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Research Article

Attitude Scale Toward Innovation for Primary School Students: Scale Development and Validation

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Abstract: This study aimed to develop a valid and reliable scale to assess the attitudes of primary school students toward innovation. The research was conducted with data from 733 third- and fourth-grade students in the Marmara Region. Designed as a descriptive study, the research employed exploratory and confirmatory factor analyses to evaluate the data. Initially, a literature review examined the concept of innovation and how it could be measured appropriately for children. Based on the findings, a pool of 44 items was created using a five-point Likert scale (ranging from strongly disagree to agree strongly). After expert reviews and a pilot study, this pool was refined to 38 items. The exploratory factor analysis results indicated that the scale consisted of four factors: Curiosity, Self-Confidence, Alternative Usage, and Creativity. These factors accounted for 55.66% of the total variance. Each factor included three items, with factor loadings exceeding 0.30, which supported the construct validity of the scale. The confirmatory factor analysis revealed that the model demonstrated excellent goodness-of-fit values. Findings from the second-order CFA confirmed the relationship between the factors and innovation and showed an excellent fit. As a result, this study developed a valid and reliable instrument for measuring the attitudes of primary school students toward innovation. The scale is anticipated to help understand students' tendencies toward innovative thinking, develop strategies to enhance these tendencies, and evaluate innovation-focused educational programs.

Keywords: Innovation, Primary School Students, Scale Development

1. Introduction

Economist and policy scientist Joseph Schumpeter first defined innovation as “the driving force of development” (Elçi & Karataylı, 2008). Innovation has recently become a significant factor in international competition among countries (Yalçıntaş Gülbaş, 2011). In the contemporary competitive landscape, fostering innovation is among the critical priorities for nations striving to achieve sustainable economic growth and development (Yılmaz & İncekaş, 2018). Economically strong countries are innovation-driven, driven by innovation, while weak economies are factor-driven, based on natural resource wealth (Işık & Kılınç, 2012). Economic power comes from intensive investment and development in concepts such as diversity, creativity, innovation, and R&D. In countries lagging in competition, it is evident that the concept of innovation has not yet been fully understood (Yılmaz & İncekaş, 2018).

Over the past century, the term innovation has gained significance, and numerous definitions focusing on different aspects of innovation have emerged over time. In 1911, Schumpeter conceptualized innovation as the introduction of a previously unknown product to consumers or the enhancement of an existing product’s quality in the market. Additionally, he defined innovation as the adoption of a novel production method, the expansion into a new market, the identification of a new source of raw materials or semi-finished goods, or the restructuring of an industry (as cited in Elçi & Karataylı, 2008). Pierce and Delbecq (1977) defined innovation as initiating, adopting, and implementing new ideas or activities within an organizational context. Damiano (2011) defined innovation as introducing products, processes, or services that are novel for the firm, the market, or the global context. Örtlek (2015) described innovation in its most comprehensive form as transforming knowledge into products, processes, services, and systems facilitated by influential factors such as skilled labor, knowledge, and infrastructure. According to Boak (2022), innovation is the process of generating new and effective

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ideas and making them technically and commercially viable, or introducing new and improved ways of performing tasks. An examination of the definitions in chronological order reveals that the meaning of innovation has shifted over time from a theoretical and commercial perspective to concepts of newness, novelty, and methods of renewal over time. Similarly, in the TDK dictionary (2024), the word "innovation" is listed as synonymous with "renewal", which is defined as "the introduction of new methods in social, cultural, and administrative contexts to adapt to changing conditions."

Innovation is associated with phenomena such as creativity, entrepreneurship, commercialization, learning, and invention, and conceptual clarification is needed to better understand and advance innovation in practice (Klausen, 2017). Innovation is often regarded as synonymous with creativity and is particularly used as a substitute for the term creativity in the field of sociology. However, while these two concepts are closely related, they are not entirely identical. The realization of innovation requires a creative process; however, not every creative process must necessarily result in or be transformed into economic value (Keleşoğlu & Kalaycı, 2017). Although innovation does not fully correspond to the term "novelty," it is fundamentally a process of novelty. However, not every novelty is considered innovation; the essence of innovation lies in its aim to generate economic or social benefit. Since it encompasses the concept of novelty, innovation is often confused with inventions. However, innovation does not mean making an invention, although it is possible to utilize inventions within the innovation process (Taş, 2017). Creativity and innovation are inseparable components of the same process; while research on creativity focuses on idea generation, studies on innovation concentrate on the implementation of those ideas (Anderson et al., 2014). Innovation is more than creativity or technology; it requires the transformation of ideas into practical, implementable products, services, processes, or business models (Taylor, 2017).

Innovation enhances economic growth, job creation, and quality of life by increasing productivity and competitiveness. It enables efficient use of resources, turning them into valuable products and services, thus improving overall societal welfare (Çeliktaş, 2008). Innovation is a process composed of successive stages, beginning with the development of new ideas through research. Inspiration and imagination play a critical role in the emergence of new ideas as the innovation process advances through the shaping of creative ideas and their realization as practical, implementable solutions (Ahmed & Abdalla, 1999).

Drucker (1998) identified seven sources of innovation, four of which are internal and three external. These sources include unexpected events (successes or failures), process needs, changes in industry and market structures, economic or process incongruities, demographic shifts, shifts in perception, and the generation of new knowledge. Eurostat and OECD (2005) categorize innovation into four main types: product, process, marketing, and organizational. Product innovation refers to the introduction of new or significantly improved goods or services in terms of technical specifications, materials, usability, or other functional features. It may rely on new technologies or novel combinations of existing knowledge (Eurostat, n.d.-c). Process innovation involves the implementation of significantly improved production or delivery methods, including changes in techniques, equipment, or software, aimed at reducing costs or enhancing quality (Eurostat, n.d.-a). Marketing innovation is defined as the application of a new marketing method that entails substantial changes in product design, packaging, promotion, placement, or pricing. Such innovations aim to better meet customer needs, open new markets, or reposition products (Eurostat, n.d.-d). Lastly, organizational innovation encompasses the adoption of new methods in business practices, workplace organization, or external relations to improve performance, reduce costs, or enhance knowledge flow. These methods must be new to the firm and the result of deliberate strategic decisions (Eurostat, n.d.-b).

One of the most critical factors for the success of an innovation is establishing an innovation-oriented culture and structure (Akyos, 2007). The cultural structure of societies profoundly influences innovation, and innovative actions are more likely to occur in societies with an innovative culture

(Muthukrishna & Henrich, 2016). Fostering an innovation-oriented culture places significant responsibility on education systems. One of the key factors in the success of development and innovative activities is the human capital that societies possess. Education must be the primary focus to cultivate a skilled workforce (Yılmaz & İncekaş, 2018). Innovation is a process that can emerge in various forms across many areas of society. Numerous countries have successfully implemented this process, reaping economic and social benefits. Innovation has accounted for 66–75% of labor productivity growth in developed countries through multi-factor productivity gains. (OECD, 2010). Achieving such success requires globally aware individuals, willing to take risks, creative, inquisitive, highly communicative, collaborative, and productive (Taş, 2017). In this context, innovation can be regarded as the product of a culture that embraces novelty, welcomes change, and embodies an entrepreneurial spirit (Örtlek, 2015).

Education is widely recognized as a critical enabler of innovation and economic growth (Brennan et al., 2014). Policies aimed at expanding educational access, enhancing quality, and investing in higher education institutions have the potential to foster innovation at both individual and societal levels (Biasi et al., 2021). Beyond increasing participation rates, the quality of education plays a decisive role in driving technological advancement, as evidenced by its correlation with patent-based innovation metrics (Fernández-Rodríguez Labordeta & Giménez, 2012). Educational processes contribute to innovation by equipping individuals with essential competencies such as communication, collaboration, and problem-solving skills (Leiponen, 1996). Furthermore, innovations within the educational domain—such as the integration of digital technologies, personalized learning models, and inclusive pedagogical practices—support students in becoming critical thinkers and autonomous learners (Rabinowitz & Miles, 1965). At the entrepreneurial level, innovation is positively influenced by educational attainment, targeted training, supportive policy environments, and cultural values that emphasize individualism (Hovne et al., 2014). In this context, a shift in formal education is required to prioritize the development of soft skills and to promote lifelong learning as foundational elements of an innovation-oriented education system (Cobo, 2013).

Innovation relates to designing educational environments that equip individuals with the skills needed for both today and the future while aligning teaching and learning processes with the needs of society and the economy (Taş, 2017). Education is recognized as one of the fundamental components of innovation and is featured in the annually published Global Innovation Index. Education is considered one of the fundamental elements of innovation and holds a prominent place in the index (Dutta et al., 2024). The education component is calculated based on factors such as national education expenditure, public spending per student, expected years of schooling, PISA scores in reading, mathematics, and science, and the student-teacher ratio (TİM, 2022). In the Global Innovation Index 2024 Report, Turkey has risen to third place among upper-middle-income countries but remains 37th in the overall ranking (Dutta et al., 2024). Therefore, to transform our country into a more innovation-driven nation, it is crucial to cultivate generations equipped with the culture, knowledge, and skills necessary for innovation.

In the context of this study, innovation is conceptualized as a multidimensional construct encompassing curiosity, self-confidence, alternative usage, and creativity. These dimensions are drawn from a synthesis of existing literature and adapted to the developmental and cognitive characteristics of elementary school students. Curiosity, as a fundamental cognitive driver, propels scientific discovery and underpins innovation by fostering a desire to explore the unknown (Kuo, 2019; Nowotny, 2008). It is closely intertwined with creativity through their shared novelty-seeking basis, which is shaped by an individual's mental state (Ivancovsky et al., 2023). However, curiosity tends to decline as students progress through formal education (Stokoe, 2012), making it critical to support and assess it from early schooling. Self-confidence, particularly in the form of creative self-efficacy, is another foundational

aspect influencing innovation. It mediates how learners perceive challenges and their capacity to generate novel solutions (Acar et al., 2018; Chong & Ma, 2010). Alternative usage, or the ability to assign new functions or domains to existing products and ideas, represents a practical manifestation of innovative thinking (Boak, 2022; Damiano, 2011). This dimension reflects Schumpeter's (1911) view that innovation need not always involve new inventions but can emerge through novel applications of what already exists. Lastly, creativity serves as both a precursor and catalyst for innovation, facilitating the development and transformation of ideas into tangible outputs (Cropley, 2006; Patil, 2024). Nevertheless, creativity alone is insufficient without contexts that nurture and channel it toward productive outcomes (Nayak & Agarwal, 2011). In educational environments, these four dimensions are not only interrelated but also form the cognitive and emotional basis upon which innovation readiness is built. Therefore, integrating and assessing these constructs in elementary education is essential for cultivating students' long-term capacity for innovation.

An examination of the Turkey Century Education Model (MEB, 2024) reveals that learning outcomes directly related to innovation are introduced into the curriculum starting from the 6th grade. However, the overall structure of the program frequently emphasizes competencies that are closely associated with innovation, such as product design and creation skills, entrepreneurial abilities, reasoning, and scientific inquiry. Additionally, the model promotes the development of individuals who are productive, inquisitive, and creative, with a strong focus on cultivating literacy skills that enable adaptation to new situations and sensitivity to change. In this regard, it is anticipated that these competencies and qualifications will play a significant role in foregrounding innovation within educational contexts in the future.

A review of the literature on innovation reveals a significant number of studies focusing on schools and innovation (Çayak & Erol, 2022; Ergöz et al., 2023), teachers' levels of innovation across various variables (Fidan, 2019; Gökbulut, 2021; Özer, 2022; Özerdem & Serin, 2022; Yüner & Özdemir, 2020), school administrators' perceptions and views on innovation (Erdemet, 2017; Sarıçan, 2018), program development efforts aimed at training innovative teachers (Akdeniz, 2020), and school administrators' competencies in innovation (Bayrakçı & Erarslan, 2014; Eren et al., 2024; Özerdem & Serin, 2022). These studies highlight the critical role of key educational stakeholders, including school administrators and teachers, in fostering innovation. However, a literature review indicates that studies focusing on students and innovation are limited. Existing studies include research on the innovative thinking tendencies of middle school students (Deveci & Kavak, 2020), attitudes toward innovative thinking (Gedik & Demirezen, 2023), the innovation levels of 7th-grade students (Akkaya, 2016), and the effects of innovation project applications aimed at 6th-grade students (Kavacık et al., 2015). In the literature, there are measurement tools designed to assess individual innovation competencies in adults (Kılıçer & Odabaşı, 2010; Naillioğlu Kaymak et al., 2022; Ovacı & Yıldırım Saatçi, 2020; Sarıoğlu, 2014) and innovation skills among youth (Altınışık et al., 2023).

A review of studies related to innovation in primary schools reveals a considerable focus on innovative educational models (Carless, 2004; Hornstra et al., 2015; Leoste et al., 2021; Zhang et al., 2011) and the integration of innovation into primary education (Attema-Noordewier et al., 2012; Heißenberger, 2016; Pollock, 2008). However, there appears to be a limited number of studies specifically aimed at fostering innovation development among primary school students. The literature includes research on the development of instructional models to support creativity and innovation at the primary level (Likar et al., 2014), as well as findings indicating that makerspaces in primary schools enhance students' motivation toward innovation (Leskinen et al., 2023). Additionally, it has been observed that innovation is frequently addressed within the framework of 21st-century skills in studies focusing on children in primary education (Chalkiadaki, 2018; Chu et al., 2012; Soderlund, 2020) and that efforts have been made to assess innovation-related competencies within the broader framework of 21st-century skills at

the primary education level (Boyacı & Atalay, 2016). However, a review of the literature indicates that no appropriate measurement tools for assessing innovation-related attitudes among elementary school children have been encountered.

Integrating innovation into education has become a critical priority in today's rapidly evolving knowledge economy. Education must adopt innovation as a fundamental principle of pedagogy, preparing students not only to adapt to the current world but also to shape the challenges and opportunities of the modern era (Sawyer, 2006). Innovation education at the primary school level is a strategic and socially responsible investment that supports both individual development and long-term societal progress. As highlighted by Likar et al. (2014), promoting creativity and innovation should begin in early education, when students are most receptive to cultivating curiosity, critical thinking, and initiative. Therefore, equipping children with attitudes and dispositions related to innovation from a young age is essential for building future-ready, adaptive learners who can contribute meaningfully to their communities. For this reason, this study aims to develop a measurement tool to evaluate elementary school students' attitudes toward innovation.

2. Method

A descriptive research design was employed in this study, which aims to develop a measurement tool to assess elementary school students' attitudes toward innovation. Descriptive research seeks to identify and carefully describe a given phenomenon as it exists (Büyüköztürk et al., 2020, p. 24).

2.1. Study group

The research was conducted during the 2024-2025 academic year. The study group consists of 3rd and 4th-grade primary school students. In forming the study group, convenience sampling was employed. Convenience sampling is a non-probability sampling method in which participants are selected based on their accessibility and proximity to the researcher, rather than through random procedures (Baltacı, 2018). Accordingly, the participants of the study were chosen from among students who were readily accessible to the researchers during the data collection process. The inclusion of both 3rd and 4th-grade students was a deliberate methodological choice grounded in developmental and educational theory. These grade levels represent a transitional phase in which children's metacognitive awareness, self-regulatory abilities, and strategic thinking begin to consolidate and become more consciously accessible (Flavell, 1979; Kuhn, 2000). Research shows that while the early signs of metacognitive processes appear in preschool and the early grades, their functional and observable use in academic contexts becomes more prominent between the ages of 8 and 10, which generally corresponds to 3rd and 4th grades (Kuhn, 2000). Therefore, these two grades were specifically selected, rather than 1st or 2nd grade, as they reflect a developmental stage in which students are more likely to articulate their thoughts, reflect on their learning processes, and respond meaningfully to measurement instruments designed to capture cognitive and behavioral tendencies (Alexander et al., 2001).

The study group consisted of 733 third and fourth-grade students enrolled in three different public schools in a central district of the Marmara region. The prepared item pool was administered to 765 students; however, 32 responses were excluded from the study due to issues such as incomplete or improperly filled data.

Table 1

Demographic Information of the Participant Group

Gender	3rd Grade	4th Grade	Total
Female	167	219	386
Male	161	226	387
Total	328	445	773

An analysis of Table 1 reveals the demographic information of the participant group. Of the study group, 42.43% are 3rd-grade students, while 57.56% are 4th-grade students. Also, 49.93% of the study group consists of female students, while 50.07% are male students. The collected data was organized and transferred into a statistical analysis software. The collected data were divided into two subsets during the data analysis phase. 301 data were used in exploratory factor analysis, and 472 data were used in confirmatory factor analysis.

2.2. Scale development progress

In developing the Attitude Scale Toward Innovation for Elementary School Students, the 8-step framework proposed by DeVellis (2022) was utilized. The procedures carried out within these steps are presented below;

Since the study aims to measure elementary school students' attitudes toward innovation, the process began with a comprehensive review of the literature on the concept of innovation. At this stage, definitions of the concept of innovation provided by different researchers and studies on measuring innovation in children were reviewed in the literature. As a result of this process, the structure of how innovation may manifest in children and how it could be identified was determined. Following this, the development of an item pool commenced.

During the creation of the item pool, concepts related to innovation, expressions found in the definitions, studies focused on measuring innovation in adults, and the indicators of innovation self-efficacy developed by Gerber et al. (2012) were examined. Based on the reviewed studies, a list of indicators specific to children was created, and child-appropriate expressions were written for these indicators to form the item pool. During this process, the written items were discussed with children at an elementary school under the guidance of the researcher. The children's understanding of the items and whether the items were interpreted correctly were carefully examined.

The relevant literature was reviewed at the step of determining the measurement scale. An analysis of scales developed for elementary school students revealed several examples utilizing 3-point Likert scales (Kaya & İzci, 2024), 4-point Likert scales (Alkış Küçükaydın et al., 2024), and 5-point Likert scales (Toma, 2021). Mellor and Moore (2013) noted that 5-point Likert scales are developmentally appropriate for children aged 8 years and older, as they are capable of distinguishing between more nuanced response options. Massey (2021) found that the addition of emojis to Likert-type response formats improved young children's understanding of response categories and increased their ability to accurately express emotional attitudes, especially in survey contexts requiring affective judgment. In addition to the literature, expert consultation was sought from an expert in educational measurement and evaluation regarding scale structure and age appropriateness. Based on these findings and expert input, a 5-point Likert scale was adopted, and emojis ranging from a crying face to a smiling face were placed beneath each response option to enhance comprehensibility.

An expert review form was developed along with the prepared item pool and Likert structure. The expert review form was designed using the Lawshe (1975) technique. The form began with an explanation of the purpose of the scale development study, details about the target sample, and ethical considerations. During the feedback process, the first column of the expert review form listed the scale items, while the adjacent columns included checkboxes labeled "appropriate," "needs revision," and "should be removed." The far-right column allowed experts to write specific feedback on each item. The expert review form was sent to three primary school field experts, containing the initial draft item pool of 42 items. Based on the feedback received from these experts, several items were revised or removed from the scale. Additionally, in light of the feedback received from the experts, new items were added, resulting in a second draft item pool consisting of 44 items. This second draft item pool was then sent to an education measurement and evaluation expert and an expert in the field of educational sciences

who has previously developed an innovation scale. For example, as expert opinions, the item *"I feel happy when the things I make work"* included in the draft item pool was removed following the feedback of a primary education expert, who noted that *"if the student has not made anything, they will not be able to respond to this item."* Similarly, the item *"I listen to others' opinions when making my own decisions"* was excluded from the form based on the suggestion of another expert in primary education, who indicated that more appropriate items could be included under the relevant factor. Moreover, considering the opinion provided by a measurement and evaluation expert stating that *"the verb 'want' may not adequately reflect emotional states, so it is preferable to use verbs that directly express emotions, such as 'like'"*, the verbs used in the form were revised. Additionally, considering the view of an educational sciences expert who had previously developed an innovation scale—asserting that *"innovation is a process related to transformation,"* the existing items were revised, and items such as *"I transform broken toys into new ones"* were added to the item pool. Following their recommendations for revisions, a final item pool of 38 items, ready for pilot testing, was developed.

Data analysis was conducted using statistical analysis software to evaluate the items and adjust the scale length. In the data analysis phase, the normality of the distribution was first examined. In literature, skewness and kurtosis values between +1.5 and -1.5 (Tabachnick & Fidell, 2013) or +2.0 and -2.0 (George & Mallery, 2010) indicate a normal distribution. The entire dataset was divided into two subsets for exploratory factor analysis (EFA) and confirmatory factor analysis (CFA). Both datasets fell within the specified range of values, indicating normal distribution. Following this step, exploratory factor analysis (EFA) was conducted.

The Kaiser-Meyer-Olkin (KMO) test for sampling adequacy was first examined in the EFA. The KMO test was performed to determine whether the sample was adequate to represent the population and suitable for factor analysis. The results of the KMO test are presented in Table 2.

Table 2

KMO Test Result

KMO Test	Value
Kaiser-Meyer-Olkin Measure of Sampling Adequacy	.787
Bartlett's Test Chi-Square Value	500.178
Bartlett's Test Degrees of Freedom	66
Bartlett's Test p	.000

When Table 2 is examined, the KMO value is 0.787. According to this value, the sample size is adequate for proceeding with factor analysis and reasonably represents the population (Hutcheson & Sofroniou, 1999). The dataset's compliance with the multivariate assumption was assessed using Bartlett's Test of Sphericity. The obtained value indicates that the dataset meets the assumption of multivariate normality *($\chi^2 = 500.178; p < 0.01$).*

In addition to these assumptions, the issue of multicollinearity among variables was examined using Pearson's Product-Moment Correlation, and it was determined that no multicollinearity was present. To determine the construct validity of the scale, principal component analysis (PCA) followed by the Varimax orthogonal rotation method was applied during the exploratory factor analysis (EFA). During the PCA, factors with eigenvalues greater than one were considered, and items with factor loadings of at least 0.32 (Tabachnick & Fidell, 2003) were selected for inclusion in the final scale.

First-order and second-order confirmatory factor analysis (CFA) methods were applied to validate the structure of the scale. This stage involves testing the measurement model. This process examined whether the factorized structure obtained from principal component analysis could be validated as a model.

3. Findings

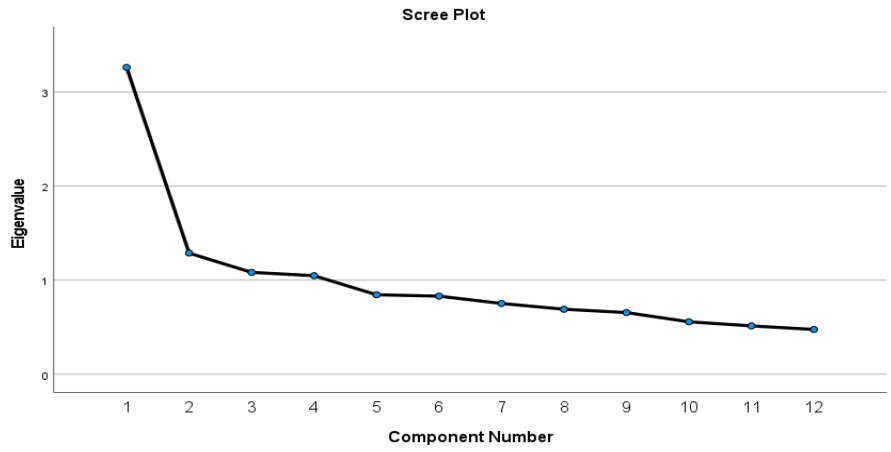
This section presents the results related to the Attitude Scale Toward Innovation for Elementary School Students, including the model developed through exploratory factor analysis, the results of the first-order confirmatory factor analysis conducted on the developed model, and the results of the second-order confirmatory factor analysis, which tested the unification of the model validated in the first-order analysis under the innovation factor.

3.1. Findings Related to Exploratory Factor Analysis (EFA)

Exploratory factor analysis (EFA) was utilized to identify the underlying factors of the observed variables in the dataset. During the EFA process, principal component analysis was used. The Varimax orthogonal rotation method was applied to make the factor structure more meaningful and interpretable. The final analysis revealed that the scale has a four-factor structure with eigenvalues greater than 1.00. The scree plot of the eigenvalues for the scale is presented in Figure 1.

Figure 1

Eigenvalue Analysis for the Attitude Scale Toward Innovation for Elementary School Students



When Figure 1 is examined, it is observed that the inflection point begins after the fourth factor. In the eigenvalue scree plot, sharp and distinct drops are considered a critical criterion in determining the number of factors (Büyüköztürk, 2021). This finding supports the conclusion that the scale consists of a four-factor structure. The factors comprising the scale and the total variance explained by these factors are presented in Table 3.

Table 3

Factors, Eigenvalues, and Explained Variance of the Attitude Scale Toward Innovation for Elementary School Students

Factor	Eigenvalues	Explained Variance	Cumulative %
1	3.262	27.182	27.182
2	1.288	10.730	37.911
3	1.183	9.024	46.935
4	1.047	8.728	55.663

When Table 3 is examined, it is observed that the four factors constituting the scale explain 55.66% of the total variance. The first factor explains 27.18%, the second factor 10.73%, the third factor 9.02%, and the fourth factor 8.72% of the variance. The items forming each factor were analyzed, and based on their contextual meaning, the factors were named in alignment with the literature. The names of the factors and their respective items are presented in Table 4.

Table 4

Naming of the Factors in the Attitude Scale Toward Innovation for Elementary School Students

Factor	Number of Items	Item Numbers
Curiosity (Factor 1)	3	15.16.17
Self-Confidence (Factor 2)	3	3.5.23
Alternative Usage (Factor 3)	3	18.19.20
Creativity (Factor 4)	3	2.7.10

Table 4 presents the factors identified in the Attitude Scale Toward Innovation for Elementary School Students. The scale consists of four factors: Curiosity, Self-Confidence, Alternative Usage, and Creativity. Each factor comprises three items.

Table 5

Items and Factor Loadings of the Attitude Scale Toward Innovation for Elementary School Students

	1 Curiosity	2 Self-Confidence	3 Alternative Usage	4 Creativity
16- I observe what is happening around me.	.758			
17- I ask questions about topics I am curious about.	.660			
15- When I see something new, I scrutinize it.	.629			
23- I do not give up when encountering difficulties while creating something new.		.811		
5- I do not give up until I achieve my dreams.		.754		
3- I am confident in my ability to create new things.		.408		
19- I transform broken toys into new ones.			.771	
18- I enjoy creating new things from waste materials.			.708	
20- I like making new toys for myself from different materials.			.614	
2- I like activities that require using my imagination.				.307
7- I want to invent new things.				.801
10-I enjoy lessons where I can invent new things.				.766

Note: The scale was developed in Turkish, and the translation was carried out by the researchers.

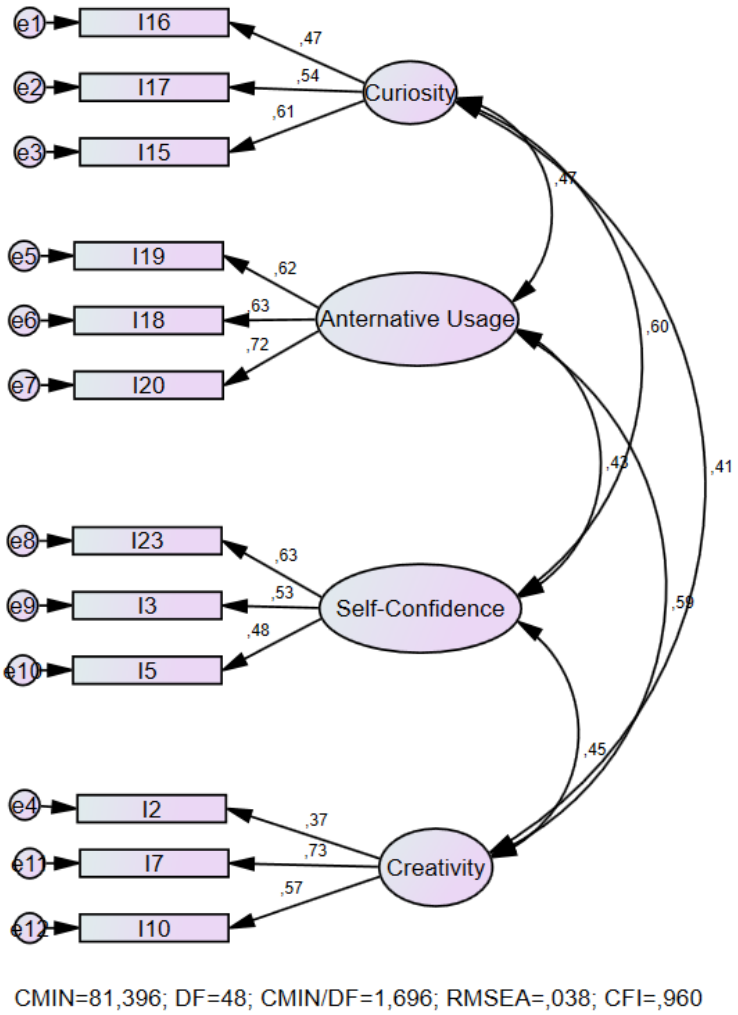
When Table 5 is examined, it is observed that the items grouped under the four factors have factor loadings greater than 0.30, which are considered acceptable values (Büyüköztürk, 2021). This indicates that the items are strongly associated with their respective factors. The items in the Curiosity subdimension aim to evaluate the child's interest in their surroundings, attentiveness, observational skills, and sense of curiosity. The items grouped under the Self-Confidence subdimension are designed to assess the child's motivation to overcome challenges, handle difficulties, and pursue their dreams. The items in the Alternative Usage subdimension measure the child's tendency to create new things using similar or different materials and their interest in this process. The items in the Creativity subdimension aim to measure the child's enjoyment of using their imagination, their willingness to engage in imaginative activities, and their preference for environments that allow them to showcase this ability.

3.2. Findings Related to Confirmatory Factor Analysis (CFA)

Following the EFA, first-order CFA was conducted to determine whether the four-factor structure of the scale could be validated. The results of the first-order CFA for the Attitude Scale Toward Innovation for Elementary School Students, consisting of four factors and 12 items, are presented in Figure 2.

Figure 2

First-Order CFA Model for the Attitude Scale Toward Innovation for Elementary School Students



When the first-order CFA results in Figure 2 are examined, it is observed that the factor loadings of the items range between 0.37 and 0.73. Factor loadings above 0.30 indicate a strong relationship between the item and its corresponding factor (Harrington, 2009). The goodness-of-fit indices for the model are presented in Table 6.

Table 6

Goodness-of-Fit Indices Calculated for the First-Order CFA of the Attitude Scale Toward Innovation for Elementary School Students

X2/sd	P	RMSEA	CFI	GFI	IFI	AGFI
1.696 Perfect Fit*	.002	0.038 Perfect Fit*	0.960 Perfect Fit*	0.972 Perfect Fit*	0.960 Perfect Fit*	.954 Perfect Fit*

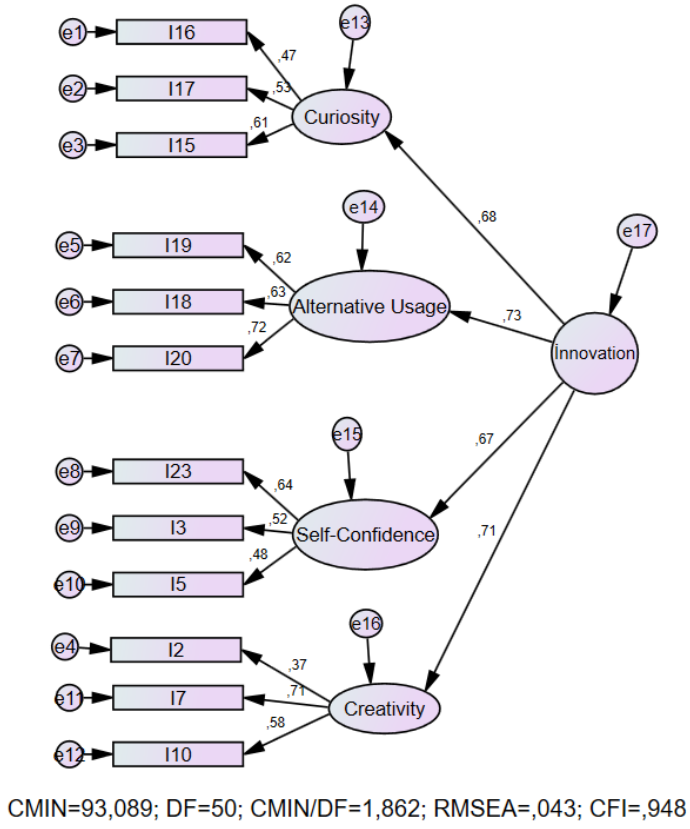
*(Hu & Bentler, 1999)

When Table 6 is examined, as a result of the first-order CFA, the chi-square value for the model of the Attitude Scale Toward Innovation for Elementary School Students is χ^2 = 81.396, with degrees of freedom df = 48, and χ^2/df = 1.696 Examining the fit indices, it is observed that the values are as follows: RMSEA = 0.03, CFI = 0.96, GFI = 0.97, IFI = 0.96, and AGFI = 0.95. Since the χ^2/df value is below 2, the RMSEA value is less than 0.05, and the CFI, GFI, IFI, and AGFI values are greater than 0.95, the model can be described as having a perfect fit.

The multidimensional structure of the Primary School Students' Attitudes Towards Innovation Scale was determined as a latent variable and tested with the second-level multifactor model. The results of the second-order CFA for this model are presented in Figure 3.

Figure 3

Second-Order CFA Model for the Attitude Scale Toward Innovation for Elementary School Students



When the second-order CFA results in Figure 3 are examined, the item's factor loadings range between 0.37 and 0.72. Additionally, the factors related to innovation range between 0.67 and 0.73. The goodness-of-fit indices for the second-order CFA model are presented in Table 7.

Table 7

Goodness-of-Fit Indices Calculated for the Second-Order CFA of the Attitude Scale Toward Innovation for Elementary School Students

X2/sd	P	RMSEA	CFI	GFI	IFI	AGFI
1.862	.000	0.043	0.948	0.968	0.949	.950
Perfect Fit*		Perfect Fit*	Good Fit*	Perfect Fit*	Good Fit*	Perfect Fit*

*(Hu & Bentler, 1999)

When Table 9 is examined, as a result of the second-order CFA, the chi-square value for the model of the Attitude Scale Toward Innovation for Elementary School Students is χ^2 = 93.089, with degrees of freedom df = 50, and χ^2/df = 1.862. Fit indices values are as follows: RMSEA = 0.04, CFI = 0.94, GFI = 0.96, IFI = 0.94, and AGFI = 0.95. Given that the χ^2/df value is below 2, the RMSEA value is less than 0.05, and the CFI, GFI, IFI, and AGFI values are at or above the 0.95 threshold, the model can be described as having a perfect fit.

3.3. Findings related to scale reliability

The reliability of the Attitude Scale Toward Innovation for Elementary School Students has been tested through multiple analyses. McDonald's Omega coefficient analysis was conducted to assess internal

consistency, and a correlation matrix was generated to examine the relationships among factors. Moreover, an independent samples t-test was applied to examine the scale's effectiveness in differentiating between participants with high and low scores. Finally, a test-retest reliability analysis was carried out to evaluate its stability over time.

Table 8

McDonalds Omega coefficient of the Attitude Scale Toward Innovation for Elementary School Students

Factor	McDonald omega (ω)
Scale Overall	.854
Curiosity (Factor 1)	.701
Self-Confidence (Factor 2)	.739
Alternative Usage (Factor 3)	.737
Creativity (Factor 4)	.706

For internal consistency, McDonald's Omega coefficient values for the scale overall and for each of the factors were calculated. The results indicate that the overall scale exhibits a high level of reliability (ω = .854), suggesting that the instrument provides a consistent measurement of students' attitudes toward innovation. Among the factors, the highest internal consistency was observed for the Self-Confidence factor (ω = .739), followed closely by Alternative Usage (ω = .737) and Creativity (ω = .706). The Curiosity factor demonstrated the lowest, yet still acceptable, reliability (ω = .701).

Table 9

Correlation Matrix of the Attitude Scale Toward Innovation for Elementary School Students

Factors		Curiosity (Factor 1)	Confidence (Factor 2)	Alternative Usage (Factor 3)	Creativity (Factor 4)	Scale Overall
Curiosity (Factor 1)	r	1				
Self-Confidence (Factor 2)	r	.588**	1			
Alternative Usage (Factor 3)	r	.394**	.421**	1		
Creativity (Factor 4)	r	.544**	.535**	.463**	1	
Scale Overall	r	.777**	.790**	.768**	.802**	1

*** p<.01*

Table 9 presents the correlation matrix for the Attitude Scale Toward Innovation for Elementary School Students. The correlation coefficients (r) indicate statistically significant relationships among the factors (p < .01). Specifically, Curiosity (Factor 1) demonstrates a moderate positive correlation with Self-Confidence (r = .588) and Creativity (r = .544), while exhibiting a lower yet significant correlation with Alternative Usage (r = .394). Self-Confidence (Factor 2) is moderately correlated with Alternative Usage (r = .421) and Creativity (r = .535). Similarly, Alternative Usage (Factor 3) shows a moderate correlation with Creativity (r = .463). The correlation values between each factor and the overall scale are notably high, indicating strong internal consistency. Creativity (Factor 4) exhibits the highest correlation with the overall scale (r = .802), followed closely by Self-Confidence (r = .790), Curiosity (r = .777), and Alternative Usage (r = .768). These findings suggest that all four factors contribute at a moderate to high level (Çokluk et al., 2012) to the overall construct of innovation attitude in elementary school students.

Table 10

Independent Group T-Test Results based on the Lower-Upper Group Variable

Factor	Group	N	Mean	sd	t	sd	p
Curiosity (Factor 1)	The Upper %27 Group	80	14.46	.50	22.04	158	0.00
	The Lower %27 Group	80	9.30	2.0			
Self-Confidence (Factor 2)	The Upper %27 Group	80	14.73	.44	17.99	158	0.00
	The Lower %27 Group	80	9.62	2.50			
Alternative Usage (Factor 3)	The Upper %27 Group	80	14.31	.73	17.26	158	0.00
	The Lower %27 Group	80	9.42	2.42			
Creativity (Factor 4)	The Upper %27 Group	80	14.86	.34	22.41	158	0.00
	The Lower %27 Group	80	9.17	2.24			
Scale Overall	The Upper %27 Group	80	56.36	1.87	21.29	158	0.00
	The Lower %27 Group	80	37.98	7.48			

Table 10 presents the results of the independent samples t-test conducted to compare the upper 27% group and the lower 27% group in terms of their scores on the Attitude Scale Toward Innovation for Elementary School Students. The findings indicate statistically significant differences *(p < .001)* across all factors and the overall scale. The mean score for Curiosity (Factor 1) was higher in the upper 27% group (M = 14.46, SD = 0.50) compared to the lower 27% group (M = 9.30, SD = 2.00), yielding a significant t-value ($t(158) = 22.04$, $p < .001$). Similarly, Self-Confidence (Factor 2) showed a significant difference between the upper 27% group (M = 14.73, SD = 0.44) and the lower 27% group (M = 9.62, SD = 2.50), with $t(158) = 17.99$, $p < .001$. For Alternative Usage (Factor 3), the upper 27% group (M = 14.31, SD = 0.73) scored significantly higher than the lower 27% group (M = 9.42, SD = 2.42), $t(158) = 17.26$, $p < .001$. A similar trend was observed in Creativity (Factor 4), where the upper 27% group (M = 14.86, SD = 0.34) outperformed the lower 27% group (M = 9.17, SD = 2.24), $t(158) = 22.41$, $p < .001$. The overall scale score also indicated a significant difference, with the upper 27% group (M = 56.36, SD = 1.87) scoring higher than the lower 27% group, $t(158) = 21.29$, $p < .001$. These results suggest that the scale effectively differentiates students with high and low attitudes toward innovation, supporting its construct validity.

Table 11

Test-Retest Reliability of the Attitude Scale Toward Innovation for Elementary School Students

Factor	N	r	p
Curiosity (Factor 1)	93	.537	.000
Self-Confidence (Factor 2)	93	.530	.000
Alternative Usage (Factor 3)	93	.679	.000
Creativity (Factor 4)	93	.529	.000
Scale Overall	93	.753	.000

Table 11 presents the test-retest reliability results for the Attitude Scale Toward Innovation for Elementary School Students, based on a sample of 93 participants. The test-retest method involves applying the same test to the same individuals at different times under similar conditions. The reliability coefficient of this method shows the consistency and invariance of the property evaluated by the measurement tool over time (Doğan & Aybek, 2021). The correlation coefficients (r)between the two administrations of the scale indicate moderate to high stability over time, with all correlations being statistically significant *(p < .001)*. The test-retest reliability values for the subdimensions range between 0.529 and 0.679, demonstrating a consistent pattern across factors. The overall scale shows a higher

stability with a correlation coefficient of 0.753, indicating strong reliability in measuring students' attitudes toward innovation over time. These findings support the temporal consistency of the scale, suggesting that it provides reliable and consistent measurements across different time points.

4. Conclusion and Discussion

As a result of this study, which aimed to develop a measurement tool to assess elementary school students' attitudes toward innovation, the Attitude Scale Toward Innovation for Elementary School Students was developed, consisting of 4 factors and 12 items. The results of the exploratory factor analysis (EFA) indicate that the four factors comprising the scale explain 55.66% of the total variance. These factors were named Curiosity, Self-Confidence, Alternative Usage, and Creativity. Additionally, first-order and second-order confirmatory factor analysis (CFA) tests were conducted to validate the developed model. The results of the CFA tests indicate that the model demonstrates an excellent fit.

In the present study, the Attitude Scale Toward Innovation was developed to measure elementary school students' dispositions across four dimensions: Curiosity, Self-Confidence, Creativity, and Alternative Usage. Although these dimensions have been individually addressed in various instruments across the literature, no existing scale was found to incorporate all four constructs in a unified framework specifically designed for children. A review of previously developed innovation scales for adults reveals that the factors of Creativity (Ovacı & Yıldırım Saatçi, 2020), Self-Confidence (Altınışık et al., 2023), and Alternative Usage (Altınışık et al., 2023; Girardi et al., 2005) are similarly present in various scale applications, further confirming the theoretical relevance of these constructs. Yıldız (2021), in her social innovation scale, emphasized individuals' ability to find alternative solutions to social problems, revealing a conceptual overlap with the "Alternative Usage" dimension of this study. Furthermore, scales developed by Flight et al. (2011) and Alegre and Chiva (2006) include constructs such as "creativity" and "novelty seeking," supporting the theoretical basis for the curiosity and creativity dimensions identified here. In Clauss's (2016) Business Model Innovation Scale, dimensions such as "resource recombination" and "radical creativity" also parallel the notion of repurposing and imaginative transformation reflected in the Alternative Usage dimension of the current scale. Collectively, these studies support the multidimensionality and conceptual validity of the proposed scale by demonstrating that its components reflect broader theoretical constructs previously validated in innovation research, now adapted to the developmental context of elementary education.

Creativity and innovation are critically important at both individual and institutional levels for generating new ideas and their transformation into tangible products, processes, or services (Maravilhas, 2015; Patil, 2024). As the driving force of the innovation process, creativity facilitates developing new ideas and redesigning existing products or processes (Cropley, 2006; Okpara, 2007). Designing a product is achievable only through the combined application of creativity and innovation (Medyna et al., 2013). However, while creativity is a necessary condition for innovation, it is not sufficient on its own; suitable contexts in which creativity can thrive must also be established (Nayak & Agarwal, 2011). In this regard, it can be stated that creativity is a crucial component of innovation and that the emergence of innovation requires the creation of environments conducive to creativity.

Alternative usage is applying existing products in new domains or for different functions. Literature review reveals that alternative usage is considered one of the fundamental elements of innovation and is frequently mentioned in definitions of the concept. Damiano (2011) defines innovation as assigning new areas of use to a product. Similarly, Boak (2022) emphasizes that for an idea to be innovative, it must be new and valuable—in other words, innovation involves making existing elements more functional or practical. Boak (2022) describes innovation as not merely creating something new but ensuring it is good, essentially transforming what already exists into something more useful. Schumpeter (1911) emphasized that innovation is not necessarily about creating a new product but about discovering new areas of use for existing ones. These perspectives in the literature suggest that

innovation is not limited to producing new products but also involves modifying and transforming existing ones.

Curiosity is regarded as a fundamental element of innovation at both individual and societal levels, serving as the driving force behind scientific activities (Nowotny, 2008; Walsh et al., 2022). The relevant literature indicates that curiosity predicts innovation (Celik et al., 2016) and stimulates creativity (Gross et al., 2020). In this context, curiosity and creativity emerge as indispensable components of pursuing innovation (Ivancovsky et al., 2023), guiding individuals toward exploratory processes (Kuo, 2019). Thus, the motivational impact of curiosity plays a critical role in the emergence of innovation and innovative approaches.

Individual traits such as self-confidence, self-efficacy, and creativity are key determinants of innovation. High levels of self-confidence enhance individuals' willingness to take risks, facilitating their engagement in innovative endeavors (Karahan & Patir, 2021; Koellinger, 2007). Self-efficacy positively influences innovation by supporting individuals' motivation (Benabou & Tirole, 2002; Kumar & Uzkurt, 2010). Creative self-efficacy, in combination with self-beliefs such as identity, mindset, and metacognition, is a significant factor that strengthens individuals' innovative potential (Puente-Díaz & Karwowski, 2017). However, the impact of self-confidence may not always be positive; while over-optimism can be positively associated with innovation, overly critical self-confidence may lead to adverse outcomes (Herz et al., 2014). Innovation also requires persisting in seeking solutions despite setbacks, which indicates individuals' innovation skills (Gerber et al., 2012). Therefore, self-confidence can be regarded as a crucial element for innovative endeavors, aligning with the findings of this study.

In measurement tools developed for elementary school students in Turkey, 3-point (Uysal & Sarıça, 2018), 4-point (Akar & Uluçınar, 2023), and 5-point Likert-type response formats (Balantekin & Oksal, 2014; Hacıömeroğlu et al., 2013; Tahiroğlu & Çakır, 2014) have been utilized. However, considering the cognitive developmental characteristics of children, it has been noted that Likert scales based on verbal frequency expressions (e.g., “never” to “always”) are more comprehensible for students aged 6–10 compared to numeric ratings and yield greater consistency than yes/no formats (Mellor & Moore, 2014). The study by Adelson and McCoach (2010) also demonstrated that, within this age group, the 5-point Likert format provides higher reliability, stronger factor structures, and fewer model misfits compared to the 4-point version. Furthermore, students did not show an excessive tendency to select the neutral option. In addition, the use of visually supported Likert scales with facial expressions enhances children's engagement with all response categories, increases response variance, and improves data quality (Hall et al., 2016). In line with the literature, the present study concluded that the 5-point emoji-supported Likert scale offers a valid and reliable structure suitable for use with elementary school students.

Future research is recommended to apply the scale across a broader range of grade levels to assess its developmental appropriateness and structural stability. For younger students, such as those in 1st and 2nd grades, simplified item wording and visually supported response formats (e.g., pictorial Likert scales) may be necessary to accommodate their cognitive and linguistic capabilities. Applications with upper primary grades, such as 5th and 6th, could further test the consistency of factor structures and reveal how attitudes toward innovation evolve with age. These efforts would contribute to validating the scale as a developmentally robust instrument for longitudinal and cross-sectional research in primary education.

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reveal how attitudes toward innovation evolve with age. These efforts would contribute to validating the scale as a developmentally robust instrument for longitudinal and cross-sectional research in primary education. Furthermore, the scale can be utilized in future studies to examine how various demographic variables—such as gender, socioeconomic status, parental education level, and school type—affect students' attitudes toward innovation in elementary education. Such comparative analyses would help identify which student profiles are more inclined toward innovative thinking and could inform the development of targeted pedagogical strategies. In addition, both descriptive and correlational research could explore individual (e.g., self-efficacy, curiosity) and contextual (e.g., teacher support, classroom climate) variables that potentially enhance innovation in early education. Identifying these contributing factors at an early stage may facilitate the development of instructional practices that effectively nurture innovation-related dispositions among young learners.

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Attitude Scale Toward Innovation for Primary School Students

No	Item	Strongly Disagree 	Disagree 	Neutral 	Agree 	Strongly Agree 
1	Çevremde olanları gözlemlerim. (I observe what is happening around me.)					
2	Merak ettiğim konularda sorular sorarım. (I ask questions about topics I am curious about.)					
3	Yeni bir şey görünce onu dikkatle incelerim. (When I see something new, I scrutinize it.)					
4	Yeni bir şey üretirken güçlüklerle karşılaşınca pes etmem. (I do not give up when encountering difficulties while creating something new.)					
5	Hayallerimi gerçekleştirene kadar pes etmem. (I do not give up until I achieve my dreams.)					
6	Yeni bir şeyler yapma konusunda kendime güvenirim. (I am confident in my ability to create new things.)					
7	Kırılan oyuncaklarımı yeni oyuncaklara dönüştürürüm. (I transform broken toys into new ones.)					
8	Atık malzemelerden yeni şeyler üretmeyi severim. (I enjoy creating new things from waste materials.)					
9	Farklı şeylerden kendime yeni oyuncaklar üretmeyi severim. (I like making new toys for myself from different materials.)					
10	Hayal gücümü kullanmayı gerektiren etkinlikleri severim. (I like activities that require using my imagination.)					
11	Yeni bir şeyler icat etmek isterim. (I want to invent new things.)					
12	Yeni şeyler icat edebildiğim dersleri severim. (I enjoy lessons where I can invent new things.)					

Items 1, 2 and 3 Curiosity, Items 4, 5 and 6 Self-Confidence Items 7, 8 and 9 Alternative Usage, Items 10, 11 and 12 are included in Creativity factors. There is no reverse item. (İlkokul Öğrencileri için İnovasyona Yönelik Tutum Ölçeği - Madde 1, 2 ve 3 Merak, Madde 4, 5 ve 6 Özgüven Madde 7, 8 ve 9 Farklı Kullanım, Madde 10, 11 ve 12 Yaratıcılık faktörleri içerisinde yer almaktadır. Ters madde bulunmamaktadır.)

We support open science policy. For this reason, you can use the scale in educational research in which the scale is implemented to students with ethics committee permission with citation. For other purposes, please contact the authors. (Açık bilim politikasını destekliyoruz. Bu nedenle ölçeğin öğrencilere uygulandığı eğitim araştırmalarında etik kurul izni dahilinde atıf vererek kullanabilirsiniz. Farklı amaçlardaki araştırmalar için lütfen yazarlar ile iletişime geçiniz.)