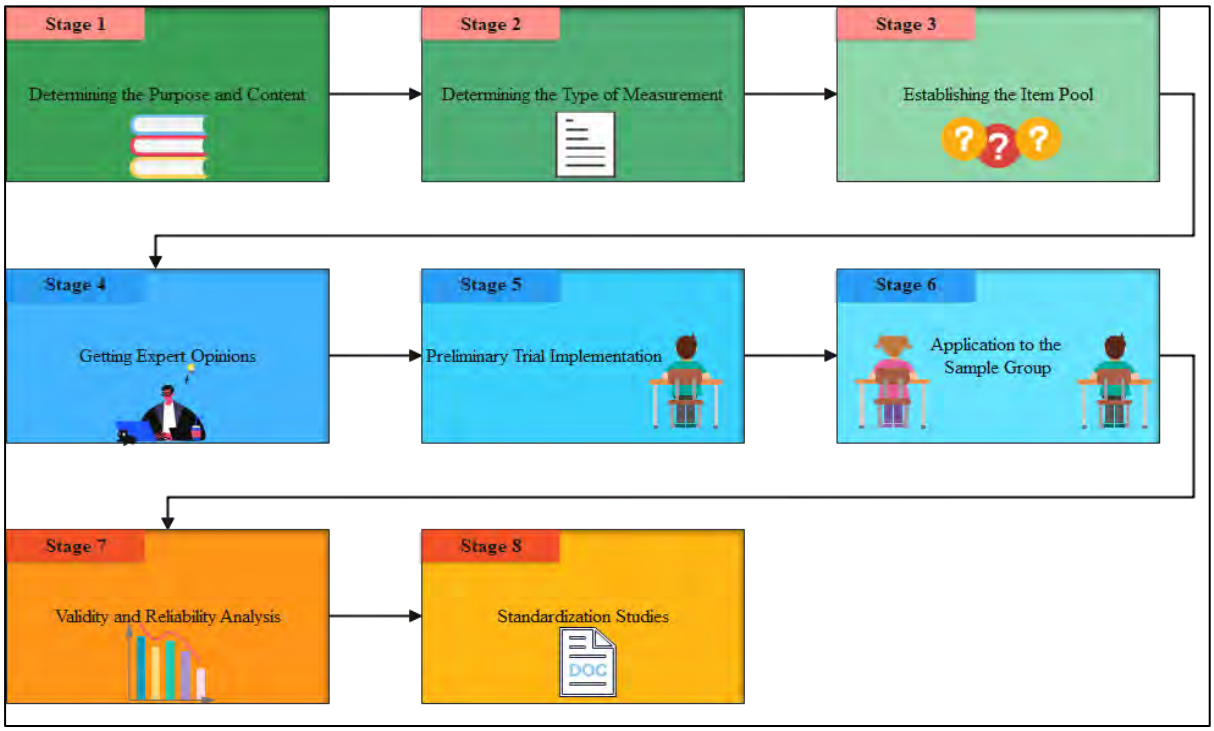

Figure 2. Scale development stages

Determining the Purpose and Content of the Scale: In order to develop the scale in line with the purpose of the research, a literature review was conducted on the concepts of waste, recycling, sustainability, recycling, and zero waste.

Determination of the Measurement Format: Due to its compatibility with the structure to be measured, the Likert-type scale format was chosen as the scale form developed to collect data in the study. The items on the attitude scale were arranged in a five-point Likert type using the expressions "Strongly agree, I participate, I'm undecided, I don't participate, I strongly disagree" The scoring of the items on the scale is given in Table 2.

Table 2. Scoring of items in the scale

Options	Positive Substances	Negative Substances
Strongly agree	5	1
I participate	4	2
Undecided	3	3
I don't participate	2	4
Strongly disagree	1	5

Creation of the Item Pool: In the process of creating the item pool, Concepts such as recycling, zero waste, recycling, and sustainability in the literature were researched, the items of the scales made for the related concepts were analyzed and information was collected from experts who had knowledge on the subjects related to the research. The item pool was created in accordance with the information obtained from the studies and experts on the structure to be measured by writing the items in accordance with the subject and the Likert-type scale format. After item writing, a 55-item scale pool containing positive and negative items was obtained. No additions were made to the item pool from the questions asked in the studies conducted on concepts such as recycling, zero waste, and recycling in the literature. In item writing, attention was paid to ensuring that the items did not contain more than one judgment and that they were plain and simple.

Obtaining Expert Opinions and Content Validity: The 55-item pool prepared for the development of the attitude scale was evaluated by a grammar expert in terms of form and intelligibility. After the assessment of the attitude scale by the grammar expert, the online form was sent to eight people for expert opinion on the subject, to mark each item as "essential, useful, but not essential, not necessary." as used in the Lawshe (1975) technique. A field has been added to the form to indicate the reasons if the items are corrected and removed. In line with the opinions of the experts, the necessary corrections were made, and the analysis for the validity of the content was carried out. The results of the analysis are given in detail in the findings section.

Preliminary Trial Implementation: In scale development, the preliminary trial process focuses on the identification of unforeseen or overlooked problems (readability, understandability, time sufficiency, etc.) that are not foreseen or overlooked by the scale preparer rather than collecting data (Yurdabakan & Çüm, 2017; Crocker & Algina, 2006; Boateng et al., 2018). There are different opinions about the number of participants who will take part in the preliminary trial application. Crocker & Algina (2006) states that 5-30 people will be needed to participate in the preliminary trial application; Şeker & Gençdoğan (2020) states that 30-50 people will be needed; and Carpenter (2018) states that 5-100 people will suffice. Thirty people from representing the target audience, took part in the scale's preliminary trial application. The participants who participated in the application stated that the items on the scale were sufficiently understandable, that the explanation parts at the beginning of the scale were informative about the scale and appropriate in terms of timing, and that the items were suitable for the structure. After the preliminary trial application, the feedback from the participants and the necessary examinations of the data were made, and the scale was applied to the sample group (the main application) without the need to remove any item from the draft scale.

Application to the Sample Group: Although there are many different opinions in the literature regarding the size of the sample group in scale development, it is generally stated in the literature that the sample size can be determined as 5–10 times the items in the scale (Hatcher, 1994; Field, 2005; Hair et al., 2014; Nunnally & Bernstein, 1994). Sapnas (2004) stated that the sample size for scale development studies was at least 100 people; Guilford (1954) stated that it should be at least 200 people; Preacher & MacCallum (2002) stated that it should be 100–250 people; Tavşancıl (2014) and Gorsuch (1974) stated that it should be at least 5 times; if Cattel (1978) stated that it should be 3-6 times. The actual application was carried out with a total of 250 social studies teacher candidates, and it is seen that it is suitable for scale development. The Kaiser-Meyer-Olkin (KMO) coefficient and Barlett's Test were used to determine the suitability of the data for factor analysis, exploratory factor analysis, and confirmatory factor analysis for construct validity, and Cronbach Alpha internal consistency coefficients for reliability were applied. The analysis results are given in detail in the findings

section. At the last stage of the scale, standardization studies of the scale were carried out, and the scale's final shape was given.

Analysis of Data

The data obtained from the participants were transferred to the Excel application. The analysis of the data was carried out with the SPSS 26.0 and Lisrel 8.8 programs. The SPSS 26 and Lisrel 8.8 programs were preferred for the KMO coefficient and Barlett's Test, exploratory factor analysis (EFA), confirmatory factor analysis (CFA), and Cronbach's alpha reliability coefficient processes performed within the scope of the research.

Findings

To determine the content validity of the 55-item question pool prepared for the development of the attitude scale, the qualitative data obtained from eight experts in the field were converted into numerical data in the Excel application. The content validity rates (CVR) and content validity index (CVI) of the scale were calculated in the Excel application.

The content validity rate was calculated using the formula CVR= (n_e-N/2)/(N/2). The "n_e" in the formula is the number of experts who state that the item is "essential"; "N" represents the total number of experts who gave their opinion on the item. Content validity ratios are directly removed from the item pool since items with zero or less than zero have no content validity (Lawshe, 1975; Yeşilyurt & Çapraz, 2018). For each of the items in the draft scale with a positive value, the content validity criterion (CVR) was checked at the significance level of 0.05. The content validity criterion expresses the value of the content validity rate required to decide the suitability of the items to be included in the scale. Content validity criterion values are determined according to the number of experts required to determine whether the items to be included in the scale are appropriate or unsuitable. This value differs according to the number of experts evaluating the scale (Yeşilyurt & Çapraz, 2018). In order to determine the CVC of the scale, the content validity criterion values in Table 3 determined by Ayre & Scally (2014) were taken into consideration. Table 2 shows that the CVC value for eight experts at the draft scale's =0.05 significance level is 0.750.

Table 3. Minimum content validity rates at significance levels of 0.05 (Ayre & Scally, 2014)

Number of Experts	CVC	Number of Experts	CVC	Number of Experts	CVC	Number of Experts	CVC
5	1.000	14	0.571	23	0.391	32	0.375
6	1.000	15	0.600	24	0.417	33	0.333
7	1.000	16	0.500	25	0.440	34	0.353
8	0.750	17	0.529	26	0.385	35	0.314
9	0.778	18	0.444	27	0.407	36	0.333
10	0.800	19	0.474	28	0.357	37	0.297
11	0.636	20	0.500	29	0.379	38	0.316
12	0.667	21	0.429	30	0.333	39	0.333
13	0.538	22	0.455	31	0.355	40	0.300

After the content validity criterion was calculated, the content validity index calculation was carried out for the entire scale. The content validity index is obtained by taking the average of the content validity rates of all the items to be included in the scale (Yeşilyurt & Çapraz, 2018). Within the parameters specified, the CVI value of our scale was determined to be 0.941 (Table 3). In line with the opinions obtained from the experts, the content validity rates calculated based on the items on our scale and the content validity index value calculated for the whole scale are given in Table 4.

16 items (5, 9, 12, 18, 20, 22, 24, 25, 33, 34, 36, 38, 40, 47, 48, 52) with CVR≤0 were directly excluded from the scale. It was decided whether the items with a CVR > 0 value would be excluded from the scale by looking at the CVC values in Table 3 regarding the statistical significance of the CVR values. When Table 3 is examined, item 42, whose CVC value for eight experts is less than 0.750, is removed from the scale in development. Thus, a total of 17 items were removed from the scale under development, leaving a total of 38 items.

Table 4. Content validity rates of items and content validity index value of the scale

Item Number	Essential	Useful, but not essential	Not necessary	CVR	Item Number	Essential	Useful, but not essential	Not necessary	CVR
1	8	0	0	1.000	29	7	1	0	0.750
2	8	0	0	1.000	30	8	0	0	1.000
3	8	0	0	1.000	31	8	0	0	1.000
4	7	0	1	0.750	32	8	0	0	1.000
5	2	0	6	-0.500**	33	2	0	6	-0.500**
6	8	0	0	1.000	34	2	0	6	-0.500**
7	7	1	0	0.750	35	8	0	0	1.000
8	8	0	0	1.000	36	2	0	6	-0.500**
9	1	1	6	-0.750**	37	8	0	0	1.000
10	8	0	0	1.000	38	1	0	7	-0.750**
11	7	1	0	0.750	39	8	0	0	1.000
12	2	0	6	-0.500**	40	2	0	6	-0.500**
13	8	0	0	1.000	41	8	0	0	1.000
14	8	0	0	1.000	42	6	2	0	0.500*
15	7	0	1	0.750	43	8	0	0	1.000
16	8	0	0	1.000	44	7	1	0	0.750
17	8	0	0	1.000	45	8	0	0	1.000
18	1	0	7	-0.750**	46	8	0	0	1.000
19	8	0	0	1.000	47	2	0	6	-0.500**
20	2	0	6	-0.500**	48	1	0	7	-0.750**
21	8	0	0	1.000	49	8	0	0	1.000
22	2	0	6	-0.500**	50	7	1	0	0.750
23	8	0	0	1.000	51	8	0	0	1.000
24	1	0	7	-0.750**	52	2	0	6	-0.500**
25	2	0	6	-0.500**	53	8	0	0	1.000
26	8	0	0	1.000	54	8	0	0	1. 000
27	7	1	0	0.750	55	8	0	0	1.000
28	7	0	1	0.750					

Total Number of Experts: 8
CVC: 0.750 - CVI: 0.941
*Substances below the CVC value (0.750) ** Substances with CVR≤0

The fact that the content validity index value determined because of the analysis is greater than the value of the content validity criterion (CVI > CVC) shows that the content validity of the items in the scale (except for those excluded) is statistically significant (Ateş, 2013; Lawshe, 1975; Öngöz, 2011). In addition, the items in the draft scale (38 items) are statistically significant since CVI (.941)>CVC (0.750). The results of the analyses show that our draft scale has content validity.

Exploratory factor analysis and confirmatory factor analysis were applied to determine the construct validity of the scale. Exploratory factor analysis is a technique to reveal how many sub-dimensions the items in the scale can have and what kind of relationship there is between them (Seçer, 2018). Confirmatory factor analysis is a powerful statistical method that examines the hidden structures in the scale and the relationships between them (Jackson et al., 2009). This analysis gives information about which variables in the model will be loaded on which factors, which factors are related to each other, and so on (Stevens, 2009). Before starting the exploratory factor analysis, the KMO coefficient was calculated, and Bartlett's test was performed (Table 5).

Table 5. Results on KMO coefficient and Barlett's test

Kaiser-Meyer-Olkin Measure of Sampling Adequacy		0.918
Bartlett's Test of Sphericity	Approx. Chi-Square	5148.76
	Df	703
	Sig.	0.00

When the KMO coefficient and Barlett's test values in Table 5 were examined, the KMO was 0.918 and the Barlett's test was 5148.76 ($p<0.01$). The KMO value shows a value in the range of 0–1, and the resulting value

is close to 1 means that it shows a perfect fit (Field, 2005). According to Pallant (2001), the KMO value should be at least 0.60. The KMO value is between 0.70 and 0.80 for good, 0.80 and 0.90 for very good, and 0.90 and 1.0 for excellent, according to Hutcheson and Sofroniou (1999) and Field (2005). The KMO coefficient found because of the measurement was 0.918 was significant, indicating that the sample was adequate for exploratory factor analysis.

In the EFA to be performed to determine the construct validity of the scale, principal axis factoring (PAF) and the varimax rotation technique were used. PAF is an approach used to determine the factor structure in scale studies and can calculate the common variance between the observed variables (Fabrigar et al., 1999). The main priority of PAF is to define the basic dimensions and focus on common variance (Malhotra, 2010). The principal axis factoring method is the most widely used method in factor subtraction analysis (Harman, 1967). PAF aims to determine the maximum variance at right angles to each other from the dataset with successive factors (Tabachnick & Fidell, 2014). Since the main purpose of scale studies is to detect hidden structures among the variables (Fabrigar etc., 1999; Cattel, 1978), the PAF technique was preferred in EFA. In addition, PAF has few variables per factor and better recovers weak factors (Briggs & MacCallum, 2003; De Winter & Dodou, 2012). Principal axis analysis has an important advantage. In this method, the common factor variance is analyzed by subtracting the original and error variances. This is a method in line with the logic of factor analysis (Karaman, 2015). If a variable has a high degree of load on different factors, it becomes difficult to interpret the factor (Malhotra, 2010). Rotation is performed to make the factor structure more understandable and interpretable (DeVellis, 2017). The varimax rotation technique was preferred because the factors identified items with high correlation with them, providing ease of interpretation and frequency of use (Büyüköztürk, 2003; Yiğit & Kurnaz, 2010; Kahyaoğlu, 2011).

In Table 6, the variance values of each of the items on the scale belonging to a common factor are given. According to Seçer (2018) and Çokluk et al., (2012), the common variance of the items described by the factors should not be less than 0.10. The variance explanation rate for each item on our scale in the common factor is greater than 0.10.

Table 6. Rate of explaining variances of substances in common factor

Item	Initial	Extraction	Item	Initial	Extraction	Item	Initial	Extraction
T1	0.552	0.576	T14	0.739	0.720	T27	0.379	0.357
T2	0.567	0.531	T15	0.644	0.586	T28	0.472	0.483
T3	0.558	0.636	T16	0.499	0.636	T29	0.567	0.611
T4	0.532	0.538	T17	0.698	0.681	T30	0.332	0.298
T5	0.595	0.592	T18	0.654	0.644	T31	0.627	0.643
T6	0.494	0.456	T19	0.800	0.728	T32	0.534	0.499
T7	0.337	0.293	T20	0.766	0.692	T33	0.353	0.281
T8	0.678	0.607	T21	0.679	0.634	T34	0.617	0.551
T9	0.619	0.584	T22	0.464	0.473	T35	0.608	0.623
T10	0.443	0.413	T23	0.599	0.682	T36	0.271	0.290
T11	0.514	0.466	T24	0.447	0.394	T37	0.423	0.423
T12	0.704	0.666	T25	0.256	0.197	T38	0.511	0.501
T13	0.466	0.515	T26	0.555	0.486			

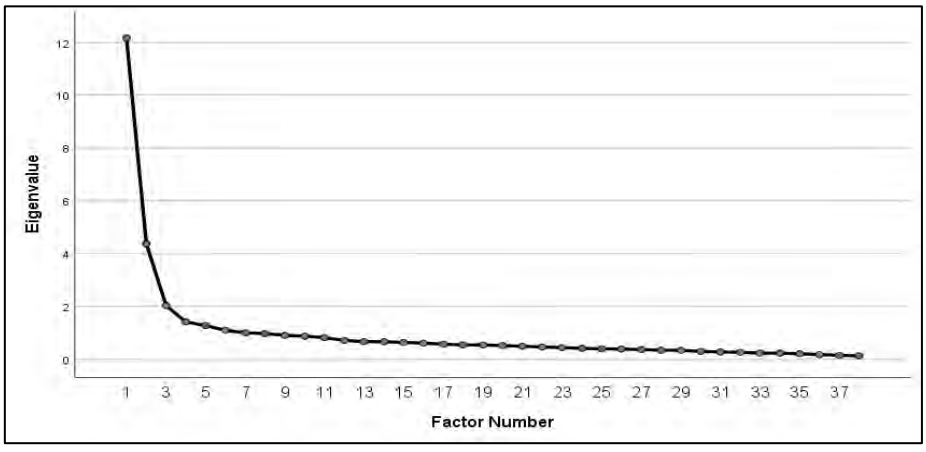

Figure 3. Slope-accumulation graph of the scale

Table 7. Announced total variance rates (without matter extraction)

Factor	Initial Eigenvalues			Extraction Sums of Squared Loadings			Rotation Sums of Squared Loadings		
	Total	% of Variance	Cumulative %	Total	% of Variance	Cumulative %	Total	% of Variance	Cumulative %
1	12.158	31.996	31.996	11.746	30.910	30.910	8.389	22.076	22.076
2	4.376	11.516	43.512	3.866	10.174	41.084	3.213	8.456	30.532
3	2.032	5.346	48.858	1.584	4.168	45.252	3.148	8.285	38.817
4	1.414	3.722	52.580	0.974	2.563	47.815	2.941	7.740	46.558
5	1.275	3.354	55.934	0.764	2.010	49.826	0.897	2.360	48.917
6	1.098	2.888	58.823	0.579	1.524	51.350	0.751	1.976	50.893
7	1.003	2.640	61.462	0.470	1.238	52.588	0.644	1.695	52.588
8	0.971	2.555	64.018						
9	0.907	2.386	66.404						
10	0.873	2.297	68.701						
11	0.820	2.159	70.860						
12	0.714	1.879	72.739						
13	0.669	1.761	74.499						
14	0.666	1.752	76.252						
15	0.636	1.673	77.924						
16	0.612	1.611	79.535						
17	0.570	1.500	81.035						
18	0.544	1.431	82.466						
19	0.542	1.426	83.892						
20	0.518	1.364	85.256						
21	0.494	1.301	86.557						
22	0.461	1.214	87.771						
23	0.440	1.158	88.930						
24	0.414	1.090	90.019						
25	0.394	1.037	91.056						
26	0.387	1.019	92.075						
27	0.369	0.970	93.045						
28	0.342	0.900	93.945						
29	0.341	0.897	94.842						
30	0.295	0.777	95.618						
31	0.276	0.728	96.346						
32	0.264	0.696	97.042						
33	0.233	0.614	97.655						
34	0.232	0.609	98.265						
35	0.208	0.548	98.812						
36	0.175	0.461	99.274						
37	0.147	0.387	99.661						
38	0.129	0.339	100.00						

The K1 rule and scree plot methods were used in this study to determine the number of factors. Kaiser (1960) developed the K1 rule, which states that factors with eigenvalues greater than one are considered significant (Guttman, 1954; Pallant, 2010; Verma, 2013). Cattell developed another method for determining the factor number, the slope-accumulation graph (scree plot), and the factor number is obtained by determining the point where the lines in the graph flatten (Shrestha, 2021).

Table 7 shows the total variance values for the raw data described on the scale without any item extraction applied. When the slope-accumulation graph given in Figure 3 is examined, a horizontal trend is observed in the graph after the third factor, and the total variance effects of the fourth and subsequent factors are close to each other. When the literature is taken into consideration, it is decided that the scale consists of a 3-factor structure. The results of the K1 rule and the Scree Plot method were examined together, and it was decided that the scale consisted of a 3-factor structure when the field literature was taken into consideration.

In exploratory factor analysis procedures, it is necessary to determine the load values of the items in the minimum factor according to the sample size and to remove the items below this minimum value from the scale. The item load of each substance in the factors should be at least 0.45 (Tabachnick & Fidell, 1989, as cited in Büyüköztürk 1997). Furthermore, the difference in loads for the same substance across multiple factors should not be less than 0.10 (overlapping substance) (Büyüköztürk, 2020; Seçer, 2018). In addition, it is stated in the literature that there should be at least three items in a factor (MacCallum et al., 1999; Raubenheimer, 2004). The item removal process was continued during the scale development phase until the item load was more than 0.45 and no overlapping item was discovered. It was also considered that there should be at least three items in a factor. Substances that did not meet the conditions specified during the deletion of substances were removed one by one, not all together, and the results were examined and the delete process was carried out. In this context, 5 items (7-11-25-36-37) with factor loadings below 0.45 were deleted. Three items (2-4-34), which were included in more than one factor and had less than a 0.10 difference between item loads, were deleted. 3 items (1-3-13) that did not provide the minimum number of items required in a factor were deleted. A total of 11 items were removed from the scale. The item distributions related to the 3-factor structure that emerged after the item delete processes are presented in Table 8.

Table 8. Distribution of substances by factors

Item	Factor 1	Item	Factor 2	Item	Factor 3
T14	0.800	T23	0.820	T29	0.716
T19	0.790	T22	0.678	T31	0.701
T12	0.772	T10	0.579	T27	0.513
T20	0.770	T16	0.530	T26	0.480
T17	0.747	T28	0.527		
T18	0.746	T33	0.471		
T15	0.746	T30	0.450		
T21	0.741				
T8	0.729				
T5	0.714				
T9	0.661				
T6	0.627				
T35	0.626				
T32	0.552				
T38	0.547				
T24	0.524				

Loads of the items on the scale range from 0.450 to 0.820. The item deletion process was terminated because there was no item load of less than 0.45 on the scale and no substance in more than one factor (Table 8).

Table 9. Total variance values explained by factors

Factor	Declared Value of Variance (%)
Factor 1	30.606
Factor 2	10.643
Faktor 3	8.485
Total Variance Value Explained	50.094

As can be seen in Table 9, factor 1 explains 30.606% of the total variance, factor 2 explains 10.643%, and factor 3 explains 8.485%. For multi-factor structures in scale development, it is generally considered sufficient that the total declared variance value is 40–60% (Gorsuch, 1983; Kline, 1994; Tavşancıl, 2014). The total detected variance value determined is 50.094%, and it is seen that this value is sufficient.

After the exploratory factor analysis, a confirmatory factor analysis was applied to confirm the structure. In confirmatory factor analysis, we used the maximum likelihood calculation method. In confirmatory factor analysis, the evaluation of the suitability of the factor model is carried out according to some compliance indicators. These are some of the indices: Chi-square ($\chi 2$)/degrees of freedom (df), Goodness of Fit Index GFI), Adjustment Goodness of Fit Index (AGFI), Root Mean Square Error of Approximation (RMSEA), Root Mean Square Residual (RMR), Standardized Root Mean Square Residual (SRMR), Incremental Fit Index (IFI), Normed Fit Index (NFI), Non-Normed Fit Index (NNFI), Parsimony Goodness of Fit Index (PGFI), Parsimony Normed of Fit Index (PNFI), Comparative Fit Index (CFI) and Relative Fit Index (RFI).

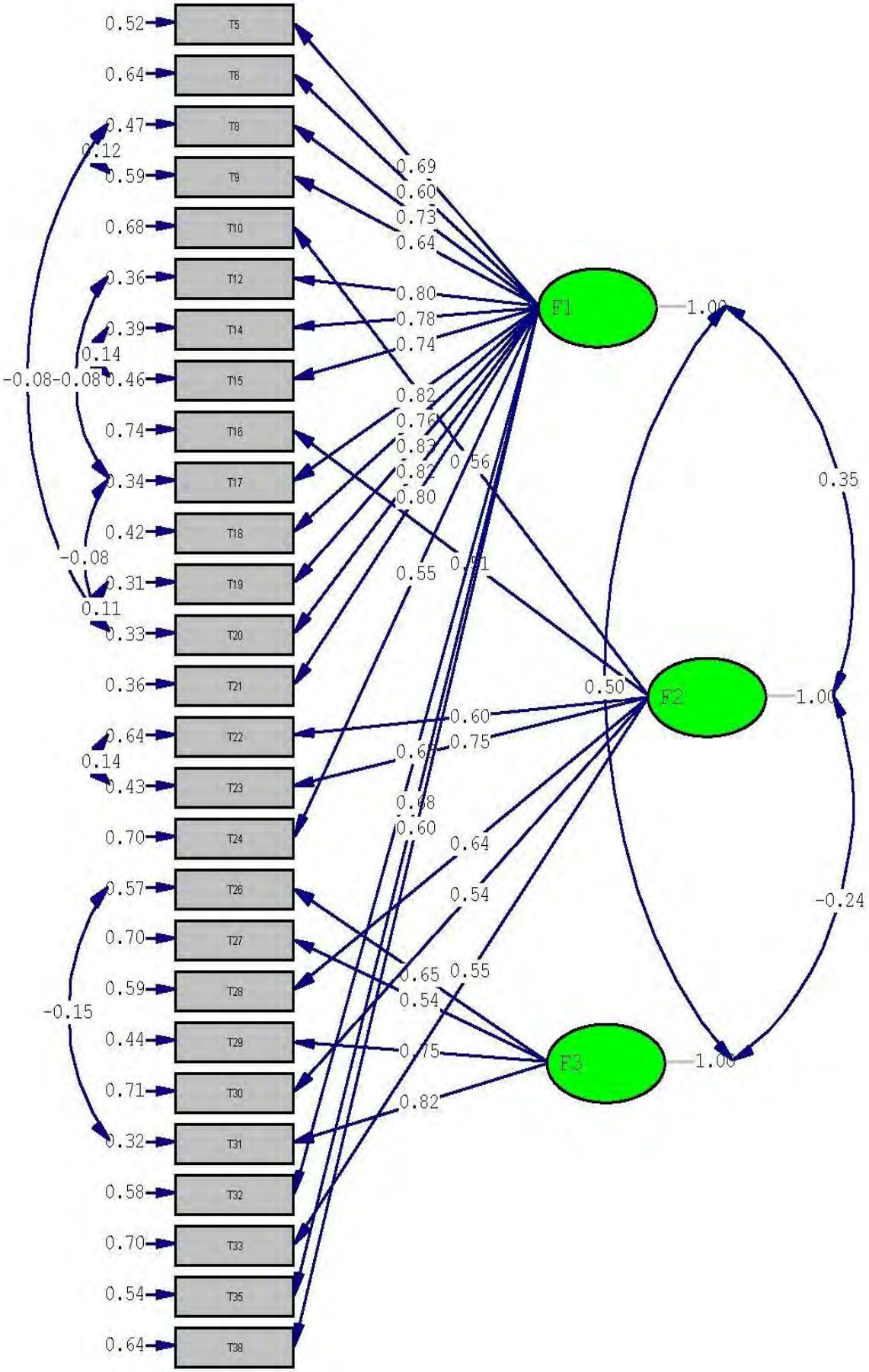

Figure 4. Model's standardized solutions

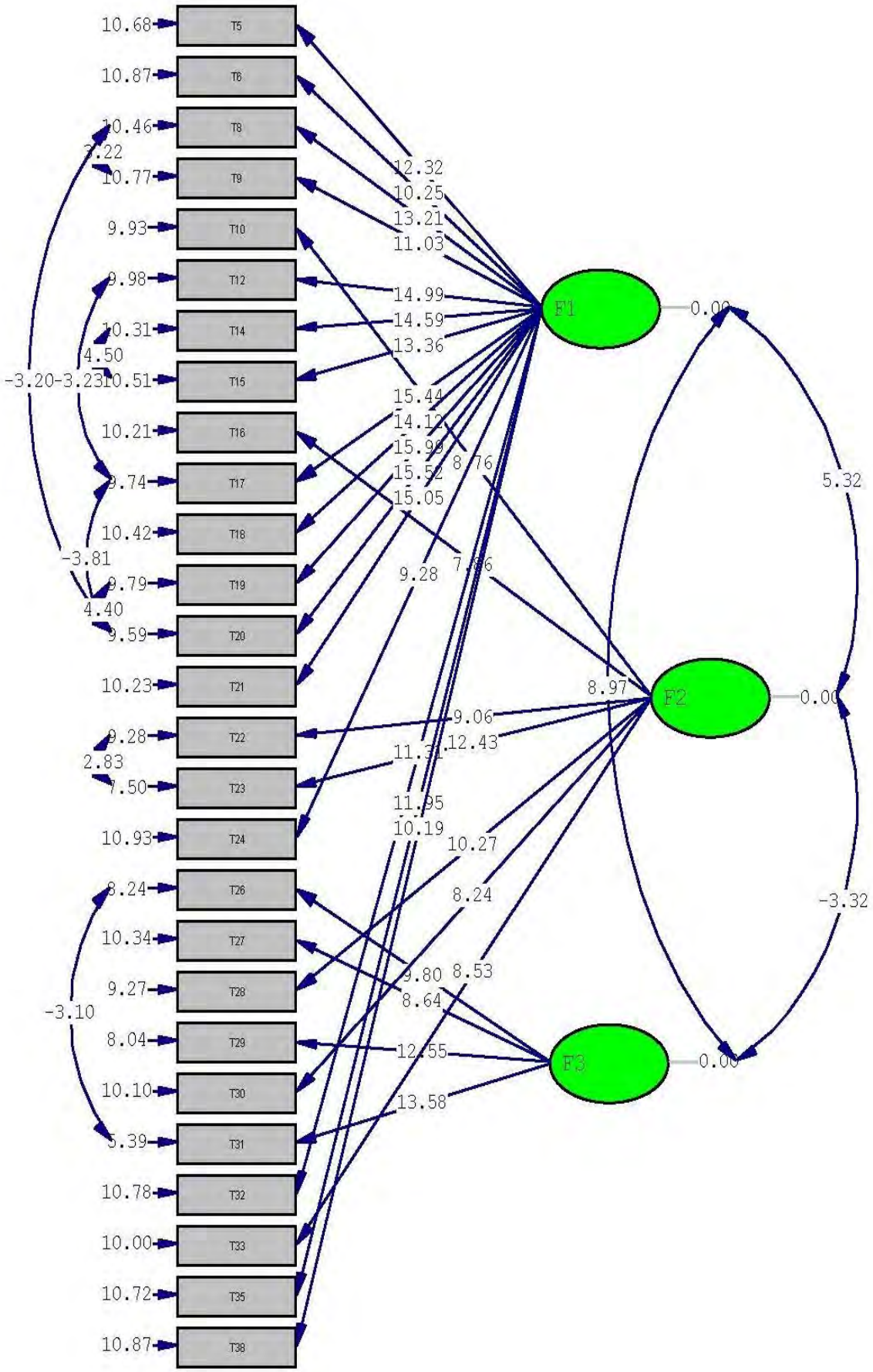

Figure 5. Model's t values

Table 10. Results of compliance indexes

Fit Index	Calculated Fit Index	Fit Indices in the Literature	References
χ2/sd	1.95	Perfect Fit (χ2/sd ≤2)	Schumacker & Lomax (2004); Tabachnick & Fidell (2007); Kline (2011)
GFI	0.85	Acceptable Fit (GFI≥0.85)	Anderson & Gerbing, (1984); Cole, (1987); Marsh et al., (1988); Bryant et al., (1996); Chabrol et al., (2002); Schumacker & Lomax (2004); Weizmann-Henelius et al., (2010)
AGFI	0.81	Acceptable Fit (AGFI≥0.80)	Anderson & Gerbing, (1984); Cole, (1987), Marsh et al., (1988); Bryant et al., (1996); Chabrol et al., (2002); Weizmann-Henelius et al., (2010)
RMSEA	0.06	Perfect Fit (RMSEA≤0.06, 0.08, 0.10)	Steiger, (1990); Hu & Bentler, (1999); Byrne, (2001)
RMR	0.08	Acceptable Fit (0.05≤RMR ≤0.08, 0.10)	Anderson & Gerbing, (1984); Cole, (1987); Marsh et al., (1988); Bentler, (1990); Hu & Bentler, (1999)
SRMR	0.06	Acceptable Fit (0.05≤SRMR≤0.08)	Hu & Bentler (1999); Schermelleh-Engel et al., (2003); Şimşek, (2007).
IFI	0.97	Perfect Fit (IFI≥0.95)	Hu & Bentler (1999); Hooper et al., (2008); Karagöz (2019)
NFI	0.95	Perfect Fit (NFI≥0.95)	Hu & Bentler (1999); Kaplan (2000); Schumacker & Lomax (2010).
NNFI	0.97	Perfect Fit (NNFI≥0.95)	Bentler & Bonett (1980); Kelloway, (1998); Hu & Bentler (1999)
PGFI	0.70	Perfect Fit (PGFI≥0.50)	Mulaik et al., (1989); Chiao et al., (2018); Li et al., (2022)
PNFI	0.84	Perfect Fit (PNFI≥0.50)	Mulaik et al., (1989); Chiao et al., (2018); Li et al., (2022)
CFI	0.97	Perfect Fit (CFI≥0.95)	Bentler, (1995); Hu & Bentler (1999); West et al., (2012)
RFI	0.94	Acceptable Fit (0.90≤RFI≤0.95)	Bentler & Bonett, (1980); Baumgartner & Homburg, (1996); Marsh et al., (2006)

In the literature, there is no definite rule about which fit indices will be used in the studies. Researchers have come up with different recommendations about which indices should be used (Crede & Harms, 2019). Gerbing & Anderson (1992) explain which fit indices should be evaluated in research and state that this is as difficult as answering the question, "What is the best car on the market?" They emphasized the importance of purpose in choosing the fit index. Each of the fit indices serves different purposes and differs from each other (Iacobucci, 2010). According to the objectives of the study, the concordance indices preferred by the researchers may also vary (İlhan & Çetin, 2014). In our study, chi-square/degrees of freedom χ2/sd, GFI, AGFI, RMSEA, RMR, SRMR, IFI, NFI, NNFI, PGFI, PNFI, CFI, and RFI compliance indices were evaluated.

In cases where the fit indices do not meet the threshold values specified in the field literature or to improve the compliance indices, modification is required. When the modification process is carried out, it is done only between the substances included in the same factors (Seçer, 2015; Gürbüz, 2021). In order to improve the GFI fit index value, changes were made between the items under the same factors (9-8, 15-14, 17-12, 20-8, 20-17, 20-19, 23-22, and 31-26), depending on the structure of the scale.

Standardized solution values of the scale are shown in Figure 4 and t values are shown in Figure 5. Standardized solution factor loadings should be at least 0.30 and above (Doris et al., 2011; Seçer, 2015; Hashem-Dabaghian et al., 2022). When Figure 4 is examined, the standardized solution values of the scale are above 0.30. In addition, t values at the $p<0.01$ level in CFA should have values of 2.56 and above (Doris et al., 2011; Thomas & Devi, 2020; Çokluk et al., 2021). When Figure 5 is examined, it is seen that the t values are appropriate. The fit indices determined after the model modification procedures are given in Table 10.

When Table 10 is examined, χ2/sd, RMSEA, IFI, NNFI, PGFI, PNFI, NFI, and CFI fit indices show perfect fit, and GFI, AGFI, RMR, SRMR, and RFI fit indices show acceptable fit. After determining the factors, the factors

need to be named. When naming the factors, there is no rule other than giving the names that best express the items in the factors (Yong & Pearce, 2013). In this direction, factor 1 was named "Conscious Use and Protection of Resources", factor 2 "Being Sensitive to the Environment", and factor 3 "Developing Zero Waste Awareness" (Table 11).

After determining the validity of the scale, its reliability was checked. Reliability, one of the basic criteria, is a criterion used to evaluate the quality of the data obtained (Wagemaker, 2020). Different methods have been developed to calculate reliability. In addition to the Cronbach Alpha coefficient, which is one of the most reliable methods and widely used (Shelby, 2011; Tavakol & Dennick, 2011). in our study, McDonald's Omega method was also preferred due to the different factor loads (McDonald, 1985; Yurdugül, 2006). Reliability values vary between 0 and 1, and although the value of 0.70 is sufficient, some researchers state that smaller values can also be accepted (Nunnally, 1978). In general, less than 0.50 is considered unacceptable, 0.50-0.60 is considered poor, 0.60-0.70 is considered doubtful, 0.70-0.80 is considered acceptable, 0.80-0.90 is considered good, and 0.90 and above is considered perfect (George & Mallery, 2020). The reliability results of the scale are given in Table 12.

Table 11. Factors and items

Factor Name	Item Number	Item	Mean ($\bar{x}$)	Std. Deviation.
Conscious Use and Protection of Resources	T14	I know that the unconscious consumption of natural resources is a problem.	4.42	0.903
	T19	I am happy that people prefer packaged products that can be recycled.	4.40	0.940
	T12	I am happy to encourage people to use packaged products that can be recycled.	4.21	0.998
	T20	I am happy to use packaged products that are reused after recycling.	4.37	0.860
	T17	Zero waste plays an important role in solving environmental problems.	4.28	0.975
	T18	I know that the zero-waste policy prevents waste.	4.33	0.916
	T15	I know that the zero-waste policy contributes to the economy.	4.24	0.982
	T21	Leading people to zero waste makes me happy.	4.30	1.002
	T8	I recognize the recycling symbol.	4.43	0.960
	T5	I think that with the zero-waste policy. natural and energy resources will be consumed less.	4.28	0.889
	T9	I know how to protect natural resources.	4.15	0.989
	T6	I think that with the zero-waste policy. the amount of waste left in the environment will decrease.	4.24	1.021
Being Sensitive to the Environment	T35	I am aware of the environmental problems caused by waste.	4.22	0.945
	T32	I am happy to use products with recyclable packaging.	4.04	0.991
	T38	I know that waste is a raw material with economic value.	4.10	0.993
	T24	I separate my waste and leave it in the relevant waste bins.	3.86	1.000
	T23*	The gradual increase in environmental problems caused by waste does not bother me.	4.05	1.318
	T22*	It doesn't bother me that waste is thrown directly into the trash.	3.66	1.351
	T10*	I think the problems caused by waste are exaggerated.	3.75	1.401
	T16*	I don't think the zero-waste policy improves the quality of life.	3.59	1.542
	T28*	Harming the environment does not make me unhappy.	4.20	1.339
	T33*	I do not think that environmental education is important in preventing waste.	3.66	1.585
	T30*	I think it is not possible to reduce waste.	3.47	1.321
Developing Zero Waste Awareness	T29	I participate in events organized about zero waste.	3.23	1.209
	T31	I do research on what can be done to reduce waste.	3.33	1.181
	T27	I buy products with packaging suitable for recycling. even if they are expensive.	2.75	1.191
	T26	I make an effort to provide products with packaging suitable for recycling.	3.64	1.104

*Negative Items: 10-16-22-23-28-30-33

Table 12. Cronbach's Alpha Coefficient and McDonald's Omega values of the scale

Total Number of Items	Alpha Coefficient	McDonald's Omega
27	0.90	0.90

When Table 12 is examined, the reliability value for the sum of the scale was determined as 0.90 (excellent) according to the alpha and omega results. These values show that the reliability of the scale is appropriate (excellent), according to George & Mallery (2020).

Conclusion

In the literature research, no zero-waste attitude scale was directly found for social studies teacher candidates. This scale was developed to evaluate the attitudes of social studies teacher candidates towards the zero-waste policy. The processes for the development of the scale were meticulously implemented. The scale was developed in a five-point Likert type. The content validity process was performed on the data obtained from the experts, and the items that should be removed were determined. In the content validity process, in line with the opinions of the experts, it was decided to remove 17 items from a total of 55. KMO and Barlett tests show that the scale is valid and reliable for measurement. An exploratory factor analysis was performed for the remaining 38 items in the draft scale. As a result of the EFA process, a scale consisting of 27 items in three dimensions emerged. As a result of the EFA process, confirmatory factor analysis was applied to verify the scale. As a result of the CFA process, it was decided that the scale developed was appropriate. After the factor analysis procedures, Cronbach's alpha and McDonald's omega reliability tests were applied to determine the reliability of the scale. Cronbach's alpha and McDonald's omega reliability values on the scale were found to be 0.90. According to this value, it was determined that the reliability of the scale was "perfect".

The five items with the highest average on the scale are as follows: "I recognize the recycling symbol ($\bar{x}$=4.43)", "I know that the unconscious consumption of natural resources is a problem ($\bar{x}$=4.42), "I am happy that people prefer packaged products that can be recycled ($\bar{x}$=4.40)", "I am happy to use packaged products that are reused after recycling ($\bar{x}$=4.37)", and "I am happy to use packaged products that are reused after recycling ($\bar{x}$=4.33)". The five items with the lowest average on the scale are as follows: "I buy products with packaging suitable for recycling. even if they are expensive ($\bar{x}$=2.75)", "I participate in events organized about zero waste ($\bar{x}$=3.23), "I do research on what can be done to reduce waste ($\bar{x}$=3.33)", "I think it is not possible to reduce waste ($\bar{x}$=3.47)", and "I don't think the zero-waste policy improves the quality of life ($\bar{x}$=3.59)".

Individuals' attitudes and behaviors play an important role in achieving the goal of a zero-waste policy in the fight against environmental problems. However, it is possible for individuals to have a positive attitude with a good education. The social studies course has a high effect on transferring subjects related to environmental problems to the students. The meticulous conduct of this course by a well-equipped social studies teacher is important for the positive development of students' attitudes towards the environment. Equipped teachers will ensure that the course is carried out better and that teacher behaviors reflect positively on students. With this scale developed in this respect, it will be possible to determine the attitudes of social studies teacher candidates about zero waste. Studies to be carried out in line with the data obtained from the scale will contribute to the training of a good social studies teacher of the future. Thus, more solid steps will be taken in the fight against environmental problems.

Recommendations

By using this developed scale, the zero-waste attitudes of social studies teacher candidates can be evaluated using different variables. This developed scale can guide researchers who want to work on a related subject in different disciplines. By adding this scale to different disciplines, it can be studied by increasing its diversity.

Scientific Ethics Declaration

The authors declare that the scientific ethical and legal responsibility of this article published in JESEH journal belongs to the authors.

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Appendix

Zero Waste Attitude Scale

	Expressiones	Strongly agree	Agree	Undecided	Disagree	Strongly disagree
1	I know that the unconscious consumption of natural resources is a problem.					
2	I am happy that people prefer packaged products that can be recycled.					
3	I am happy to encourage people to use packaged products that can be recycled.					
4	I am happy to use packaged products that are reused after recycling.					
5	Zero waste plays an important role in solving environmental problems.					
6	I know that the zero-waste policy prevents waste					
7	I know that the zero-waste policy contributes to the economy.					
8	Leading people to zero waste makes me happy.					
9	I recognize the recycling symbol.					
10	I think that with the zero-waste policy. natural and energy resources will be consumed less.					
11	I know how to protect natural resources.					
12	I think that with the zero-waste policy. the amount of waste left in the environment will decrease.					
13	I am aware of the environmental problems caused by waste.					
14	I am happy to use products with recyclable packaging.					
15	I know that waste is a raw material with economic value.					
16	I separate my waste and leave it in the relevant waste bins.					
17	The gradual increase in environmental problems caused by waste does not bother me.					
18	It doesn't bother me that waste is thrown directly into the trash.					
19	I think the problems caused by waste are exaggerated.					
20	I don't think the zero-waste policy improves the quality of life.					
21	Harming the environment does not make me unhappy.					
22	I do not think that environmental education is important in preventing waste.					
23	I think it is not possible to reduce waste.					
24	I participate in events organized about zero waste.					
25	I do research on what can be done to reduce waste.					
26	I buy products with packaging suitable for recycling. even if they are expensive.					
27	I make an effort to provide products with packaging suitable for recycling.					
Negative Items: 17-18-19-20-21-22-23						

Zero Waste Attitude Scale (Turkish)

	Maddeler	Kesinlikle Katılıyorum	KAtılıyorum	Kararsızım	Katılmıyorum	Kesinlikle Katılmıyorum
1	Doğal kaynakların bilinçsizce tüketilmesinin bir sorun olduğunu bilirim.					
2	İnsanların geri dönüştürülebilir ambalajlı ürünleri tercih etmesi beni mutlu eder.					
3	İnsanlara geri dönüştürülebilir ambalajlı ürünleri teşvik etmek beni mutlu eder.					
4	Geri dönüştürülerek tekrar kullanıma sunulan ambalajlı ürünleri kullanmak beni mutlu eder.					
5	Sıfır atık, çevre sorunlarının çözümünde önemli bir rol oynar.					
6	Sıfır atık politikasının, israfı önlediğini bilirim.					
7	Sıfır atık politikasının ekonomiye katkı sağladığını bilirim.					
8	İnsanları sıfır atığa teşvik etmek beni mutlu eder.					
9	Geri dönüşüm sembolünü tanırım.					
10	Sıfır atık politikası ile doğal ve enerji kaynaklarının daha az tüketileceğini düşünüyorum.					
11	Doğal kaynakların nasıl korunacağını bilirim.					
12	Sıfır atık politikası ile çevreye bırakılan atıkların azalacağını düşünüyorum.					
13	Atıklardan kaynaklanan çevre sorunlarının bilincindeyim.					
14	Geri dönüştürülebilir ambalajlı ürünleri kullanmak beni mutlu eder.					
15	Atıkların ekonomik değere sahip bir hammadde olduğunu bilirim.					
16	Atıklarımı ayırarak ilgili atık kutularına bırakırım.					
17	Atıklardan kaynaklı çevre sorunlarının giderek artması beni tedirgin etmez.					
18	Atıkların doğrudan çöpe atılması beni rahatsız etmez.					
19	Atıklardan kaynaklanan sorunların abartıldığını düşünüyorum.					
20	Sıfır atık politikasının, yaşam kalitesini artırdığını düşünmüyorum.					
21	Çevreye zarar vermek beni mutsuz etmez.					
22	Atıkları önlemede çevre eğitiminin önemli olmadığını düşünüyorum.					
23	Atıkların azaltılmasının mümkün olmadığını düşünüyorum.					
24	Sıfır atık ile ilgili düzenlenen etkinliklere katılırım.					
25	Atıkları azaltmak için neler yapılabileceğine dair araştırmalar yaparım.					
26	Geri dönüşüme uygun ambalajlı ürünleri pahalı da olsa alırım.					
27	Geri dönüşüme uygun ambalajlı ürünleri temin etmek için çaba harcarım.					
Olusuz Maddeler: 17-18-19-20-21-22-23						

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