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Research Article

Adaptation of "Trust in Science and Scientists Scale" into Turkish: Validity-Reliability Study*

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Abstract- This study investigates the validity and reliability of the scale which was obtained by adapting the "Trust in Science and Scientists Inventory" developed by Nadelson et al. into Turkish simplified for middle school students to understand. As a result of the Exploratory Factor Analysis, the total variance accounted for by the two-factor scale containing a total of 16 items was found 57.442%. Cronbach α values were used to calculate the internal consistency of the factors (0.928 and 0.814, respectively). The Cronbach α internal consistency coefficient for the whole scale was calculated as 0.822. Then, Confirmatory Factor Analysis suggested that the two-factor model was compatible with the data. The results of the study show that the scale adapted into Turkish is a valid and reliable educational measurement tool for middle school students.

Key words: trust, trust in science, trust in scientists, scale adaptation.

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Introduction

Science is a cognitive quest to find the truth and explain the phenomenal world: It is a process of trial and error based on the criterion of consistency and error clarification (Yıldırım, 1999). This process involves the formation, accumulation and interpretation of scientific knowledge. The journey of science begins with thinking and curiosity. Scientists generate knowledge through observation and experimentation to understand what is happening around them. This information is tested with other experiments, observations and ideas. Weak hypotheses are discarded and the views that best align with the evidence with evidence are strengthened, thus advancing science.

Trust in science refers to public confidence in scientists and their work, which produces knowledge with meaningful implications for people's future well-being. People who are not engaged in science have limited knowledge/understanding of science, and therefore they trust or distrust science (European Federation of Academies, 2019). The formation of trust in science in society enables scientific knowledge to gain function in daily life. In other words, applying science is closely related to people's trust in science and scientists. A sense of trust in science can help people think critically (taking science into account) when making decisions and acting in all aspects of their lives. It is one of the possible ways if people understand how scientific knowledge is produced and how science works.

Trust significantly influences the perception of science-related topics (Dunn & Schweitzer 2005; Romano, 2003) such as genetically modified foods (Broughton & Nadelson, 2012), climate change (Dunlap & McCright, 2011), vaccines (Keelan et al., 2010) and potentially biological evolution (Smith et al., 1995). Increasing students' trust in science is considered as an important target in teaching socio-scientific issues (Sadler et al., 2007). Without trust in science, societies and governments are in danger of making decisions based on (partially) informed opinions and not on scientific evidence (European Federation of Academies, 2019). Societies that do not trust science cannot develop in areas such as medicine, technology and education that improve the quality of life.

The literature review shows that science is facing a crisis of public trust (Ertürk, 2018; Weingart, 2002; Cobern et al., 2022; Rowland et al., 2022). It is thought that controversial issues such as different comments by scientists about natural disasters after the earthquake in Turkey in February 2023, anti-vaccination sentiment, which reappeared on the agenda with the COVID-19 pandemic, and the impact of human and economic factors on climate change reduce people's trust in science and scientists. Considering the rational and objective dimensions of science, as well as those including value judgment, creative fantasy, and even sensuality (Yıldırım, 1999), there may be many concepts affecting trust/distrust in science.

The ever-evolving, unlimited, multifaceted and wide-ranging nature of science (Soslu, 2021) has brought controversial issues to the agenda. Examples include technology and space exploration, evolution, climate change, the use of energy resources, and whether vaccines are effective and safe. Differences of opinion among scientists, especially on socio- scientific issues, have affected the public trust in science and scientists. For example, after the earthquake in Turkey on February 6, 2023, which caused great loss and reminded Turkey of the reality of disasters, the robustness of buildings was discussed, and different comments by scientists regarding the predicted Istanbul earthquake drew attention. When scientists put forward different opinions on similar issues, it may undermine public trust (Ertürk, 2018). In this case, it would be useful to help the public understand the origins of differing opinions and how they can work.

Due to the nature of science, disagreements are likely to occur because scientists may focus on different samples and aspects when working on the same topic, or their ability to interpret scientific data may vary due to their experience. We can think of this diversity as richness, like the variation in biology that occurs when different genes are combined to protect against diseases carried by recessive genes. Changing perspective is like interpreting the same painting differently. Where you look from changes the picture you see.

In solving complex problems, new and creative ideas can be generated through interdisciplinary collaborative studies by bringing together scientists with different areas of expertise who can examine problems from different perspectives (Weeks et al., 2004). There are many examples of the drastic impact of collaboration, such as the successful development of the human papillomavirus vaccine and the discovery of the causative agent of severe acute respiratory syndrome (Abraham, 2004; Kreimer et al., 2011). Productive scientific work environments can be established through collaboration and cooperation. The power that holds a productive team together is that team members work honestly and openly and trust each other. Bennett et al. (2010), while describing the characteristics of an effective team, emphasize the importance of trust among team members and argue that it is necessary to support differences of opinion in case of disagreement.

Another concept that we think can reduce trust in science is information pollution (info pollution). Science reaches society through different communication channels such as education, schools, scientific publications, internet, television and media. The advancement of science and technology has increased human-induced risks, and such increased risk has led to distrust in general, which has shaken people's trust in science (Ertürk, 2018). Today, with the discovery of the ability to store information and the power of the internet, access to information has become much easier. However, it has gained importance to distinguish the correct and useful information from the rest. Similar to going blind when exposed to too much light, it may be possible for excessive stimuli can devalue or render a stimulus unrecognizable. In addition, the risk of info pollution due to false statements may reduce trust as information can be shared on the internet without being censored. What is important is that people need to learn how to access reliable information by evaluating their information sources. For this reason, they should be taught critical thinking skills and scientific literacy. Critical thinking and science literacy play an important role in the process of finding reliable information. Critical thinking is a way of thinking that includes skills that require questioning. Science literacy is the ability to understand and apply the scientific method. These skills help individuals to distinguish misleading information in the process of finding reliable information (Kurt & Kürüm, 2010).

The 2002 report of the European Molecular Biology Organization (EMBO), which was founded in 1964 by the leading scientists of Europe in the field of Life Sciences, includes views on how science can produce and communicate reliable information. Weingart (2002) mentions three major problems that can undermine trust in scientific authority, which are the growing influence of politics on science, the increasing commercialization of science, and scientists using the media to gain public support for their research. The report describes examples of changing perspectives on science and scientists as a result of the close interactions between science, politics and the media. It mentions that some groups invite scientists to public hearings to protect their positions and interests in politics and economics and that scientific expertise is used to prove the views of the parties on issues such as nuclear energy, vaccines, biotechnology in agriculture, the relationship of the Genome Project with ethical values and economics, which causes the public to question the trust in science. On the other hand, it argues that scientists must use the media to find funding for their research and that the current system compels them to provide commentary on finding solutions to various issues or cures for different diseases to draw attention to their studies.

As the COVID-19 pandemic continues to affect the world, there has been an increase in the number of people who are against vaccines due to concerns such as potential side effects of vaccines and concerns about possible long-term damage to the body caused by the substances contained in them (Ataç & Aker, 2014). In February 2020, the Director- General of the World Health Organization warned the public that we were facing an "infodemic" of conspiracy theories generated by the circulation of many false news about the pandemic and the rapid spread of these news (Akkurt, 2022). Infodemic can be defined as information overload that invariably includes false or unreliable information, people's inability to access reliable and accurate information, and the rapid spread of prejudice and misinformation (Gölbaşı & Metintas, 2020). At this point, one should not believe every piece of information. Blindly trusting without questioning is as risky as distrusting science, as both prevent critical thinking. Students should learn to distinguish when to question emergent and uncertain scientific contexts and when and why one should place trust in science (Bryce & Fraser, 2014; Fensham, 2014).

Cobern et al. (2022), in their study of the reliability of science with about 500 undergraduate students studying teaching at a Midwestern State University, concluded that most students accepted science as unquestionably true and that almost all of them acknowledged the tentative nature of science, regardless of what they thought about controversial issues. However, they found that many students were not willing to say that they trusted scientific knowledge. When students were asked why science was not trustworthy, the common response was that scientific knowledge is subject to change and revision. As a requirement of science, it should be accepted that new views are suggested over time, that previously established truths may change in the light of new data, and that should not be considered as "contradictions" (Badur, 2021).

Covitt and Anderson (2022) distinguish uncertainty from unreliability. They argue that a critical goal of science education is to teach students that science is uncertain and limited, as well as how it can be used as a helpful tool for making decisions about socio-scientific issues. Resolving uncertainties in science, making sense of uncertainties and conducting research to address them contribute to the development of science. It is essential to raise individuals who believe in the capacity of science in solving problems such as environmental pollution, destruction of natural areas through concretion, global warming, drought, protection of biodiversity, and who think, take responsibility, do not harm the environment and strive to be citizens who are science literate.

While the issue of trust remains on the agenda, there is a need for scales to measure trust in science and scientists. When Nadelson et al. (2014) reviewed the literature on trust in science, they realized that there was no scale to assess students' trust in science and introduced the Trust in Science and Scientists Inventory. The Trust in Science and Scientists Inventory scale has been previously used by six researchers: Nadelson and Hardy (2015) examined the relationship between trust in science and scientists and acceptance of evolution; Kingsley and Van Kranendonk (2017) investigated the impact of science teaching through social activities on students' understanding, attitudes and perceptions of science; Blankenship and Stewart (2019) reviewed the themes of gender and identity in the context of voting and trust in the 2016 presidential election in the USA; MacDonald et al. (2020) used it in their study on public opinion on the practice of controlling insects for the protection of biodiversity; Krüger et al. (2022) selected and applied certain items of the "Trust in Science and Scientists" scale developed by Nadelson et al. (2014) while measuring the level of trust in science among secondary school students (average age 17) in Germany; and finally, Esen and Alkış Küçükaydın (2022) made the adaptation study of this scale for undergraduate students in Turkey. Nadelson et al. (2014) recommended that in future studies, necessary adjustments should be made to ensure the use of this scale they developed with students at different educational levels. Responding to this call, we aim to adjust the relevant scale at the level of middle school students as we believe that the trust developed in childhood can affect decision-making behaviors in adulthood.

In Ericson's theory of psychosocial development, the first of the eight developmental stages that people experience is a sense of basic trust versus distrust. The first step to reach the other developmental stages for a healthy state of mind is to acquire a sense of basic trust, which enables people to have a positive sense of self. Individuals with high self-perception have realistic expectations from the future. They stick by their decisions and ideas, take responsibility and assume the consequences of events (Çam et al., 2017). It can be a key step to reveal both the current status and the variables affecting trust in science to measure middle school students' trust in science as well as self-confidence in middle school ages, where self-perception is shaped. In this context, our study aims to evaluate the validity and reliability of the scale developed by Nadelson et al. (2014) for undergraduate students by simplifying and adapting its original version in English (Trust in Science and Scientists Inventory) to Turkish in a manner understandable for middle school students. Esen and Alkış Küçükaydın (2022) have adapted this scale into Turkish for use in studies with pre-service teachers. The most significant difference between our study and theirs is the sample group. The scale has been adapted for use at the middle school level.

Nadelson et al. (2014) pointed out that the original scale they developed, targeting undergraduate students, might be limiting for subsequent studies. They suggested that necessary adjustments be made for future studies to ensure the applicability of the scale to students at different educational levels. They emphasized the need to test the suitability of the scale for students from primary school to secondary school, simplifying some parts of the language used in the scale to align with the experiences of K-12 students and their level of knowledge. The sample of the study was determined by taking into account the authors' suggestion, and through the pilot implementation, the scale was simplified to match the age, knowledge, and experiences of the students. Explanations for two terms that students found unfamiliar in the scale were added to the beginning of the scale as a mini-dictionary. All these measures set our study apart from others.

In the context of uncovering factors influencing trust, Esen and Alkış Küçükaydın (2022) have proposed revealing the relationship between the trust of different age groups in science and scientists and their ideological structures. Considering these suggestions, it is believed that adapting the scale to different age groups will contribute to the field.

In this context, the following questions were sought to be answered in our study.

During the adaptation of the Trust in Science and Scientists Inventory into Turkish,

a) Has linguistic equivalence been achieved between the Turkish version and the original?

b) What is the factor structure of the Turkish adaptation of the scale?

c) Does the measurement model with factor structure fit the data?

d) Is the adapted scale a valid and reliable one that can be used in the field of education?

Method

In this study, we aimed to conduct validity and reliability studies of the Turkish version of the Trust in Science and Scientists Inventory. Considering the previous studies on the scale we were working on, we understood that some items were chosen and applied without assessing the overall structural validity in prior applications of the scale. For this reason, it was found necessary to first investigate the structure of the scale. There are basically two approaches in factor analysis. The first one is "Exploratory Factor Analysis (EFA)", which aims to reveal and discover the factor structure underlying the statements representing the variables of a newly developed or translated scale. The other one is "Confirmatory Factor Analysis (CFA)", which checks the conformity of a previously employed scale to the original factor structure when used in the current research (Suhr, 2006). In our study, exploratory factor analysis was first applied to determine the scale structure and then CFA to test the compatibility of the structure with the data. SPSS 15.0 and AMOS 22.0 programs were used in the statistical procedures.

Study Sample

The sample of this study consists of student groups studying at the fifth, sixth, seventh and eighth grade level of middle school in the academic year of 2022-2023. These groups include 20 students with whom we conducted a trial application of the scale translated into Turkish, 16 students with whom we tested the linguistic equivalence of the translated text, 290 students with whom we obtained exploratory factor analysis data, and finally 298 students for confirmatory factor analysis. The groups were determined by convenience sampling method. It refers to a process that starts from the most accessible participant and continues until it reaches the required size or all participants who can be reached in the available period (Cohen et al., 2007). While defining the sample size, the rule of at least 10 participants for each variable (Cohen & Cohen, 1983) was taken into consideration. Text begins as a new paragraph.

Data Collection Tool

In this study, the "Trust in Science and Scientists Inventory" developed by Nadelson et al. (2014) for undergraduate students was adapted into Turkish by simplifying it to be convenient for middle school students. The original scale has a unidimensional structure (Cronbach's alpha 0.86) consisting of a total of 21 items (9 positive and 12 negative) on a five point likert type. The "Trust in Science and Scientists Inventory" scale has been previously used in different forms by six researchers:

- Nadelson and Hardy (2015), in their study investigating the relationship between trust in science and scientists and acceptance of evolution, used the unidimensional "Trust in Science and Scientists Inventory" scale consisting of 21 items ($\alpha = .86$)

- Kingsley and Van Kranendonk (2017), in their study measuring the effect of science education on science understanding, attitudes and perceptions through social activities they designed, selected 11 items from the "Trust in Science and Scientists Inventory" scale and applied them in five point likert type.

- Blankenship and Stewart (2019), in their study reviewing the themes of gender and identity in the context of voting and trust in the 2016 presidential elections in the USA, used a seven point likert-type measurement tool that they created by selecting 10 items from the "Trust in Science and Scientists Inventory" scale (α = .92).

- MacDonald et al. (2020) used six items selected from the "Trust in Science and Scientists Inventory" scale on a seven point likert type in the trust aspect of their study in which they investigated public opinion on the practice of controlling insects for the protection of biodiversity.

- Krüger et al. (2022) wanted to use the 21-item "Trust in Science and Scientists Inventory" scale developed by Nadelson et al. (2014) in their study investigating the level of trust in science among secondary school students (average age 17) in Germany, and adapted the scale, which is valid and reliable at the level of undergraduate students, to the German language at the secondary school level. They pointed out that the scale was previously applied by selecting certain items without testing its general content structure, and therefore they investigated the construct validity of the scale. They determined that the scale had a two-dimensional structure and preferred to use the factor consisting of items 7, 9, 10, 11 and 12 of the original scale in a five point likert type and did not mention the information of the other factor they found.

- Esen and Alkış Küçükaydın (2022) made the adaptation study of this scale for undergraduate students in Turkey. They found a two factor structure consisting of 10 items after the adaptation. They named these factors "trust in science" and "trust in scientists".

Stages of Adapting the Data Collection Tool into Turkish

The study was initiated after encountering the "Trust in Science and Scientists Inventory" as a result of the literature review conducted after the awareness of the importance of trust in science. In order to translate this scale into Turkish, firstly, the author Nadelson was contacted via e-mail and the necessary permissions were obtained from him for the adaptation of the scale. In addition, ethics committee approval was obtained first from the institution to be applied and then from the institute of educational sciences of a university to apply the scale to students during and after the adaptation phase. During the translation of the scale into Turkish, the reverse translation method was used. A translation team consisting of language and field experts was formed to translate the scale, whose original version is in English, into Turkish, the target language. The team members and the procedures performed are as follows:

1) The team includes four experts in English: Two specialized English teachers working in a high school and a middle school affiliated to the Ministry of National Education, a graduate student from a university providing education in English, who is doing their PhD in the US, and a translator who also graduated from the same university

2) The team had three linguists in the field of Turkish: A faculty member working in the Department of Turkish Education and two specialized Turkish teachers working in a middle school affiliated to the Ministry of National Education.

3) The team had two Science experts: A faculty member working in the Department of Science Education and an expert science teacher working in a middle school affiliated to the Ministry of National Education.

First, three English language experts independently translated the original scale into Turkish. The three translations obtained were reviewed by Turkish language experts, and it was checked whether there were any differences in meaning in these translations, and all three translations were found to be close to each other. Turkish language experts came together to determine the sentences that most clearly and fluently described the statements in the scale. At this point, the opinions of science experts on language and content specific to the field were also taken into consideration, and thus the draft scale was established. The draft scale was also checked by language experts in terms of punctuation marks and adjusted as needed. Its face and content validity were ensured as a result of the arrangements made by taking expert opinions into consideration and it was applied to a total of 20 students (10 male and 10 female), five students from each of the fifth, sixth, seventh and eighth grade levels, and the students were asked to indicate any expressions they had difficulty understanding. According to the feedback received from the students, it was found that the students did not know the meaning of two scientific terms (hypothesis and theory) and one word (ethics). In addition, it was noticed that using synonyms of words in some expressions would make it easier for students to understand them (For example, the expression "go against" was preferred instead of "contradicting"). Based on the trial application, a glossary was added to the introduction of the scale and three words (hypothesis, theory and ethics) that the students did not know were briefly explained. During the preparation of the glossary, help was obtained from science experts in explaining the words that have the meaning of scientific terms. The terms were explained in the simplest form suitable for middle school students. After the necessary adjustments were made, the final version of the scale was translated back into English, the original language of the text, by a translator, and the reverse translation was compared with the original scale by foreign language experts, and it was seen that there was no difference in meaning between the two. Finally, the Turkish text and the original scale were applied to 16 middle school students who were fluent in both English and Turkish at three-seven-day intervals and the correlation between the findings was analyzed. Thus, the linguistic equivalence of the scale was tested and the translation into Turkish was finalized. The Turkish version of the "Trust in Science and Scientists Inventory" scale is a five-point Likert-type scale consisting of a total of 21 statements, 12 negative and 9 positive, as in the original scale. The scale, again as in the original, includes "Strongly Disagree", "Disagree", "Neutral", "Agree" and "Strongly Agree" options indicating the degree of agreement/disagreement with the attitude object covered by the statements.

Data Collection

The adapted version of the scale was applied online to 290 middle school students during the 2022-2023 academic year via a Google Form Application over a period of four weeks. The scale structure, derived from the exploratory factor analysis results, was also administered to 298 students using the same method.

Data Analysis

The Turkish scale was used in a five point likert type as in the original scale. The students in the group participating in the study marked one of the options "Strongly Disagree", "Disagree", "Neutral", "Agree" and "Strongly Agree" for the statements in the scale, thus reporting their degree of agreement/disagreement with the attitude object covered by each statement. Scoring of the scale items is as follows in Table 1.

Table 1 Scoring Key of the Items in the Adapted Scale

Option	Positive Statement Score	Negative Statement Score
Strongly Disagree	1	5
Disagree	2	4
Neutral	3	3
Agree	4	2
Strongly Agree	5	1

The score a student gets from the scale is the sum of the scores they get from the items in the scale. Since the scale we are working on consists of 21 items, the range of points that students can get from the scale will be between 21 and 105.

Findings

Linguistic Equivalence

In the process of quantitatively reviewing linguistic equivalence, it is necessary to reach a sample group that is fluent in both the target and source languages to make statistical applications (Seçer, 2015). The original form and the Turkish form were applied to 16 middle school students who were found successful in English and Turkish lessons by their teachers at their schools, with an interval of three to seven days. Then, a paired samples t-test was conducted to determine whether there was a significant difference between the total scores in the measurements obtained from the applications. The rank difference correlation coefficients and t-test results calculated over the item total scores for the forms in different languages are given in Table 2. In this section, research findings should be explained by benefiting from related literature.

Table 2 Total Score Statistics from Turkish and English Forms

Paired Sample Statistics					
		Mean	*N*	Standard Deviation	Mean of Standard Errors
Pairing 1	Turkish	80.5000	16	10.17186	2.54296
	English	79.3125	16	10.26138	2.56534

Paired Samples Test Paired Differences								
				95% Confidence Interval for the Difference				
	Mean	Standard Deviation	Mean of Standard Errors	Upper	Lower	*t*		*p*
Pairing 1 Tr- Eng	1.18750	6.99732	1.74933	-2.54111	4.91611	.679	15	.508

According to Table 2, the mean scores, standard deviation and error values of the forms in different languages were remarkably close to each other. A high correlation was found between the total scores obtained from the forms (r: 0.765). There was no significant difference between the arithmetic averages (p>0.05). Based on these data, it was accepted that linguistic equivalence between the original form and the translation was achieved.

Normality Analysis of Data Set

One way to check whether the distribution of data conforms to the normal curve is simply to create a histogram and look at the overall shape of the distribution. Another way is to perform skewness and kurtosis tests or a general test that measures the normality of the distribution, such as the Shapiro-Wilk and Kolmogorov-Smirnov tests (Cohen et al., 2021). The normality analysis of the 290 sets of data to be used in the exploratory factor analysis was carried out in four stages:

1. Analysis of skewness and kurtosis values,
2. Dividing skewness and kurtosis values by standard error,
3. Checking extreme values,
4. Performing Shapiro-Wilk and Kolmogorov-Smirnov tests.

In normal distributions, the measures of skewness and kurtosis are zero. In positive sciences, it is possible for data to show a normal distribution. However, especially in social sciences and educational research, it is accepted that these values are close to zero. As these values move away from zero, so does the distribution from normality. For a distribution to be "normal" at an acceptable level, skewness and kurtosis values should be between -1.00 and +1.00 (Büyüköztürk et al., 2011; Hair et al., 2013).

Table 3 Distribution of Data

Data	Statistics	Standard Error
Skewness	-.192	.143
Kurtosis	.174	.285

According to Table 3, the skewness (-.192) and kurtosis (.174) values of the data are in accordance with the normal distribution. The other condition for a normal distribution is that the value found by dividing the skewness and kurtosis values by the standard error should be between -1.96 and +1.96 (Büyüköztürk, 2015). Accordingly, when Table 3 is analyzed, the values found (-0.192: 0.143= - 1.342; 0.174: 0.285= 0.61) show that the data have a normal distribution. When the extreme values were checked (histogram, graph showing deviations from normal and box plot), it was understood that a data with the lowest score value was an extreme value.

Table 4 Normality Analysis Test

	Kolmogorov-Smirnov			Shapiro-Wilk		
	Statistics	df	Sig.	Statistics	df	Sig.
Total	.046	290	.200*	.993	290	.193

The normality analysis test results applied to the data set are as shown in Table 4. Shapiro-Wilk test when the group size is smaller than 50 and Kolmogorov-Smirnov (K-S) test when the group size is larger are the two tests used to analyze the normality of the scores. Since the statistical null hypothesis in the analysis is "the distribution of the scores does not differ significantly from the normal distribution", a p value greater than .05 is interpreted as the scores do not deviate significantly (excessively) from the normal distribution at this significance level and are in conformity (Büyüköztürk, 2015). Here, the p value in the Kolmogorov-Smirnov test is greater than .05 (p= .200> .05). When the Kolmogorov-Smirnov test result, skewness and kurtosis values and the graphs drawn were interpreted, it was understood that the data set met the normal distribution criteria. For this reason, it was deemed appropriate to conduct exploratory factor analysis without removing the extreme value found from the data set.

Construct Validity

The construct validity of the Trust in Science and Scientists Scale Inventory was reviewed. In order to decide whether the data were fit for factor analysis, Kaiser- Meyer-Olkin (KMO) coefficient was calculated, and Bartlett's test of sphericity was applied. Furthermore, to conduct factor analysis, the KMO coefficient must be greater than 0.60 and Bartlett's test of sphericity must be significant ($p<0.05$) (Cohen et al., 2021).

Table 5 Data on the Suitability of the Scale for Factor Analysis

Kaiser-Meyer-Olkin (KMO) Sample Measurement Adequacy		.895
Bartlett Test	Chi-Square Value	2400.356
	df	120
	Sig. (p value)	.000

In Table 5, the KMO coefficient value is 0.895, which indicates that the sample size is sufficient for principal component analysis. When the KMO value is calculated as 0.80 and above, sampling adequacy is interpreted as excellent (Sipahi et al., 2006; Nakip, 2006). The result of Bartlett's test of sphericity is significant ($x^2_{(120)}$ =2400.356; $p < 0.05$).

Factor analysis is used to see whether the items in a scale are divided into fewer factors that exclude each other, that is, for item reduction. Thus, the items measuring the same factor are gathered together and the group formed is given a name based on the content of the items (Balcı, 2022). During the analysis, if there is a correlation between the factors, the oblique rotation method should be selected, and if the factors are not related, the orthogonal rotation method should be employed (Güngör, 2016). In this study, Direct Oblimin method, one of the oblique rotation methods, was used in principal component analysis since the factors were thought to be related.

Each factor is expected to account for at least 5% of the total variance in the scale (Seçer, 2015). Kaya (2013) suggests that in cases where an item shows strong correlation in more than one factor, items with a difference of less than 0.10 between two factors should be removed from the scale. Based on this information, when the overlapping items (items 3, 4, 8, 13 and 18) were removed from the scale, it was seen that the items were grouped under two factors that complied with the rule of accounting for at least 5% of the total variance. Factors have an eigenvalue which is found by summing the squares of the loads of all variables on each factor. Factors with an eigenvalue greater than 1 are considered significant (Yaşlıoğlu, 2017). The Scree Plot graph generated shows the eigenvalues. Figure 1 indicates that the scale items are grouped under two factors with eigenvalues greater than one.

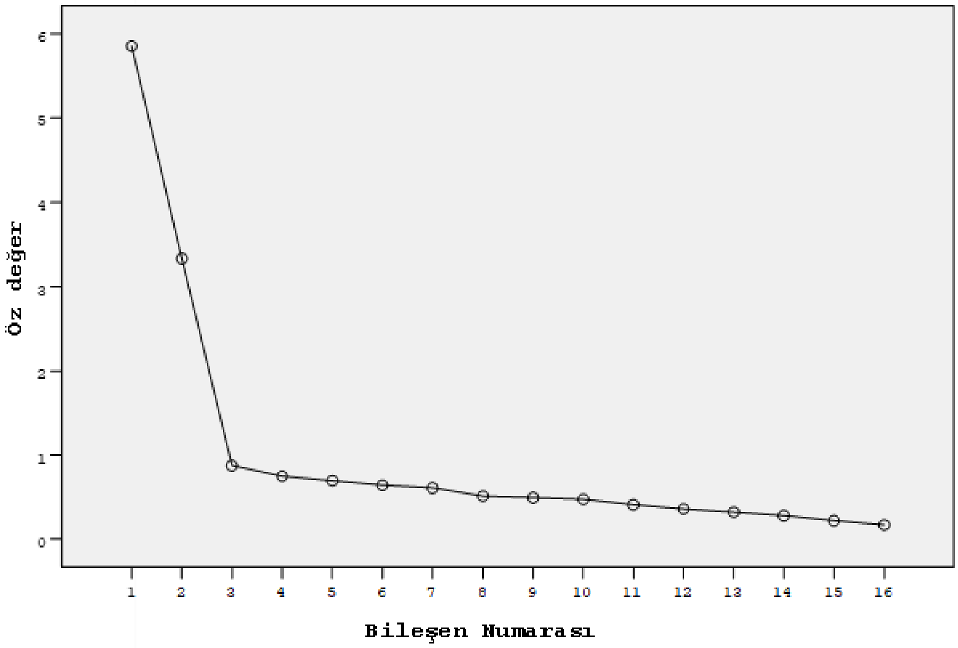

Figure 1 Scree Plot Graph

When the results of the Exploratory Factor Analysis (EFA) were interpreted in the scree plot, it was determined that the first sub-factor of the measurement tool consisted of nine items (10, 9, 11, 16, 15, 7, 14, 12, 5) and the second sub-factor seven items (20, 17, 21, 6, 2, 19, 1), totaling 16 items (Appendix 1). When the sub-factors were analyzed, it was understood that all nine items under the first factor were positive statements, and all of the second factor items were negative statements. For this reason, the first factor was named "Trust" while the second factor was named "Distrust".

Table 6 Factor Structures of the Scale

Factor	Eigenvalue	Variance Percentage	Accumulated Percentage	Cronbach α
1	5.857	36.608	36.608	.928
2	3.333	20.834	57.442	.814
Scale Sum				.822

As shown in Table 6, the eigenvalue of the first sub-factor of the measurement tool was 5.857 and the variance accounted for was 36.608%, while that of the second sub-factor was 3.333 and the variance accounted for was 20.834%. It is an important criterion of factor analysis that this variance exceeds 50% of the total variance (Yaşlıoğlu, 2017). In conclusion, it was determined that the measurement tool accounted for 57.442% of the variance, which indicates a high rate. Factor loads are presented in Table 7. To improve the interpretability of the factors, items with factor loads > 0.647 were selected for factor 1 and > 0.539 for factor 2.

Table 7 Factor Loads of Scale Items

Items	Factors	
	1	2
m10	.864	
m11	.851	
m9	.848	
m15	.818	
m16	.817	
m7	.806	
m12	.756	
m14	.752	
m5	.647	
m17		.785
m20		.753
m21		.736

m6	.719
m2	.682
m1	.585
m19	.539

Reliability Analysis of the Scale

The reliability of the scale was calculated through Cronbach's α reliability coefficient applied to the entire scale and each sub-factor. An internal consistency coefficient of .70 and above indicates that the measurement tool is exceptionally reliable (Büyüköztürk et al., 2011). Table 6 shows that Cronbach Alpha coefficients represent a high level of internal consistency for the 16-item scale and its sub-dimensions. The internal consistency coefficient of the scale was alpha=.822. In addition, the internal consistency coefficient for the sub-factors was calculated as F1=,928 and F2=,814. These values show that the Trust in Science and Scientists Inventory scale is a reliable measurement tool with its two-factor structure.

Item Discrimination

The raw scores of the students were sorted from the highest to the lowest and the most successful 27% of the group were named as the "**upper group**" (high scorers) (n1=78). The least successful 27% of the group was labeled as "**lower group**" (low scorers) (n2=78). It was examined whether there was a significant difference between the scores obtained by the lower and upper groups from each item and the total of the test. Since the lower and upper groups in the whole test showed normal distribution, independent variables t-test analysis was performed over parametric statistics. It was determined that the t values for the differences between the item scores of the 27% upper and lower groups of the scale ranged between 4.705 and 11.133 and were significant (p<.01) (Table 8). A correlation coefficient between 0.70-1.00 is defined as a high-level relationship, between 0.70-0.30 as a medium level relationship, and between 0.30-0.00 as a low-level relationship (Büyüköztürk, 2015). Based on this information, it can be said that the item total correlations are at a moderate level.

Table 8 Item Analysis Results

Item	Group	Mean	Standard Deviation	Item Total Correlation *(n=290)*	*t*	*p*
m1	Upper (27%)	4.0385	1.07440	.376	4.873	.000
	Lower (27%)	3.1282	1.25210		4.873	.000
m2	Upper (27%)	4.3974	1.07316	.470	6.719	.000
	Lower (27%)	3.1154	1.29916		6.719	.000

m5	Upper (27%)	3.8077	.98109	.447	4.705	.000
	Lower (27%)	2.9103	1.36929		4.705	.000
m6	Upper (27%)	4.7692	.45365	.516	10.266	.000
	Lower (27%)	3.2179	1.25509		10.266	.000
m7	Upper (27%)	4.4872	.84889	.644	9.363	.000
	Lower (27%)	2.7949	1.35185		9.363	.000
m9	Upper (27%)	4.4103	.88912	.713	10.908	.000
	Lower (27%)	2.5641	1.20162		10.908	.000
m10	Upper (27%)	4.3462	.73550	.740	11.133	.000
	Lower (27%)	2.5000	1.26645		11.133	.000
m11	Upper (27%)	4.1667	.79637	.736	8.692	.000
	Lower (27%)	2.6795	1.28421		8.692	.000
m12	Upper (27%)	3.9103	.99591	.578	8.047	.000
	Lower (27%)	2.5256	1.14783		8.047	.000
m14	Upper (27%)	4.1410	1.11337	.574	7.908	.000
	Lower (27%)	2.6667	1.21320		7.908	.000
m15	Upper (27%)	4.2051	.87325	.665	9.290	.000
	Lower (27%)	2.5897	1.26323		9.290	.000
m16	Upper (27%)	4.3333	.87782	.667	9.598	.000
	Lower (27%)	2.5897	1.34296		9.598	.000
m17	Upper (27%)	4.6923	.60961	.610	10.490	.000
	Lower (27%)	2.9615	1.32354		10.490	.000
m19	Upper (27%)	3.9103	1.23988	.355	5.346	.000
	Lower (27%)	2.8974	1.12342		5.346	.000
m20	Upper (27%)	4.4231	1.00025	.562	8.518	.000
	Lower (27%)	2.8590	1.27640		8.518	.000
m21	Upper (27%)	4.6538	.89482	.537	8.843	.000
	Lower (27%)	3.1026	1.26481		8.843	.000
Total	Upper (27%)	85.6795	4.56837	1.00	30.753	.000
	Lower (27%)	60.2692	5.69044		30.753	.000

Unlike the data used in the exploratory factor analysis, data were collected from 298 students to confirm the predicted two-factor structure of the scale. Confirmatory factor analysis was performed on the data obtained with IBM AMOS 22 package program. First, the distribution of the data was analyzed. When calculation methods that require normality assumption (maximum likelihood) are used, the data should show normal or near-normal distribution. According to Gürbüz (2021), while the normal distribution of the data is accepted in Structural Equation Modeling (SEM) with a multiple kurtosis critical value below 10, it does not pose a problem up to 20. The multiple kurtosis critical value of the study data was calculated as 19.134. Since the data were close to normal distribution, maximum likelihood calculation method was used. The goodness of fit values calculated as a result of CFA and the threshold values of these indices accepted in the literature (Schumacker & Lomax, 2004; Hu & Bentler, 1999; Sümer, 2000; Thompson, 2004; Kline, 2016) are given in Table 9.

Table 9 Goodness of Fit Indices and Threshold Values for CFA

Index	Good Fit	Acceptable	Study Values
X^2 (CMIN): Chi-Square	p>.05	should be (insignificant)	285.802 p: 0.00
X^2/df: Normed Chi-Square	≤3	$3 \leq X^2/df \leq 5$	2.775
RMSEA: Root Mean Square Error of Approximation	≤.05	≤.08	.077
SRMR: Square Root of Standard Mean Error	≤.05	≤.08	.095
CFI: Comparative Fit Index	≥.95	≥.90	.942
NFI: Normed Fit Index	≥.95	≥.90	.913
NNFI (TLI): Non-Normed Fit Index	≥.95	≥.90	.933
IFI: Incremental Fit Index	≥.95	≥.90	.942
GFI: Goodness of Fit Index	≥.95	≥.90	.891
AGFI: Adjusted Goodness of Fit Index	≥.95	≥.90	.855

In order to ensure a good fit between the proposed model and the data, the X^2 value is expected to be insignificant. However, it is accepted that the quotient of this value to the degrees of freedom (X^2/df) is more accurate in evaluating the goodness of fit of the general model (Güngör, 2016; Gürbüz, 2021). In cases where the X^2 value, which is sensitive to sample size, is significant, the X^2/df ratio being less than five is seen as an indicator of fit (Sumer, 2000; Hooper, Coughlan & Mullen, 2008; Kline, 2011). Table 9 shows that the X^2/df value obtained as a result of CFA is significant (X^2=285.802, df=103, p=0.00). It is seen that the X^2/df ratio is excellent and the RMSEA, CFI, NFI, NNFI, IFI indices are within the limits of good fit.

Although the GFI (.891) and AGFI (.855) indices are slightly below the goodness of fit limit, it can be stated that the model-data fit is achieved as they are remarkably close to the limit value and when the obtained indices are evaluated. The standardized coefficients -path diagram- obtained as a result of CFA are given in Figure 2.

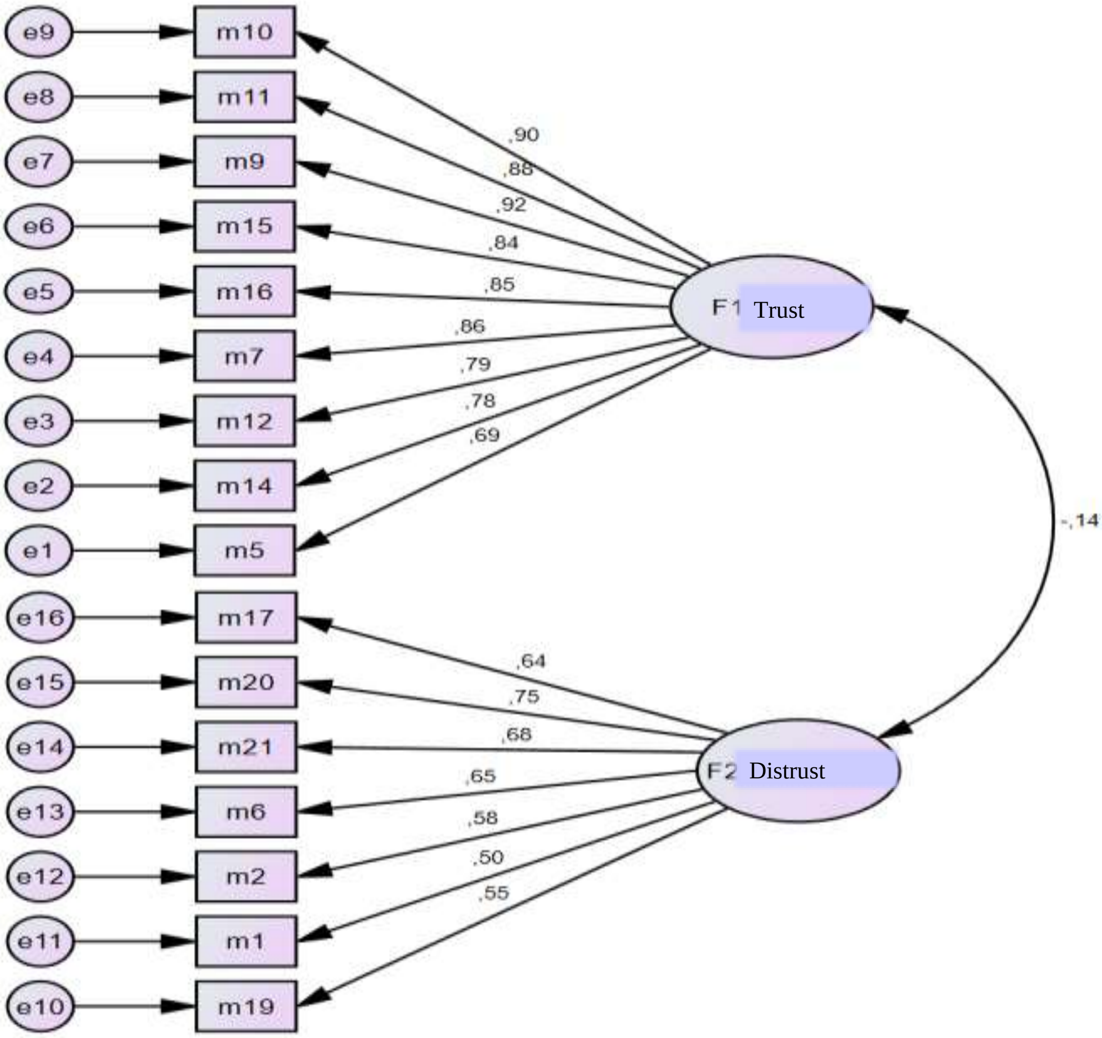

Figure 2 Standardized Coefficients of the Scale

In an ideal Structural Equation Modeling, factor loads are expected to be high (>.50) and correlations between factors do not exceed .85 in multi-factor models (Gürbüz, 2021). Figure 2 shows that the factor loadings range between .69 and .92 for the "F1: Trust" sub-dimension and between .50 and .75 for the "F2: Distrust" sub-dimension. It is seen that the correlation between the two factors in the proposed model is .14. All these values indicate that the data are compatible with the model.

Discussions, Conclusions and Suggestions

In this study, the validity and reliability of the Turkish adaptation of "Trust in Science and Scientists Inventory" ("Bilime ve Bilim İnsanlarına Güven Ölçeği") developed by Nadelson et al. (2014) was investigated. The appearance, content and construct validity of the scale were analyzed for validity, and item-total test score correlation and internal consistency coefficients for reliability. The construct validity of the scale was tested with exploratory and confirmatory factor analyses. First, linguistic equivalence between the Turkish form of the scale and the original was ensured. Exploratory analysis which aims to find the factor structure of the scale revealed a 2-factor structure and whether this structure is valid in Turkish culture was tested by confirmatory factor analysis. It was seen that the positive and negative items of the scale were grouped under two separate factors and the positive factor was named "Trust" and the negative factor "Distrust". The factor loads of the items gathered under the "Trust" factor are higher than those of the items under the "Distrust" factor. This is thought to be since students understand positive items more easily than negative ones. In their study investigating middle school students' trust in science, Krüger et al. (2022) concluded that the scale we adapted had two different dimensions in German culture and continued their research by using only the part of these dimensions containing positive items and did not provide information about the negative one. At the end of our study, both factors were found valid and reliable (Cronbach α_{trust}: 0.928 and Cronbach $\alpha_{distrust}$: 0.814). The 2-factor structure of the scale supports the findings of Krüger et al.

The Cronbach's Alpha reliability coefficient calculated for the entire scale is 0.822. A high internal consistency coefficient (0.822) indicates that the scale items are consistent with each other. The t-test results between the item mean scores of the upper 27% and lower 27% groups for the item discrimination showed that the differences were significant for all items. The adapted scale can distinguish between those that have the property to be measured and those that do not. The total variance accounted for by the final scale consisting of 16 items was found to be 57.442% (36.608% for the first factor and 20.834% for the second factor).

Compared to the study of Esen and Alkış Küçükaydın (2022), fewer items were removed from the original scale and the total variance explained by the scale was calculated higher. The factor structures found are also different. Different from our study, Esen and Alkış Küçükaydın (2022) named the two factors they found as "trust in science" and "trust in scientists".

The study findings show that the Trust in Science and Scientists Inventory (Appendix A) adapted into Turkish is a valid and reliable scale that can be used in the field of education for middle school students. In future studies, validity and reliability of the scale can be investigated in larger sample groups.

Ertürk (2018) suggests that trust in science can be improved through a humanistic approach. Krüger et al. (2022) state that it would be useful to investigate which factors have an encouraging effect on the development of trust during school years. The adapted scale can be used to middle school students to investigate students' trust in science and scientists. Studies that are unique and require active participation of students can be organized to help build this trust.

Compliance with Ethical Standards

Disclosure of potential conflicts of interest

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Research involving Human Participants and/or Animals

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Bilime ve Bilim İnsanına Güven Ölçeği'nin Türkçe'ye Uyarlanması: Geçerlik-Güvenilirlik Çalışması

Özet:

Bu çalışmada, Nadelson ve diğerleri (2014) tarafından geliştirilen "Trust in Science and Scientists Inventory"nin ortaokul öğrencilerinin anlayabileceği sadelikte Türkçe'ye uyarlanmasıyla elde edilen "Bilime ve Bilim İnsanlarına Güven Ölçeği"nin geçerlik- güvenirlik çalışması yapılmıştır. Açımlayıcı Faktör Analizi sonucunda toplam 16 madde içeren iki faktörlü ölçeğin açıkladığı toplam varyans %57,442 olarak bulunmuştur. Faktörlerin içsel tutarlılıklarının hesaplanmasında Cronbach α değerleri kullanılmıştır (bu değerler sırasıyla 0,928; 0,814). Ölçeğin tamamı için Cronbach α iç tutarlık katsayısı 0,822 olarak hesaplanmıştır. Ardından Doğrulayıcı Faktör Analizi yapılarak iki faktörlü modelin verilerle uyum gösterdiği belirlenmiştir. Çalışmanın bulguları Türkçe'ye uyarlanan ölçeğin, eğitim alanında ortaokul öğrencilerine yönelik geçerli ve güvenilir bir ölçme aracı olduğunu göstermektedir.

Anahtar kelimeler: güven, bilime güven, bilim insanlarına güven, ölçek uyarlanması.

References

Abraham, T. (2004). *Twenty-first century plague: The story of SARS*. The Johns Hopkins University Press.

Akkurt, S. B. (2022). *How do different threat types caused by COVID-19 affect trust in science through issue ownership beliefs?* [Unpublished master's thesis]. Kadir Has University.

Ataç, O., & Aker, A. A. (2014). Aşı karşıtlığı [Vaccine opposition]. *Sağlık Düşüncesi ve Tıp Kültürü Dergisi [Journal of Health Thought and Medical Culture], 30*(1), 42-47.

Badur, S. (2021). Truth and wrongs in the COVID-19 pandemic period. *Society and the Physician, 36*(3), 180-189. https://www.acarindex.com/pdfler/acarindex-fdfdf7800d1e421f06256f91b230385f.pdf

Balcı, A. (2022). *Sosyal bilimlerde araştırma, yöntem, teknik ve ilkeler [Research, methods, techniques and principles in social sciences]* (16th ed.). Pegem Akademi.

Bennett, L. M., Gadlin, H., & Levine-Findley, S. (2010). *Team science and collaboration: A field guide*. Department of Health and Human Services.

Bennett, L. M., Gadlin, H., Ataseven, L., & Yılmaz, R. (2013). Collaboration and team science: from theory to practice. *Bilgi Dünyası*, *14*(2), 420-439. https://doi.org/10.15612/BD.2013.131

Blankenship, B. T., & Stewart, A. J. (2019). Threat, trust, and Trump: Identity and voting in the 2016 presidential election. *Politics, Groups, and Identities*, *7*(3), 724-736. https://doi.org/10.1080/21565503.2019.1633932

Broughton, SH, & Nadelson, LS. (2012). *Food for thought: Pre-service teachers' knowledge, emotions, and attitudes toward genetically modified foods*. Paper presented at the annual meeting of the American Educational Researchers Association. National Conference.

Bryce, J., & Fraser, J. (2014). The role of disclosure of personal information in the evaluation of risk and trust in young peoples' online interactions. *Computers in Human Behavior*, *30*, 299-306. https://doi.org/10.1016/j.chb.2013.09. 012

Büyüköztürk, Ş. (2015). *Sosyal bilimler için veri analizi el kitabı istatistik, araştırma deseni SPSS uygulamaları ve yorum [Handbook of data analysis for social sciences statistics, research design SPSS applications and interpretation]* (21st ed.). Pegem Akademi

Büyüköztürk, Ş., Çokluk, Ö., & Köklü, N. (2011). *Sosyal bilimler için istatistik [Statistics for social sciences]* (7th ed.). Pegem Akademi.

Çam, M. O., Engin, E., & Uğuryol, M. (2017). Ego development and sense of trust in university students. *Journal of International Social Research*, *10*(51). http://dx.doi.org/10.17719/jisr.2017.1784

Cobern, W. W., Adams, B. A., Pleasants, B. A., Bentley, A., & Kagumba, R. (2022). Do we have a trust problem? Exploring undergraduate student views on the tentativeness and trustworthiness of science. *Science & Education*, *31*(pp. 1209–1238). https://doi.org/10.1007/s11191-021-00292-1

Cohen, J., & Cohen, P. (1983). *Applied multiple regression/correlation analysis for the behavioral sciences.* Lawrence Erlbaum Associates Inc.

Cohen, L., Manion, L., & Morrison, K. (2007). *Research methods in education* (6 th ed.). Routledge.

Cohen, L., Manion, L., & Morrison, K. (2021). Veri analizi ve raporlama [Data analysis and reporting]. In E. Dinç & K. Kıroğlu (Eds.), *Eğitimde araştırma yöntemleri [Research methods in education]* (pp. 8-735). Pegem Akademi.

Covitt, B. A., & Anderson, C. W. (2022). Untangling trustworthiness and uncertainty in Science. *Science & Education*, *31*(5):1-26. https://doi.org/10.1007/s11191-022-00322-6

Dunlap, RE, & McCright, AM. (2011). Organized climate change denial. In J. S. Dryzek, R. B. Norgaard & D. Schlosberg (Eds.), *The Oxford handbook of climate change and society* (pp. 144-160). Oxford University Press.

Dunn, J, & Schweitzer, M. (2005). Feeling and believing: the influence of emotion on trust. *Journal of Personality and Social Psychology*, *88*(6), 736-748. https://doi.org/10.1037/0022-3514.88.5.736

Ertürk, D. (2018). Risk society: the subject within uncertainty, fear and the search for trust. *Electronic Turkish Studies*, *13*(10), 275-289. http://dx.doi.org/10.7827/TurkishStudies.13105

Esen, S., & Alkış Küçükaydın M. (2022). Turkish adaptation study of the trust in science and scientists scale: Validity and reliability study. *Research on Education and Psychology (REP)*, *6*(Special Issue), 57-68. https://doi.org/10.54535/rep.1089295

European Federation of Academies (2019). Trust in science and changing landscapes of Communication. *ALLEA Discussion Paper 3*. ALLEA_Trust_in_Science_and_Changing_Landscapes_of_Communication-1.pdf

Fensham, P. J. (2014). Skepticism and trust: Two counterpoint essentials in science education for complex socioscientific issues. *Cultural Studies of Science Education, 9*(3), 649-661. https://doi.org/10.1007/s11422-013-9560-1

Gölbaşı, S. D., & Metintas, S. (2020). COVİD-19 pandemic and infodemia. *ESTÜDAM Halk Sağlığı Dergisi*, *5*, 126-137. https://doi.org/10.35232/estudamhsd.797508

Güngör, D. (2016). Summary a guide to scale development and adaptation in psychology. *Turkish Psychological Articles, 19*(38), 104-112. https://www.tpd.com.tr/tr/yayinlar/dergiler/1031828/tpy1301996120160000m000041.pdf

Gürbüz, S. (2021). *Amos ile yapısal eşitlik modellemesi [Structural equation modeling using Amos]*. Seçkin.

Hair, J. F., Black, W. C., Babin, B. J., Anderson, R. E., & Tatham, R. L. (2013). *Multivariate data analysis*. Pearson Education Limited.

Hooper, D., Coughlan, J., & Mullen, M. R. (2008). Structural equation modelling: guidelines for determining model fit. *The Electronic Journal of Business Research Methods, 6*(1), 53-60. https://doi.org/10.21427/D7CF7R

Hu, L., & Bentler, P. M. (1999). Cut off criteria for fit indexes in covariance structure analysis: conventional criteria versus new alternatives. *Structural Equation Modelling, 6*, 1-55. https://doi.org/10.1080/10705519909540118

Kaya, M. F. (2013). A scale development study on the attitudes of sustainable development. *Marmara Coğrafya Dergisi*, *28*, 175-193. https://dergipark.org.tr/tr/download/article-file/3351

Keelan, J., Pavri, V., Balakrishnan, R., & Wilson, K. (2010). An analysis of the Human Papilloma Virus vaccine debate on MySpace blogs. *Vaccine, 28*(6), 1535-1540. https://doi.org/10.1016/j.vaccine.2009.11.060

Kingsley, O., & Van Kranendonk, S. (2017). Space science outreach-are we decreasing public understanding. In *International Astronautical Congress paper for IAC2017, IAC-17 E* (Vol. 1). Published by the IAF.

Kline, R.B. (2011), P*rinciples and practice of structural equation modelling* (3rd ed.). The Guilford Press.

Kline, R. B. (2016). *Principles and practice of structural equation modeling*. The Guilford Press.

Kreimer, A. R., González, P., Katki, H. A., Porras, C., Schiffman, M., Rodriguez, A. C., …, CVT Vaccine Group. (2011). Efficacy of a bivalent HPV 16/18 vaccine against anal

HPV 16/18 infection among young women: A nested analysis within the Costa Rica Vaccine Trial. *The Lancet Oncology, 12*(9), 862-870. https://doi.org/10.1016/S1470-2045(11)70213-3

Krüger, J. T., Höffler, T. N., & Parchmann, I. (2022). Trust in science and scientists among secondary school students in two out-of-school learning activities. *International Journal of Science Education, Part B, 12*(2), 111-125. https://doi.org/10.1080/21548455.2022.2045380

Kurt, A., & Kürüm, D. (2010). Relationship between media literacy and critical thinking: A conceptual view. *Mehmet Akif Ersoy University Journal of Social Sciences Institute, 2*(2), 20-34. https://dergipark.org.tr/en/download/article-file/181706

MacDonald, E. A., Balanovic, J., Edwards, E. D., Abrahamse, W., Frame, B., Greenaway, A., Kannemeyer, R., Kirk, N., Medvecky, F., Milfont, T. L., Russell, J. C., & Tompkins, D. M. (2020). Public opinion towards gene drive as a pest control approach for biodiversity conservation and the association of underlying worldviews. *Environmental Communication, 14*(7), 904-918. https://doi.org/10.1080/17524032.2019.1702568

Nakip, M. (2006). *Pazarlama araştırmaları, teknikler ve (SPSS destekli) uygulamalar [Marketing research, techniques and applications (SPSS supported)]*. Seçkin.

Nadelson, L. S., & Hardy, K. K. (2015). Trust in science and scientists and the acceptance of evolution. *Evolution: Education and Outreach, 8*(9), 1-9. https://doi.org/10.1186/s12052-015-0037-4

Nadelson, L., Jorcyk, C., Yang, D., Jarratt Smith, M., Matson, S., Cornell, K., & Husting, V. (2014). I just do not trust them: the development and validation of an assessment instrument to measure trust in science and scientists. *School Science and Mathematics, 114*(2), 76-86. https://doi.org/10.1111/ssm.12051

Romano, DM. (2003). *The nature of trust: conceptual and operational clarification* [Unpublished doctoral dissertation]. Louisiana State University. http://etd.lsu.edu/docs/available/etd-0130103-070613/unrestricted/Romano_dis.pdf. Accessed 2 Jun 2015.

Rowland, J., Estevens, J., Krzewińska, A., Warwas, I., & Delicado, A. (2022). Trust and mistrust in sources of scientific information on climate change and vaccines: Insights from Portugal and Poland. *Science & education, 31*(5), 1399-1424. https://doi.org/10.1007/s11191-021-00304-0

Sadler, T. D., Barab, S. A., & Scott, B. (2007). What do students gain by engaging in socioscientific inquiry? *Research in Science Education*, *37*(4), 371-391. https://doi.org/10.1007/s11165-006-9030-9

Schumacker, R. E., & Lomax, R. G. (2004). *A beginner's guide to structural equation modelling*. Lawrence Erlbaum Associates Inc.

Seçer, İ. (2015). *Psikolojik test geliştirme ve uyarlama süreci [Psychological test development and adaptation]*. Anı Publisher.

Sipahi, B., Yurtkoru, E.S., & Çinko, M.(2006*). Sosyal bilimlerde SPSS ile veri analizi [Data analysis in social sciences with SPSS]*. Beta Publisher.

Smith, MU, Siegel, H, & McInerney, JD. (1995). Foundational issues in evolution education. *Science & Education*, *4*(1), 23-46. https://doi.org/10.1007/BF00486589

Soslu, Ö. (2021). An investigation of primary school students' opinions about the nature of science in terms of some variables. *International Journal of Active Learning*, *6*(2), 141-153. https://dergipark.org.tr/tr/download/article-file/1837069

Suhr, D. D. (2006). *Exploratory or confirmatory factor analysis* (pp. 1-17). SAS Institute.

Sümer, N. (2000). Yapısal eşitlik modelleri: temel kavramlar ve örnek uygulamalar [Structural equation modelling: Basic concepts and applications]. *Türk Psikoloji Yazilari [Turkish Psychology Articles]*. *3*(6), 49–74. https://psycnet.apa.org/record/2006-04302-005

Tan, Ş. (2015). *Öğretimde ölçme ve değerlendirme KPSS el kitabı [Measurement and evaluation in teaching KPSS handbook]*. Pegem Akademi.

Thompson, B. (2004). *Exploratory and confirmatory factor analysis: understanding concepts and applications.* American Psychological Association.

Weeks, W. B., Wallace, A. E., & Kimberly, B. C. (2004). Changes in authorship patterns in prestigious US medical journals. *Social Science & Medicine, 59*(9), 1949-1954. https://doi.org/10.1016/j.socscimed.2004.02.029

Weingart, P. (2002). The moment of truth for science. *EMBO reports*, *3*(8), 703-706.

Yaşlıoğlu, M. M. (2017). Factor analysis and validity in social sciences: application of exploratory and confirmatory factor analyses. *Istanbul University Journal of the School of Business*, *46*, 74-85. https://dergipark.org.tr/tr/download/article-file/369427

Yıldırım, C. (1999). *Bilimin öncüleri [The pioneers of science]* (14th ed.). Tübitak.

Appendix A: Trust in Science and Scientists Inventory

The meanings of the words marked with an asterisk on the scale are as follows:

*** Ethics:** In accordance with the code of ethics.

**** Theory:** Scientific views that explain an event with the help of observations and experiments.

Trust Factor

Original scale no.	Adapted scale no.	
10	1	We need to trust that scientists are honest in their work.
9	2	We need to trust the work of scientists.
11	3	We need to trust that scientists act ethically* in their work.
16	4	I trust that scientists can find solutions to our important technology-related problems.
15	5	We can rely on science for explanations of the natural life.
7	6	I trust that scientists make life better for us through their work.
14	7	People who understand science better trust science more.
12	8	Scientific theories** are reliable.
5	9	We can trust that scientists share their discoveries with us, even if they do not like what they find.

Distrust Factor

Original scale no.	Adapted scale no.	
20	10	Today's scientists ignore the well-being of others to advance their research.
17	11	We cannot trust scientists since they have a biased viewpoint.
21	12	We cannot trust science as it is progressing too slowly.
6	13	Scientists do not value the opinions of others.
2	14	Scientists ignore other studies that do not support their own work.
19	15	We cannot trust that scientists take into account ideas that contradict their own.
1	16	I lose trust in scientists when they change their mind about a scientific idea.

Trust in Science and Scientists Inventory Turkish version:

Bilime ve Bilim İnsanlarına Güven Ölçeği

Ölçekte yıldızla işaretlenen kelimelerin anlamları aşağıdaki gibidir:

*** Etik:** Ahlak kurallarına uygun.

**** Teori:** Bir olayı gözlem ve deneyler yardımıyla açıklayan bilimsel görüşlerdir.

Güven Faktörü

Orijinal ölçek no	Uyarlanan ölçek no	
10	1	Bilim insanlarının, çalışmalarında dürüst olduklarına güvenmeliyiz.
9	2	Bilim insanlarının çalışmalarına güvenmeliyiz.
11	3	Bilim insanlarının, çalışmalarında etik* davrandığına güvenmeliyiz.
16	4	Bilim insanlarının, teknolojiyle ilgili önemli problemlerimize çözüm bulabileceğine güvenirim.
15	5	Doğal yaşama dair açıklamalara ulaşmak için bilime güvenebiliriz.
7	6	Bilim insanlarının çalışmalarıyla hayatı bizim için daha iyi yaptıklarına güvenirim.
14	7	Bilimi daha iyi anlayan insanlar, bilime daha çok güvenir.
12	8	Bilimsel teoriler** güvenilirdir.

5	9	Bilim insanlarının, buldukları hoşlarına gitmese bile keşiflerini bizimle paylaşabileceklerine güvenebiliriz.
		Güvensizlik Faktörü
Orijinal ölçek no	Uyarlanan ölçek no	
20	10	Günümüz bilim insanları araştırmalarını ilerletmek için başkalarının iyiliğini görmezden gelirler.
17	11	Bilim insanlarına güvenemeyiz çünkü onlar önyargılı bakış açısına sahiptir.
21	12	Bilime güvenemeyiz çünkü bilim çok yavaş ilerliyor.
6	13	Bilim insanları başkalarının fikirlerine değer vermez.
2	14	Bilim insanları kendi çalışmalarını desteklemeyen diğer çalışmaları görmezden gelir.
19	15	Bilim insanlarının, kendi fikirlerine ters düşen düşünceleri dikkate aldıklarına güvenemeyiz.
1	16	Bilim insanları, bilimsel bir fikir hakkında görüşlerini değiştirdiklerinde onlara olan güvenim azalır.