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Development and Validation of the Inspiration from Nature Scale for Primary School Students

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Abstract

This research aims to develop a valid and reliable scale that determines primary school students' level of inspiration from nature. The scale is called the Inspiration from Nature Scale (IfNS). Participants are primary school students studying in Konya in the second semester of the 2021-2022 academic year. In line with the purpose of the research, the literature related to the scale development process was reviewed, and an item pool was created. In line with the opinions of field experts, 19 of these items were decided, and the scale was applied to 847 students studying in different provinces. Exploratory and confirmatory factor analysis, Cronbach alpha analysis, item analysis, test-retest reliability and criterion validity were performed to examine the validity and reliability of the scale. As a result of the factor analysis performed with the data obtained, the scale structure was determined as three factors (interest, bonding, fear) and 13 items. The Inspiration from Nature Scale has been determined as a valid and reliable tool that can be used to reveal primary school students' levels of inspiration from nature.

Keywords: Inspiration from nature, Biomimicry training, Primary school students, Scale development.

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Introduction

Nature and humans have been inseparable whole since the existence of life. Humankind, which obtains all the substances it needs to live from nature, has been inspired by nature for millions of years. People try to overcome the difficulties they encounter with the solutions they see in nature. The efforts of people to harmonize their own designed products with nature in some way have led to the emergence of biomimicry. The concept of biomimicry, which means 'imitating nature, being inspired by nature, emerged at the end of the 21st century, although it is as old as the history of humanity (Kennedy, 2004). Biologist Janine Benyus first mentioned biomimicry's concept, and its usage levels were examined in three dimensions. Accordingly, the organism level that imitates a single organism directly, the imitation of how more than one natural area or entity behaves in a broad context is classified as the behavioral level, and the imitation of an ecosystem itself is classified as the ecosystem level (Benyus, 1997). Today, biomimicry is generally considered a design methodology that can take place under the roof of different disciplines for a sustainable future (Speck, Horn, Gantner, & Sedlbauer, 2017). As a result of the widespread use of alternative or preliminary uses of natural and living sciences in the field of design, biomimicry has started to take place in many disciplines as a separate discipline (Iouguina et al., 2014).

Biomimicry has become a useful source of fieldwork in architectural and urban design, computer, coding, digital design, robotic informatics and space sciences, materials and engineering sciences, industrial product development, the agriculture industry, health sciences, and even art and fashion. Examining where and why biomimicry is used can help us understand the wide range of applications and the impact it has.

According to a bibliometric study on architectural and innovative space designs, biomimicry has been described as an innovative field of philosophy with natural solutions (Meena D'Costa et al., 2021). Biomimicry focuses on natural processes or functions humans can apply to the manufactured world. In this sense, creating a properly designed space depends on integrating creative processes learned from nature (Karabetça, 2018; Öztoprak, 2020). When the wealth of information in technology and tools is synthesized with biomimicry, it will be effortless to create living spaces compatible with nature (Goss, 2009; Jamei & Vrcelj, 2021; Karabetça, 2018; Öztoprak, 2020). When the wealth of information in technology and tools is synthesized with biomimicry, it will be effortless to create living spaces compatible with nature (Goss, 2009; Jamei & Vrcelj, 2021). For example, the ability of water mimosas to adapt to flood and tsunami natural disasters in response to the current climate crisis has inspired creative industrial modular designs (floating capsules) (Haryanti & Susilawati, 2022). Considering that energy is one of humanity's greatest needs, energy-efficient facade systems have become essential in biomimicry. According to the problems experienced in the creation of these designs, biological solutions should be well-defined, and biomimicry features should be integrated into the design (Gündoğdu & Arslan, 2020; Nalçacı & Nalçacı, 2020; Radwan & Osama, 2016). In addition to human needs, biomimicry principles were used in designs such as bat houses and snail nests for the well-being of other living things in nature (Ak & Özen Yavuz, 2019; Keskin & Özen Yavuz, 2019). In architectural designs, biomimicry has not only been used in the context of basic requirements and problems but also has been a source of inspiration for architectural structures with its visual dimension. Studies have shown how architecture can use biomimicry to create visually striking designs. For example, some religious buildings have been made to resemble trees, stairs have been designed to look like snail

shells when viewed from above, and interiors have been decorated with flower drawings and stones. In addition, stained glass details on windows can create a rainbow effect through light refraction (Buck, 2017; İnner, 2019). Students' awareness and knowledge about using biomimicry in architectural and innovative space design are beneficial in getting better inspiration while observing nature.

When the subject was examined in terms of informatics, robotics, materials, and engineering, it was seen that biomimicry-based cognitive agents and simulators were developed by imitating living things (Lawniczak, Ernst & Di Stefano, 2014). The contributions of biological information to the studies in the field of space with the use of robotics have been examined by many researchers (Knigh, 2017; Menon, Broschart & Lan, 2007; Ramezani, Chung & Hutchinson, 2017). Inspired by flying birds and insect species, micro-aircrafts for defense and security have been tried to be developed (Moses, 2020). In another study, the creation of nano-scale radiation cooling systems was tested by calculating the rate of change in air pressure during the flapping of a butterfly's wings (Didari & Mengüç, 2018). Biomimicry inspires scientists and manufacturers in engineering and addresses everyday issues that concern everyone (Wahl, 2006). Innovations inspired by nature are becoming increasingly common. For instance, moth eyes have been studied to develop screen technology, and the rosary beetle has influenced furniture design. Scientists have looked at the unique properties of a cat's tongue to create toothbrushes, and the interlocking and sticking properties of phlox inspired the invention of Velcro, which has since been patented under that name. Foldable and modular products have also been produced based on nature's designs. It concerns the daily life of all humanity (Yıldız, 2012). It has also been evaluated that biomimicry can be used to make the packaging used by all segments sustainable (Caferoğlu, 2021).

Considering the agricultural sector, it can be said that the return to biomimicry-based natural agricultural practices has accelerated since it is understood that artificial agriculture practices are not sustainable. The search for renewable resources, especially for water scarcity, leads scientists to imitate stable natural ecosystems (Othmani, Sahak & Yunos, 2021). Regarding technological developments in health, micro-scale engineering technologies are frequently used in cell studies. In a technology developed based on the acculturation phenomenon in nature, cells are prepared to be propagated by culturing on a chip and used to compensate for organ damage (Huh et al., 2012). Biomimicry was also used to answer the question of where collagen, the most abundant protein in mammals, and silica, one of the most abundant minerals in nature, can be used in the health field apart from their current usage areas (Brannum, 2017). When the subject is approached in the context of art, Karataş (2020) has historically examined how biomimicry can be used within the scope of ecological art and how it can contribute to sustainability. In addition, it has been proven with an applied thesis that digital art designs can be made in an ethnic-futuristic style with an algorithmic biomimicry approach (Dündar, 2019).

Since there are dozens of fields of science in which biomimicry is used, it is essential to have interdisciplinary educational content. When the studies on the subject are examined, it is evident that biomimicry, which contributes significantly to various fields of human life, has not been adequately incorporated into basic education curricula. Educational applications of biomimicry have been implemented in different age groups and education levels. For instance, in a quasi-experimental study, biomimicry designs were combined with design-based learning approaches to enhance undergraduate students' educational outcomes in an evolutionary biology course.

Biomimicry design is an interdisciplinary field that requires biology and design skills and provides information on creating sustainable designs by emulating biological structures and functions that emerge from natural selection. In this context, biomimicry designs were integrated into the curriculum and processed with design-based learning. Natural examples were examined by integrating biomimicry designs into two randomly selected groups of four undergraduate biology students. On the other hand, the design-based learning method was applied to the students in the control group, but no application was made outside the curriculum. When students were taught biomimicry designs as part of their evolutionary biology course, they showed a greater tendency to apply their knowledge of biological structure and function to benefit society. This was revealed by comparing their pre-test and post-test results (Fried et al., 2020).

Since biomimicry manifests itself in many areas, children should be introduced early (Williams, Barber & Sheppard, 2019). In the process of acquaintance with biomimicry, students need to show interest in nature, establish a connection between structures in nature and technological products, and determine their fears about structures in nature so that they can be inspired by living things in nature. The studies have determined that children's perception of being inspired by nature has been examined through qualitative data collection methods such as interviews, observations, practices, or drawings (Yakışan & Velioğlu, 2019). On the other hand, no measurement tool was found to determine the children's inspiration from nature. The Inspiration from Nature scale fills a critical gap in the literature by providing a valid and reliable measure of the extent to which the natural environment inspires individuals. The development of the Inspiration from Nature scale represents a significant contribution to the field, as it allows researchers to investigate the relationship between nature and creativity, well-being, and a host of other outcomes. By creating the Inspiration from Nature scale, we are advancing our understanding of the benefits of nature exposure and providing a valuable tool for educators, designers, and policymakers to create environments that foster creativity, learning, and mental health.

Such a measurement tool will also provide researchers with easy application in schools. With this developed scale, the development of children's inspiration from nature will be quantitatively and practically determined. In this sense, it is predicted that it can contribute to the literature and future biomimicry and STEM education at the preliminary stage.

Method

Research Design

The research was examined with exploratory and confirmatory factor analyses within the construct validity framework. Exploratory factor analysis (EFA) is a statistical analysis technique used to determine the latent variables (factors) underlying the observed variables and formed by the combination of the observed variables. Confirmatory factor analysis (CFA), on the other hand, means that the relationships between the variables whose existence was determined before and the structures created are studied with a new participant group and tested with the data obtained (Büyüköztürk, 2018; Orçan, 2018). The criterion validity of the scale (Seçer, 2018) was calculated, and the internal consistency coefficient, test-retest, and item analysis were used within the scope of reliability studies.

Research Study Group

The maximum variability sampling method determined the study group, considering the time and appropriate conditions. This method is a sampling method in which a sample is selected to reflect maximum variability. This method increases the variability in the sample, allowing a more precise estimate of the variability of the population. Thus, the sample group consisted of 847 primary school students who answered the data collection tool. For the first-year students to participate in the research and give healthier answers, the scale was applied in the second semester when their reading skills improved. Due to the Inspiration from Nature Scale (IfNS) development process, different participant groups were used at various stages of the study—primary school 1st-4th grades within the framework of exploratory factor analysis (EFA). There were 395 participants from the students continuing their education between the classes. In this context, the data regarding the selected sample are given in Table 1.

Table 1. Demographic Information of the Sample Determined for Exploratory Factor Analysis

Gender		Female	Male						
	n	189	196						395
	%	47.84	52.26						100
		State	Foundation						
School Type	n	12	5						17
	%	70.59	29.41						100
		1st Class	2nd Class	3rd Class	4th Class				
Grade Level	n	86	102	106	101				395
	%	21.76	25.82	26.83	25.57				100
		Mediterranean	Eastern Anatolia	Aegean	Southeastern Anatolia	Central Anatolia	Black Sea	Marmara Region	
Region of residence in the process	n	54	59	55	49	62	54	62	395
	%	13.67	14.93	13.93	12.41	15.69	13.68	15.69	100

Primary school grades 1-4 for confirmatory factor analysis (CFA) in the research. There were 340 participants from the students continuing their education between the classes. In this context, the data regarding the selected sample are given in Table 2.

Table 2. Demographic Information of the Sample Determined for Confirmatory Factor Analysis

Gender		Female	Male						
	n	169	171						340
	%	49.71	50.29						100
		State	Foundation						
School Type	n	240	100						340
	%	70.59	29.41						100
		1st Class	2nd Class	3rd Class	4th Class				
Grade Level	n	83	86	91	80				340
	%	21.47	25.29	26.76	23.53				100
		Mediterranean	Eastern Anatolia	Aegean	Southeastern Anatolia	Central Anatolia	Black Sea	Marmara Region	
Region of residence	n	48	49	51	49	46	54	43	340
	%	14.12	14.41	15.00	14.41	13.53	15.88	12.65	100

In order to determine the test-retest study and criterion-dependent validity of the research, 112 participants were studied. Participants in the test-retest and criterion-dependent validity studies also participate in the CFA study.

Research Instrument and Processes

In order to be developed in the research, the IfNS was studied and used as a data collection tool. In addition, IfNS was used to determine the predictive validity of the Inspired by Nature Scale, which was desired to be developed.

Developing the Scale

When preparing the "IfNS," steps were taken to align with the scale development process. We reviewed the existing literature on how children perceive nature and identified the competencies teachers should possess to facilitate children's perception of nature. In this context, studies carried out in this field at home and abroad were examined, and expressions that could be used in the scale were determined. After receiving expert opinions on item expressions, the age group was determined primarily. Educational institutions where nature consciousness is presented formally; are schools. It was deemed appropriate to work with primary school children studying in primary school 1st, 2nd, 3rd, and 4th grades since primary school is the earliest period in which children's perception of being inspired by nature begins to form and it is possible to measure it (Avcı, 2019; Buo, 2021).

In another step, creating an item pool (Carpenter, 2018; DeVellis & Thorpe, 2021), a 45-item item pool was created, which also considers the affective characteristics of primary school children to determine their perceptions of being inspired by nature following their comprehension and grammar levels. The experimental form, consisting of 25 items, was submitted to the opinion of two experts working in the field of natural sciences, two from the field of Educational Sciences, who were knowledgeable in the subject area and were informed about the study subject in order to receive expert opinions. The candidate scale continued to be created by reflecting the experts' feedback on the scale. In order to get the opinions of the experts, a 3-point rating was used. In the prepared form, experts were expected to choose one of the options, "Suitable," "Should be corrected," or "Must be removed" for each item. Combining all expert feedback forms in a single form determined how many experts approved the possible options for each item. In this process, in line with the experts' opinions, the content validity of the items was determined by the content validity rate developed by Veneziano and Hooper (1997; cited in Yurdagül, 2005). The ratios in question were arranged by taking the ratio of the total number of experts who answered positively for each item to the total number of experts minus one. For the content validity indices of the items, the number of experts and the values of the obtained content validity rates were determined. Items with a content validity ratio of less than 0.80 were excluded from the study. On the other hand, in some articles, regulations that increase understanding are included in line with the calculations of the content validity ratios obtained. After these studies, a trial form consisting of 19 items was created. Participants were expected to express their perceptions on a 3-point Likert-type scale ranging from "Agree", "Neutral" and "Disagree."

After the item pool was completed, pilot applications were started to determine the scale items' intelligibility and

the average time it took to complete the answer. Ten from primary school 1st, 2nd, 3rd, and 4th-grade levels from a mixed group living in rural and urban areas; A pilot study was conducted with 40 children. While applying the "Inspiration from Nature Scale," practitioners read each item to the children individually and asked them to explain what they understood from each item. Items that were found to be poorly understood were rephrased. After the sample selection process, the scale was administered as a questionnaire. The validity and reliability of the scale were then determined through statistical analysis.

Data Analysis

The construct validity of the Inspired by Nature Scale was examined using exploratory and confirmatory factor analysis. Item analysis was conducted to determine the discrimination level of the scale items. The reliability of the measurement tool was assessed by calculating the Cronbach alpha and test-retest reliability coefficients. Correlations between scores obtained from the scale and the environmental attitude scale developed by Peker (2020) were examined to establish criterion validity. SPSS 25.0 and AMOS 24.0 statistical software packages were used for the analyses.

Ethic Consideration

The ethics committee approval of the research was obtained with the decision of the Necmettin Erbakan University Social and Human Sciences Scientific Research Ethics Committee, dated 28.10.2021, and numbered 7556.

Results

Exploratory Factor Analysis Results

Exploratory factor analysis was applied to explore the factor structure of the IFNS. The Kaiser-Mayer-Olkin (KMO) test is applied to test the suitability of the data structure in terms of sample size for factor analysis (Çokluk, Şekercioğlu, & Büyüköztürk, 2018). It has been stated that the data set cannot be factored for KMO ≤0.50 (Field, 2013). According to Tavşancıl (2005), the KMO value is a measure of sampling adequacy that ranges from 0 to 1, where values between 0.50-0.60 are considered bad, between 0.60-0.70 are weak, between 0.70-0.80 are moderate, and between 0.80-0.90 are moderate, while values above 0.90 are considered perfect.

A KMO value close to 1 indicates that the correlation model is compact enough to produce discrete and reliable factors (Surastina & Dedi, 2018). The KMO value was calculated as 0.86. It has been understood that the data structure is sufficient for factor analysis. The suitability of the data for factor analysis is determined by applying the Barlett Sphericity test. This test tests whether there is a significant difference between the actual correlation matrix and the unit matrix. The fact that the p-value of this test is below 0.05 shows that the matrix with the relations between the items is different from the unit matrix without the relations (Can, 2018). When the test results applied for factor analysis are evaluated, it is seen that the chi-square value (Barlett Sphericity ($\chi^2(465)$) = 4553.43; $p<0.001$) is significant. This result indicated that the data were suitable for factor analysis.

Factor analysis was carried out by applying the Principal Components Analysis method. Six factors with eigenvalues greater than one were formed. In the line graph formed as a result of the factor analysis, it was determined that the third point was the breaking point, and after this point, the training waist decreased somewhat. Accordingly, it was decided that the number of factors would be three, and the scale items were forced into three factors in the subsequent analysis. The factors in which the items were found were clarified using the Oblimax rotation method. 0.40 was determined as the cut-off point for factor loadings (Comrey and Lee, 1992). Items with low factor loading (M1, M3, M17) and loaded on more than one factor (M7, M12, M16) were excluded from the scale. As a result of repeated analyzes, it was observed that 13 items remained in the measurement tool. The factor loads of the scale items are given in Table 3.

Table 3. Values Obtained as a Result of Exploratory Factor Analysis

Item no	Factor loadings			Com*	Cor**	Initial Eigenvalues	% of Variance	Cronbach alpha
	1	2	3					
M18- I would like to have a lesson about plants and animals.	*0.73*	-0.03	0.10	0.55	0.45			
M4-I would like to go out in nature and observe insects and animals.	*0.66*	0.06	-0.26	0.51	0.47			
M19- Animal pictures in books attract my attention a lot.	*0.64*	0.12	0.03	0.42	0.40	2.97	23.85	0.75
M5- Instead of playing games on the computer. I would like to go to nature and watch insects.	0.62	0.12	-0.06	0.41	0.39			
M6- I examine an animal I see in detail.	*0.55*	-0.01	-0.22	0.40	0.36			
M2- Robots often look like animals.	-0.08	*0.76*	0.06	0.58	0.47			
M8- I think that vehicles and machines have similar aspects to living things in nature.	0.11	*0.73*	-0.16	0.57	0.51			
M14- The bucket part of the bucket truck. which is a construction machine. is similar to a human hand.	0.03	*0.65*	-0.06	0.43	0.43	1.81	14.92	0.78
M9- When I see a vehicle or machine. I think that it is inspired by living things in nature.	0.34	*0.65*	-0.07	0.54	0.45			
M11- I scream when a fly lands on me. (R)	-0.10	-0.10	*0.74*	0.57	0.50			
M10- I am afraid of animals and insects. (R)	-0.08	-0.20	*0.74*	0.59	0.51			
M13- If I see any butterfly or spider-like insect in our house. I will run away screaming. (R)	-0.04	-0.12	*0.67*	0.46	0.42	1.65	13.66	0.76
M15- I do not like to touch animals in nature. (R)	-0.08	0.27	*0.62*	0.47	0.36			

*Com= Communalities, **Cor= Corrected Item-Total Correlation, R= Reverse

As a result of the EFA, it was observed that the factor loads of the scale items took values between 0.55 and 0.76. The three-factor structure explained 52.43% of the total Variance. According to this value, approximately half of the hallucination variable was explained. This result indicated that the representative power of the items was high. The first, second, and third factors were named interest, bonding, and fear.

Exploratory Factor Analysis Results

According to the EFA results, the IFNS has a three-factor structure. Confirmatory factor analysis was applied to determine the compatibility of the three-factor structure of the measurement tool with the collected data. Analysis was performed using the Maximum Likelihood Estimation method. The fit values calculated for the three-factor model are given in Table 2.

Table 2. Calculated Accordance Values

Criterion	Good Fit	Acceptable Fit	Obtained Values	Resource
(χ^2/sd)	≤ 3	≤ 4-5	1.85	Byrne, 1989
RMSEA	≤ 0.05	0.06-0.08	0.05	Browne ve Cudeck, 1993
SRMR	≤ 0.05	0.06-0.08	0.06	
GFI	≥ 0.90	0.85-0.90	0.88	Tanaka and Huba, 1985 Jöreskog ve Sörbom,1984
AGFI	≥ 0.90	0.80-0.90	0.84	
CFI	≥ 0.95	0.90-0.94	0.96	
TLI	≥ 0.95	0.90-0.94	0.95	Bollen, 1989
IFI	≥ 0.95	0.90-0.94	0.96	

When Table 2 is examined, it can be seen that the three-factor structure of the Inspiration from Nature Scale is generally well-matched with the available data, according to the calculated fit value. This result indicates that the three-factor structure of the measurement tool has been confirmed. The three-factor model tested is shown in Figure 1. All path coefficients shown in the model are statistically significant at p<0.001 level (Table 3).

Table 3. Values Obtained as a Result of Confirmatory Factor Analysis

			β	SE	t
M18	<---	Interest	0.54		
M4	<---	Interest	0.65	0.26	6.24***
M19	<---	Interest	0.50	0.20	5.53***
M5	<---	Interest	0.50	0.25	5.54***
M6	<---	Interest	0.46	0.22	5.29***
M2	<---	Bonding	0.53		
M8	<---	Bonding	0.69	0.17	6.45***
M14	<---	Bonding	0.50	0.16	5.64***
M9	<---	Bonding	0.64	0.17	6.35***
M10	<---	Fear	0.66		
M13	<---	Fear	0.71	0.16	7.10***
M11	<---	Fear	0.52	0.10	6.37***
M15	<---	Fear	0.41	0.11	5.25***

***p<0,001

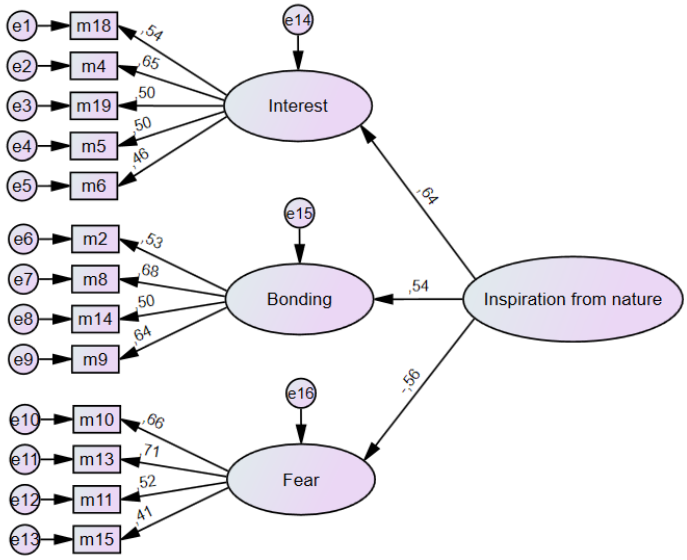

Figure 1. Confirmatory Factor Analysis Diagram, Chi-square=114.89, Df=62, p<0.001

Cronbach Alpha coefficients were calculated to determine the reliability of the IFNS. Values between 0.60-0.80 indicate that the measurement tool is highly reliable, and values between 0.81-1.00 indicate that the measurement tool is highly reliable (Özdamar, 2004). The alpha coefficients calculated for interest, bonding, and fear were 0.75, respectively, 0.78, and 0.76. The coefficients obtained showed that the internal consistency reliability of the measurement tool was at a sufficient level.

Item Analysis Results

The scale scores were ranked from highest to lowest to assess the discriminant validity of the measurement tool. Then, the participants with the highest scores (27%) were assigned to the upper group, and those with the lowest scores (27%) were assigned to the lower group. The groups' mean scores from each scale item were compared using the independent group's t-test (Table 4).

Table 4. Mean Scores by Lower and Upper Groups, Standard Deviations and Independent Groups t-Test Results

	Item no	Lower group (n=92)		Upper Group (n=92)		t
		M	Sd	M	Sd	
Interest	M4	2.20	0.87	2.89	0.40	6.97***
	M5	1.61	0.84	2.86	0.43	12.71***
	M6	1.96	0.88	2.91	0.32	9.84***
	M18	2.48	0.82	2.97	0.11	6.11***
	M19	2.16	0.94	2.94	0.13	8.53***
Bonding	M8	1.71	0.73	2.92	0.27	14.86***
	M9	1.54	0.64	2.91	0.26	19.08***
	M2	1.35	0.60	2.79	0.51	17.56***
	M14	1.76	0.86	2.96	0.21	12.95***
Fear	M10	1.09	0.28	2.74	0.55	25.38***
	M11	1.01	0.10	1.92	0.97	8.98***
	M13	1.04	0.21	2.74	0.61	25.16***
	M15	1.01	0.10	2.37	0.90	14.39***

***p<0,001

When the table is examined, it is understood that the mean scores obtained from the scale items show a significant difference according to the groups (p<0.001). The mean score of the upper group for each of the scale items is significantly higher than the mean score of the lower group. These results indicated that each of the thirteen items on the scale was distinctive.

Test-Retest Reliability Results

The IFNS was applied to the same group twice, with an interval of two weeks. Then, the correlation coefficients between the scores obtained from these two applications were calculated. The obtained correlation coefficients were accepted as reliability indicators. The high correlation coefficients calculated from the Test-Retest method show stability between the scores obtained from the two applications (Tavşancıl, 2005). In order to obtain a total score from the scale, the items in the "Fear" dimension must be reversed. The correlation coefficients calculated in this study are given in Table 5.

Table 5. Pearson Correlation Coefficients of the Relationship Between First and Last Application Scores

Test	Implementation	N	M	Sd	r
Interest	First	112	2.38	0.32	0.64*
	Last	112	2.58	0.45	
Bonding	First	112	2.20	0.62	0.69*
	Last	112	2.46	0.55	
Fear	First	112	1.91	0.60	0.72*
	Last	112	1.68	0.71	
Total score	First	112	2.70	0.39	0.73*
	Last	112	2.46	0.43	

*p<0,05

When the table is examined, it is understood that despite a specific time difference, the average scores obtained from the first and last applications are close. The first and final application scores for interest (r=0.55, p<0.05), attachment (r=0.54, p<0.05), fear (r=0.72, p<0.05), and aggregation (r=0.73, p<0.05) have moderate to high correlations. The results obtained showed that the measuring instrument had a stable structure.

Criterion Validity Results

A criterion validity study was carried out to ensure the Inspiration from Nature Scale's external validity and determine its degree of serving its purpose. In this direction, the scale of being inspired by nature and the scale of attitude towards the environment was applied to the participants in a single session. The environmental Attitude Scale (Peker, 2020) was developed to measure primary school students' attitudes toward the environment. It consists of a total of 15 items. The scale scoring was designed as a 3-point Likert (with options agree-, partially agree, and disagree). The relationships between the scores obtained from the scales were calculated and examined (Table 6).

Table 6. Pearson Correlation Coefficients of the Relationships between Inspiration from Nature Scale Scores and Environmental Attitude Scale Scores

Variables	Attitude towards the environment
Interest	0.55**
Bonding	0.42**
Fear	-0.38**
Total Score	0.47**

**p<0,01; N=50

When the table is examined, it is understood that there are moderate positive and negative relationships between environmental attitude scores and interest (r=0.55; p<0.01), bonding (r=0.42; p<0.01), fear (r=-0.38; p<0.01), and total (r=0.47; p<0.01) scores. As the positive attitudes towards the environment increase, the total scores of interest, bonding, and scale increase while the fear score decreases. The results showed that the external validity of the IFNS was provided, and the scale served its purpose.

Discussion, Conclusion and Recommendations

Since the scale aims to measure taking from nature as a whole, it aims to measure the sub-dimensions of interest in being inspired by nature, linking nature with technological structures, and fear of structures in nature. Regarding student success, one of the first factors that come to mind is interest (Demir & Kılıç, 2010; Ilgar, 2004). J. Holland considers a person's interest and desire for any profession as a reflection of that individual's personality (Holland, 1997). Personality traits and professional interests are two crucial, non-cognitive areas of individual differences in psychology. Spiritual qualities are important because they influence many outcomes associated with work and life success (Mount et al., 2005). Namely, it affects the choices about which tasks and activities individuals will perform, how much effort they should put into these tasks, and how long they should stay (Uğur & Devcar, 2018). For this reason, students' ability to be inspired by nature is closely related to their interest in structures related to nature.

The second sub-dimension of the Inspiration from Nature Scale links nature and technological structures. Connecting is a prerequisite process for meaningful learning and discovery. Meaningful learning is an educational-scientific concept expressing the ability to connect, articulate, associate, appropriate, update and use new information with existing information to acquire knowledge. Thus, meaning; is a result of the relationship between ideas, events, concepts, and objects (Ausubel, 2000). Suppose the student is not aware of this relationship. In that case, he cannot integrate and connect what he has learned with the old knowledge in his mind, or if there is not enough knowledge and experience in mind to establish a relationship between them, it is not easy to achieve meaningful learning. For this reason, being inspired by nature and connecting with the structures in nature and technology were considered essential sub-dimension. The sub-dimension of connecting nature and technological structures was included in this scale.

It is necessary not to be afraid of nature and elements such as insects, animals, and plants in nature to be interested in being inspired by its structures and to establish a connection between technological structures and elements in

nature. Ecophobia has taken its place in the literature in the sense of fear of the natural world (Kaşot, 2014). Ecophobia, called fear of nature, also means the fear of deterioration in natural life and ecological disaster (Kocalar, 2015). Entomophobia/arachnophobia is also the fear of insects and is considered among the most severe psychological problems that require treatment (Shahriari-Namadi, Tabatabaei, & Soltani, 2018). In the modern world, especially people living in cities, their contact with nature is minimal. The disconnection of people from nature threatens society's future and nature's future. Today, ecophobia is beginning to emerge in primary school children (McKnight, 2010). Children can only see plants, insects, and animals in nature on television, the internet, or in books. This causes children to stay away from nature and to be afraid (Sobel, 2014). For this reason, while measuring the features related to being inspired by nature, it was also desired to determine the issues related to fear of nature.

Reliability analyses of the scale were performed using Cronbach Alpha, item analysis, and test-test-retest. Cronbach's Alpha values were .75 for the concern dimension, .78 for the bonding dimension, and .76 for the fear dimension. The item analysis results based on comparing the lower and upper 27% slices showed that they significantly separated the two groups from each other in the context of all items. Tezbaşaran (2008) states that a scale that distinguishes the lower and upper groups from each other meaningfully is reliable in terms of discrimination. The results obtained from the test-retest method indicate that the reliability of both measures of the test was similar and positively correlated. The obtained correlation values vary between .54 and .73. All three of the methods used to test the reliability show that the reliability values of the IFNS are high. The validity and reliability features of the scale were tested with different techniques; it provided controls with multiple measurements and strengthened the scale's psychometric properties. These psychometric properties indicate that the IFNS is a valid and reliable measurement tool.

The construct validity of a scale is essential in terms of being able to be used scientifically and revealing the feature it wants to die for in wholeness (Büyüköztürk, 2018). The construct validity of the IFNS was calculated, and the sub-dimensions of interest in being inspired by nature 5; It was observed that the sub-dimension of establishing a connection between nature and technological structures and fearing the structures in nature consisted of 4 items. According to the EFA results of the scale, the total explained variance rate was determined as 52.43%. In the total Variance explained, the dimension of interest in being inspired by nature was 23.85%; Making a connection between nature and technological structures contributed 14.92%, and the sub-dimension of fear of structures in nature contributed 13.66%. The fit indices values obtained as a result of the CFA performed showed that the structure reached by the EFA was confirmed and worked similarly in a different data set. For example, Gupta & Geetika (2020) stated that 53.679% explained total Variance was sufficient in the Academic Self-Handicapping Scale they developed. Accordingly, it can be said that the factor loads explained by the sub-dimensions of IFNS are sufficient. It can be said that these values are sufficient to create a structural whole between the sub-dimensions of a scale and the whole (Büyüköztürk, 2018; Orçan, 2018).

In order to determine the criterion validity of the scale, the significant relationships between the total score of the "Attitudes towards the Environment Scale" (Peker, 2020) and the sub-score and total score of the IFNS were examined. In the findings obtained, the scale items showed highly distinctive features; This measurement tool was

reliable, highly stable, and valid. Considering all these examples, it can be said that the IFNS is a reliable scale. The validity and reliability values obtained from the analysis results and both the explained variance rates, factor scopes, and reliability coefficients reached as a result of the scale studies in the literature (Büyüköztürk, 2018; Erkuş, 2012; Deniz, 2007; Orçan, 2018) indicates that it is a measurement tool. The validity and reliability of this measurement tool can be tested in different samples. An interdisciplinary education form can be developed to develop students' attitudes of being inspired by nature by evaluating the results of the three sub-factors of the scale, namely, interest in being inspired by nature, linking nature and technological structures, and fear of structures in nature. The IFNS can be used as an assessment tool in biomimicry education. It is a preliminary preparation for the biomimicry training to be applied to improve the levels of inspiration from nature starting from primary school and an assessment tool throughout the process.

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Doğadan İlham Alma Ölçeği (Inspiration from Nature Scale-Turkish Form)

Sevgili öğrenciler,

Aşağıda bitki ve hayvanlarla ilgili düşüncelerinizin yer aldığı bazı cümleler vardır. Bu cümlelerin kesin doğru ya da yanlış cevapları yoktur. Cümlenin karşısındaki hangi ifade size uygunsa onu işaretleyiniz. Görüşleriniz özellikle sizin görüşünüz olmalıdır. Bu yüzden aile ve arkadaşlarınızın görüşleri sizi etkilemeden kendinize uygun durumu işaretleyiniz. Cevaplarınız bir bilimsel araştırma için kullanılacak olup hiç kimseye gösterilmeyecektir. Sorunuz olursa öğretmeninize sorunuz. Cümleleri acele etmeden dikkatlice okuyup işaretleyiniz. Katkınız için teşekkür ederim.

		Katılıyorum	Kararsızım	Katılmıyorum
1.	Bitki ve hayvanlarla ilgili bir dersim olsun isterdim.			
2.	Doğaya çıkıp böcek ve hayvanları gözlemeyi isterim.			
3.	Kitaplarda hayvan resimleri çok dikkatimi çeker.			
4.	Bilgisayarda oyun oynamak yerine doğaya gidip böcekleri izlemek isterim.			
5.	Gördüğüm bir hayvanı ayrıntılı incelerim.			
6.	Robotlar genellikle hayvanlara benziyor.			
7.	Araç ve makinaları doğadaki canlılara benzer yönleri olduğunu düşünürüm.			
8.	İş makinesi olan kepçenin kürek kısmı insan eline benzer.			
9.	Araç ve makinaları doğadaki canlılara benzer yönleri olduğunu düşünürüm.			
10.	Üzerime sinek konduğunda çığlık atarım.			
11.	Hayvanlardan ve böceklerden korkuyorum.			
12.	Evimizde herhangi bir kelebek, örümcek benzeri bir böcek görsem bağırarak kaçarım.			
13.	Doğada hayvanlara dokunmaktan hoşlanmam.			