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A STUDY ON DEVELOPMENT OF PERCEPTION SCALE REGARDING 21ST CENTURY LEARNING AND INNOVATION SKILLS

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Öz

21. yüzyıl öğrenme ve yenilik becerileri, günümüz eğitim anlayışında oldukça önemli bir konumda yer almakta olup, Milli Eğitim Bakanlığı tarafından yapılan eğitim planlamalarında da büyük bir öneme sahiptir. Bu beceriler sayesinde bireyler, daha üretken, yaratıcı, liderlik vasıflarına sahip ve etkin kişiler olarak yetiştirilmektedir. Bu bağlamda, öğrencilerin söz konusu becerilere ilişkin algılarının doğru ve güvenilir bir şekilde ölçülmesine yönelik geçerli bir ölçek geliştirme ihtiyacı ortaya çıkmıştır. Bu amaç doğrultusunda geliştirilen ölçek, Türkiye genelinde farklı şehir ve okullarda öğrenim görmekte olan toplam 630

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öğrenciye uygulanmıştır. Uygulama sonucunda elde edilen verilerin 309'una açımlayıcı faktör analizi, 321'ine ise doğrulayıcı faktör analizi yapılmıştır. Yapılan istatistiksel analizler neticesinde, geliştirilen ölçeğin 18 maddeden oluştuğu ve üç temel faktörü içerdiği belirlenmiştir. Ölçeğin tamamı için hesaplanan Cronbach Alfa güvenilirlik katsayısı .86 seviyesinde iken, alt faktörlerin güvenilirlik katsayıları .68 ile .95 arasında değişiklik göstermektedir. Bu kapsamlı bulgular, geliştirilen ölçeğin öğrencilerin 21. yüzyıl öğrenme ve yenilik becerilerine ilişkin algılarını ölçmekte hem geçerli hem de güvenilir bir araç olduğunu güçlü bir şekilde ortaya koymaktadır.

Anahtar Kelimeler: 21. Yüzyıl Becerileri, Öğrenme ve Yenilik Becerileri, Algı Ölçeği, Ölçek Geliştirme.

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Abstract

21st-century learning and innovation skills hold a significant position in contemporary educational paradigms and play a crucial role in the educational planning carried out by the Ministry of National Education. These skills enable individuals to develop into more productive, creative, and leadership-oriented, as well as effective persons. In this context, there emerged a necessity to develop a valid and reliable scale to accurately measure students' perceptions regarding these skills. Accordingly, the developed scale was administered to a total of 630 students studying in various schools across different cities in Türkiye. Exploratory factor analysis was conducted on data obtained from 309 students, while confirmatory factor analysis was applied to data from 321 students. Statistical analyses revealed that the scale consists of 18 items and encompasses three fundamental factors. The Cronbach's alpha reliability coefficient for the entire scale was calculated as .86, whereas the reliability coefficients for the sub-factors ranged between .68 and .95. These comprehensive findings strongly indicate that the developed scale is a valid and reliable instrument for measuring students' perceptions of twenty-first century learning and innovation skills.

Keywords: 21st Century Skills, Learning and Innovation Skills, Perception Scale, Scale Development.

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INTRODUCTION

The formation of an education system is inherently linked to the applied educational approach and philosophy centered on human development. According to the educational planning of the Ministry of National Education (MEB), equipping students with 21st-century skills is of paramount importance (EARGED, 2011). The cultivation and monitoring of these competencies within the education system are influenced by key factors such as pedagogy, curriculum design, school regulations, school climate, and assessment methods (Lai & Viering, 2012). Given that classrooms serve as the primary environments where teachers implement these skills, students observe them in practice, and subsequently apply them, preparing not only students but also educators for this process is essential (Kim, Raza, & Seidman, 2019). Therefore, instructional practices designed to enhance the development and dissemination of 21st-century competencies among educators play a crucial role in ensuring their widespread adoption (EARGED, 2011; Kim et al., 2019).

Given today's rapidly changing economic landscape coupled with globalization pressures necessitating collaboration across various domains like creativity synthesis or critical thinking capabilities—the demand remains high now more than ever before—to adeptly combine established knowledge bases into applicable problem-solving scenarios proficiently addressing real-world challenges faced continuously throughout life experiences (Rotherham and Willingham, 2010). To support professional growth aligned accordingly P21 Partnership founded collectively uniting educationalists alongside industry leaders resulted ultimately generating comprehensive guidelines known commonly referred under "P21 Framework" utilized widely across different countries including USA (P21, 2019). "This framework is widely utilized in the United States and numerous other countries. Each component of 21st-century skills, positioned at the core of modern

learning, holds significant importance. These foundational attributes contribute to cultivating holistic, lifelong learner mindsets, as illustrated in Figure 1."

Figure 1.

P21 framework for 21st-century learning (P21, 2019)



As evidenced, Figure 1 depicts four primary categories encapsulating overarching themes that directly contribute to advancing excellence among students. These themes establish pathways that facilitate their successful adaptation to emerging global innovations, achieved through enhanced collaborative efforts exemplified therein (P21, 2019). Critical thinking involves the activation of cognitive processes centered on evaluation methodologies that integrate innovative solutions. These solutions are derived through deductive or inductive reasoning, enabling constructive interpretations that foster the generation of new ideas. This, in turn, leads to tangible outcomes that benefit all stakeholders involved (Gelen, 2017). Participation in inquiry-based activities conducted collaboratively among peers, further complemented by online forums and platforms, facilitates opportunities for enhancing proficiency levels

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over time, undoubtedly elevating the standards expected in higher-order intellectual engagements (Larson and Miller, 2011).

Competencies in information, media, and technology encompass proficiency in information literacy, media literacy, and digital communication and technological fluency (P21, 2019). "Apart from basic reading comprehension, possessing the capability to retrieve and apply information, critically evaluate content, effectively utilize technology in both educational and everyday settings, and assess the reliability of media sources has become essential, particularly with advancements in technology. (Gelen, 2017). As technology becomes an integral part of education, students must develop the capability to leverage digital tools for information retrieval, structuring data effectively, and critically assessing content across online platforms (Larson and Miller, 2011).

Life and career competencies encompass several key areas: the ability to be flexible and adaptable, taking initiative and demonstrating self-direction, engaging in social and intercultural interactions, maintaining productivity with accountability, as well as exhibiting leadership qualities along with a sense of responsibility. (P21, 2019). Learning is a continuous process that occurs not just within educational settings but also throughout various life experiences. Consequently, it is essential to actively engage, embrace change, communicate effectively, take responsibility, and appreciate cultural diversity as fundamental skills required for lifelong success. (Gelen, 2017).

When reviewing the measurement instruments created for 21st-century skills as discussed in existing literature, it becomes evident that these scales assess various aspects of perception and skill application. Table 1 provides a summary of several tools along with their respective characteristics used to evaluate 21st-century competencies found in the literature.

Table 1

Measurement Tools Developed for 21st-Century Skills and Their Characteristics

Authors	Developed measurement tool	Number of questions	Sub-dimensions	Study group
Gülen, 2013	Inventory of Usage Level of 21st Century Learning Skills	33	Active Learning Proficiency Level, Learning to Learn Skills Proficiency Level, Problem Solving Skills Proficiency Level and Collaboration and Communication Skills Proficiency Level	Middle school students
Ongardwanich, Kanjana wasee ve Tuipae, 2014	21st-century skills Scale	44	Life and Career Skills, Learning and Innovation Skills, Information-Media and Technology Skills	13-15 years old
Anagün, Atalay, Kılıç ve Yaşar, 2016	21st-century skills Competence Perception Scale	42	Life and Career Skills, Learning and Innovation Skills, Information-Media and Technology Skills	Teacher candidates
Boyacı ve Atalay, 2016	21st-century skills Scale	39	Life and Career Skills, Learning and Innovation Skills, Information-Media and Technology Skills	4th grade students
Çevik, M. & Şentürk C., 2019	Multidimensional 21st-century skills Scale	41	Information and Technology Literacy Skills, Critical Thinking and Problem-Solving Skills, Entrepreneurship and Innovation Skills, Social Responsibility and Leadership Skills, Career Awareness	15-25 years old

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Çoban, Bozkurt ve Kan, 2019	21st-century skills Scale	96	Creativity and Innovation, Critical Thinking and Problem Solving, Communication, Collaboration, Information Literacy, Media Literacy, Technology Literacy, Self-Management and Initiative, Productivity and Accountability, Leadership and Responsibility, Flexibility and Adaptability, Social and Intercultural Skills	Teachers
Eryılmaz, 2020	Data Collection Tool for 21st Century Learning Skills	73	Critical Thinking Skills, Collaboration Skills, Communication Skills, Creativity and Innovation Skills, Self-Directedness Skills, Global Connections, Local Connections and Using Technology as a Tool for Learning	High school students
Yalçın, Simsar ve Dinler, 2020	21st-century skills Scale	33	Life and Career Skills, Learning and Innovation Skills, Information-Media and Technology Skills	5-6 years old

In this research, the goal was to create a perception scale that includes items related to the sub-dimensions of “creativity and renewal,” “critical thinking and problem solving,” as well as “communication and collaboration.” This scale aims to evaluate middle school students' perspectives on learning and innovation skills relevant to the 21st century. While academic literature includes existing instruments for measuring 21st-century competencies at this level, this study seeks to

expand and refine national resources by specifically developing a perception-based scale centered on 'learning and innovation' skills.

The primary aim of this scale study was to examine secondary school students' perspectives on 21st-century skills. This research holds particular significance, as it seeks to assess students' perceptions across key subdimensions such as creativity and innovation, critical thinking and problem-solving, and communication and teamwork.

METHOD

This research is a scale development study. The processes followed in the development of the 21st Century Learning and Innovation Skills Perception Scale and the characteristics of the study group are presented below.

Working Group

The study group is comprised of students from various secondary schools in the Yenimahalle district of Ankara, specifically those enrolled in the 5th through 8th grades. For scale development research, it is essential that the sample size be at least five times greater than the number of items on the scale (Tavşancıl, 2002; Gorsuch, 1983). To ensure reliable analysis results for a scale initially containing 35 items, a sample size meeting this criterion was established, resulting in a total participation of 630 individuals. The demographic details pertaining to this study group are detailed in Table 2.

Table 2

Demographic Characteristics of the Study Group

Variables	Demographic characteristics	Number of Students	Percentage
Grade Level	5	146	23
	6	182	29

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	7	212	34
	8	90	14
Gender	Female	309	49
	Male	321	51
Total		630	100

Scale development process

In developing a perception scale for 21st-century learning and innovation skills, the initial step involved conducting a literature review to examine relevant studies and compile an item pool. The primary aim of this scale study was to examine secondary school students' perspectives on 21st-century skills. This research holds particular significance as it seeks to assess students' perceptions across key subdimensions, such as 'creativity and innovation,' 'critical thinking and problem-solving,' and 'communication and teamwork. Subsequently, these items were assessed by specialists from various fields—including one expert in Measurement and Evaluation, another from Educational Sciences, three professionals focused on Science Education, alongside one specialist in Turkish Education.

In accordance with expert assessments, three items that were deemed unsuitable for their designated subcomponents were excluded, along with seven items that lacked clarity and did not adhere to a sentence structure comprehensible to middle school students. Additionally, nine similar items were removed from the scale. Corrections and revisions of certain items were made based on feedback received. A pilot study involving eight students—two from each grade level—was conducted to assess the understandability of the scale's components. The researchers read the items aloud to these students and gathered their insights regarding how easily they could comprehend them. Ultimately, it was found that all presented items were understood without issue. The final version of the 35-item trial form included an explanation detailing its

intended purpose as well as instructions on how participants should complete it. All included statements expressed positive sentiments. Each item was assessed using a 3-point Likert scale (1-Never, 2-Sometimes, 3-Always). A total of 630 participants completed the evaluation process, with completion times ranging from 20 to 40 minutes depending on their grade level.

Data Analysis

The analysis of the scale data utilized SPSS version 25. Each item was assessed using a 3-point Likert scale (1-Never, 2-Sometimes, 3-Always). A total of 630 participants completed the evaluation process, with completion times ranging from 20 to 40 minutes depending on their grade level. Following the EFA results and item extraction based on established criteria, CFA was executed with the remaining items.

Initially, the Kaiser-Meyer-Olkin (KMO) test and Bartlett's test of sphericity were applied to determine the suitability of the dataset for factor analysis. After confirming that the data met the necessary criteria, exploratory factor analysis (EFA) with varimax rotation was employed to assess the scale's construct validity. The EFA revealed both the number of factors within the scale and how its items clustered under these factors. Subsequently, confirmatory factor analysis (CFA) was carried out to verify if the structure identified through EFA appropriately fit the data.

The CFA was conducted using the AMOS 25 program. The resulting structure of the scale was assessed by analyzing various fit and error indices derived from the CFA results. To assess the model fit, multiple statistical indices were examined, including chi-square (χ^2), Adjusted Goodness of Fit Index (AGFI), Goodness of Fit Index (GFI), Standardized Root Mean Square Residual (SRMR), Normed Fit Index (NFI), Non-Normed Fit Index (NNFI), Comparative Fit Index (CFI), and Root Mean Square Error of Approximation (RMSEA).

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To evaluate the scale's reliability, Cronbach's Alpha coefficient was calculated. This analysis was conducted both for the entire scale and for its individual subdimensions to ensure consistency across different components.

RESULTS

Results Regarding the Validity of The Scale

Factor analysis was conducted to assess the construct validity of the scale and evaluate item significance through their factor loadings. Prior to initiating the factor analysis, both the Kaiser-Meyer-Olkin (KMO) coefficient and Bartlett's test were computed to verify data appropriateness for this method. The KMO value should be a minimum of 0.5; values below this threshold are deemed inadequate, while adequacy improves as it approaches 1. KMO classifications include medium at 0.5-0.7, good at 0.7-0.8, very good from 0.8-0.9, and excellent above 0.9 (Kaiser, 1974; Akt Çolakoğlu & Büyükeksi, 2014). The results derived from this analysis are shown in Table 3.

Table 3

Data Regarding the Suitability of the 21st Century Learning and Innovation Skills Scale for Factor Analysis

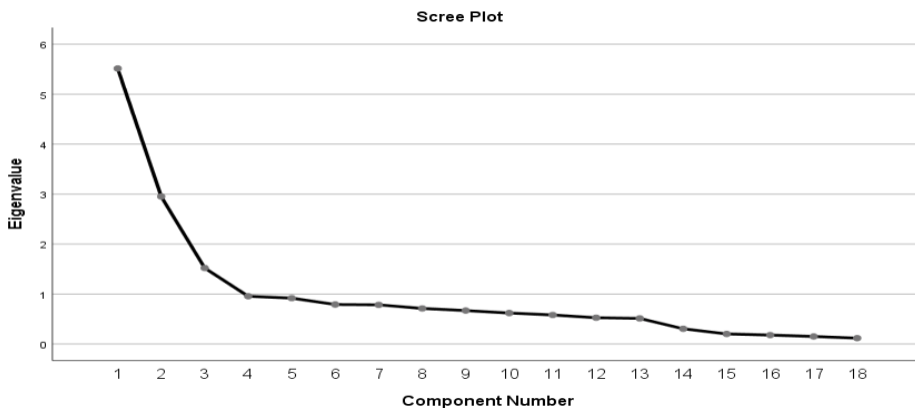
Kaiser-Meyer-Olkin (KMO) Sample Measurement Value Adequacy		,89
Barlett Sphericity Test	χ^2	2724,54
	df	153
	Sig.	,00

(p< .01)

As indicated in Table 3, the analysis yielded a KMO value of .89. This result suggests that the data is exceptionally suited for exploratory factor analysis (EFA). Furthermore, Bartlett's test [$\chi^2= 2724.54$, $sd= 153$ $p=.00$] also returned significant results. These findings confirm that all necessary conditions for conducting EFA are met. The initial EFA was performed on a scale consisting of 35 items. According to Brown (2006), rotation enhances item loading on one specific factor while reducing it on others, thereby facilitating easier interpretation by identifying items with strong relationships within their own group. Utilizing the Varimax rotation method during EFA revealed that the scale's data clustered into three distinct factors with eigenvalues exceeding 1, accounting for 55.47% of total variance explained. Upon reviewing item factor loadings, analyses were repeated after excluding items with low loadings (below .30), ambiguous overlapping items (with differences of .10 or less between loadings), and those loaded onto multiple factors individually from the original scale. Subsequently, an additional EFA was conducted using only the remaining 18 items. The final eigenvalues corresponding to these three identified factors are illustrated in Figure 2.

Figure 2.

Eigenvalues by factors



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The minimum threshold for factor loadings was set at .30, meaning that any items with loadings falling below this level were excluded from further analysis. The factors associated with the scale items and their respective factor loadings can be found in Table 4.

Table 4

Rotated Factor Loading Values of the Items of the 21st Century Learning and Innovation Skills Scale

Sub dimension	Substances	F1	F2	F3
Creativity and Renewal	m8	,94		
	m35	,92		
	m1	,92		
	m15	,91		
	m19	,87		
	m21	,86		
Critical Thinking and Problem Solving	m32		,70	
	m24		,68	
	m31		,65	
	m25		,61	
	m7		,53	
Communication and Collaboration	m33		,52	
	m12			,70
	m23			,64
	m5			,61
	m4			,59
	m17			,56
m34			,55	
Eigenvalue		5,51	2,95	1,52
Percentage of Variance Explained		30,63	16,40	8,45
Percentage of Total Variance Explained		55,48		

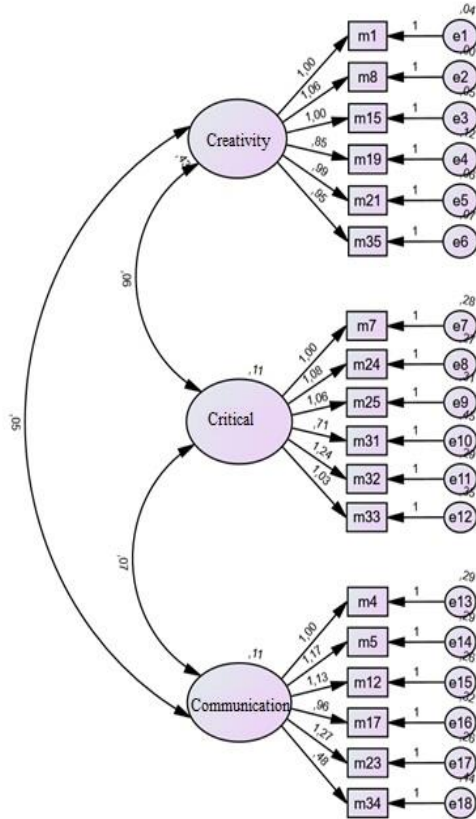
Table 4 presents the factor loading values for each scale item. Among the six items categorized under the first factor (m1, m8, m15, m19, m21, and m35), the maximum factor loading is .94 while the minimum is .86. The second factor encompasses six items (m7, m24, m25, m31, m32, and m33) with a highest loading of .70 and a lowest of .52. For the third factor that includes six items (m4, m5, m12, m17, m23, and m34), it has a peak loading value of .70 and a bottom value of .55. In determining component names consideration was given to their respective item structures. The first component accounts for 30.63% of total variance and is labeled "Creativity and Innovation." The second component explains 16.40% of total variance and is designated as "Critical Thinking and Problem Solving," whereas the third component represents 8.45% of total variance with its name being "Communication and Collaboration." "In multi-factorial designs, it is considered sufficient for the explained variance to be between 40% and 60% (Çokluk et al., 2018). In the literature, it is recommended that the factor loading value of an item should be at least .30 (Büyüköztürk, 2002). An examination of the EFA results in Table 5 reveals that the developed 18-item scale is structured around three distinct factors, each with eigenvalues exceeding 1. Collectively, these factors account for 55.48% of the total variance.

To further validate the integrity of this three-factor model, confirmatory factor analysis (CFA) was conducted to assess its construct validity (CFA). Figure 3 illustrates the structure achieved with the standardized scores from this model.

Figure 3

Path diagram related to the scale

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Chi-square = 164,38, df = 132, p- value=0,03 , RMSEA= 0,04

An examination of the EFA results in Table 5 reveals that the developed 18-item scale is structured around three distinct factors, each with eigenvalues exceeding 1. Collectively, these factors account for 55.48% of the total variance. To further validate the integrity of this three-factor model, confirmatory factor analysis (CFA) was conducted to assess its construct validity.

Table 5

Model Fit Indices and Criterion Value

	χ^2	Df	P	χ^2/df	RMS EA	CFI	GFI	NFI	AGF I
Criterion Values				≤ 2	≤.05	≥.95	≥.85	≥.90	≥ .85
Model Fit Indices	164,38	132	,03	1.24	,03	,99	,95	,96	,93

When analyzing the fit index values for the model, it is noted that the ratio of Chi-Square to degrees of freedom (χ^2/df) stands at 1.24. A value equal to or below 2 suggests a perfect model fit, while a value up to 5 indicates an acceptable level (Kline, 2013). Thus, based on this result, one can conclude that the model exhibits perfect fit. Additionally, Schumacher and Lomax (2004) state that an RMSEA value of .05 or lower, along with CFI above .95 and both GFI and AGFI exceeding .85—plus NFI greater than .90—demonstrate acceptable model fit indexes. In this analysis, the RMSEA was calculated as 0.03; therefore, confirming an acceptable fit according to its criteria. The examined fit indexes yielded results: CFI = .99, GFI = .94, NFI = 0.95, and AGFI = .93 which align with these established standards indicating that the overall model presents an acceptable fit quality.

Reliability

Cronbach’s Alpha is an internal consistency test widely utilized to assess the reliability of a perception scale focused on 21st-century learning and innovation skills. This metric can be computed for the entire scale, as well as for individual sections or items (Büyüköztürk, 2012). One significant advantage of Cronbach’s Alpha is its ability to highlight how each item or factor contributes to overall reliability. Additionally, it allows researchers to identify and remove items that detract from this reliability. The coefficient value of Cronbach’s Alpha ranges from 0 to 1; higher

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values indicate greater measurement reliability, with scores closer to 1 suggesting improved dependability. Reliability interpretations based on the Cronbach's Alpha coefficient are presented in Table 6 (Kalaycı, 2014).

Table 6

Comments Regarding Cronbach's Alpha Coefficient α Coefficient Comment

Cronbach's Alpha Coefficient	Comment
$0.80 \leq \alpha < 1.00$	Highly reliable
$0.60 \leq \alpha < 0.80$	Fairly reliable
$0.40 \leq \alpha < 0.60$	Low reliability
$0.00 \leq \alpha < 0.40$	Unreliable

According to Table 6, the developed scale exhibits values ranging from .40 to .60, indicating a low level of reliability. For the scale to be deemed reliable, Cronbach's Alpha should reach a minimum threshold of .60 or higher. It is noted that as this value nears 1, reliability improves. The analyses concerning the reliability of the perception scale related to 21st-century learning and innovation skills are presented in Table 7.

Table 7

Mean, Standard Deviation, Item Deletion Alpha Values and Cronbach's Alpha Values Obtained as a Result of the Analyses Conducted

Sub dimension	Item No.	Mean	Ss	Item Deletion α Value	α Value of Subscale	α Value of Scale
Creativity and Renewal	m8	2,37	,71	,95	,96	,86
	m35	2,37	,70	,95		
	m1	2,39	,71	,95		
	m15	2,35	,73	,95		
	m19	2,41	,69	,95		

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	m21	2,41	,70	,96	
	m32	2,47	,70	,64	
Critical Thinking and Problem Solving	m24	2,45	,65	,66	
	m31	2,27	,71	,69	,71
	m25	2,40	,67	,67	
	m7	2,50	,62	,67	
	m33	2,40	,67	,68	
		m12	2,39	,64	
Communication and Collaboration	m23	2,40	,67	,63	
	m5	2,44	,67	,64	,69
	m4	2,55	,62	,64	
	m17	2,29	,67	,66	
	m34	2,13	,71	,71	

Cronbach's Alpha internal consistency analysis was conducted on data gathered from middle school students. The results indicated a reliability coefficient of $\alpha = .95$ for the six-item 'creativity and renewal' subscale, $\alpha = .70$ for the six-item 'critical thinking and problem-solving' subscale, and $\alpha = .68$ for the six-item 'communication and collaboration' subscale. Interpreting these values in accordance with Table 7 indicates that each factor possesses adequate reliability. Furthermore, the overall Cronbach's Alpha coefficient for the complete 21st Century Learning and Innovation Skills Perception Scale was determined to be $\alpha = .86$, suggesting a high level of measurement reliability. Additionally, Table 8 presents mean scores, standard deviations of items, along with their impact on scale reliability if any item were to be deleted. These results demonstrate that all items enhance reliability and should remain included in the scale.

DISCUSSION

This study developed a measurement tool to examine middle school students' perspectives on 21st-century learning and innovation skills. The scale consists of 18 items distributed across three distinct subscales: 'creativity and renewal' (6 items), 'critical thinking and problem-solving' (6 items), and 'communication and collaboration' (6 items). Analyzing the

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factor loadings for these items revealed values ranging from .52 to .94. To ensure validity, Exploratory Factor Analysis (EFA) was conducted, followed by Confirmatory Factor Analysis (CFA), verifying the scale's effectiveness across various samples. The results from CFA indicate that there is coherence among the subscales and confirm that the scale functions effectively within different sample groups.

Cronbach's Alpha, a widely utilized method for assessing internal consistency in the social sciences, was chosen to evaluate the reliability of the scale (Yaşlıoğlu, 2017). This test enabled separate calculations for both overall item reliability and subscale reliability. The findings indicated that the "creativity and renewal" subscale exhibited a reliability coefficient of $\alpha=.95$, while "critical thinking and problem solving" had $\alpha=.70$, and "communication and collaboration" showed $\alpha=.68$. Overall, the entire scale achieved Cronbach's Alpha value of $\alpha=.86$. These results suggest that DOAÖ serves as an exceptionally reliable measurement instrument (Kalaycı, 2016). An additional analysis was performed to examine the potential impact of item removal on the scale's reliability. The findings revealed that each item contributed positively to the overall reliability metric; therefore, no items were excluded from the final version.

The 21st Century Learning and Innovation Skills Perception Scale is structured as a 3-point Likert scale, with response options ranging from 'Never' (1 point) to 'Sometimes' (2 points) and 'Always' (3 points). The total possible score on this 18-item scale ranges from a minimum of 18 (18×1) to a maximum of 54 (18×3). Higher scores reflect a positive perception of 21st-century learning and innovation skills, whereas lower scores indicate a less favorable outlook.

When reviewing the literature, it was found that various studies have assessed 21st-century skills. Existing research has established that measurement scales have been developed for various educational levels, including kindergarten (Yalçın et al., 2020), primary school (Arsad et al., 2011; Boyacı & Atalay, 2016), high school (Çevik & Şentürk, 2019;

Eryılmaz, 2020), undergraduate studies (Anagün et al., 2016, 2020; Orhan-Göksün, 2016; Özyurt, 2020; Yılmaz & Alkış, 2019), and school personnel (Çoban et al., 2019; Javed et al., 2019). However, scales developed specifically for secondary school students (Ball et al., 2010; Çevik & Şentürk, 2019; Hazar, 2019; Karakaş, 2015; Moto et al., 2018) tend to focus only on selected skills rather than providing a comprehensive assessment.

This scale distinguishes itself from existing measurement tools by providing a comprehensive assessment of secondary school students' 21st-century skills, integrating the competencies defined by P21 (2019). The studies evaluating the validity and reliability of this tool are based on data collected from a sample of 630 students enrolled in grades 5 through 8 at a secondary institution. Consequently, conducting similar research with diverse samples drawn from schools in various regions will enhance the evaluation of the findings related to validity and reliability analyses.

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GENİŞLETİLMİŞ ÖZET

Amaç

21.yüzyılda eğitim, bireylerin hızla değişen küresel dinamiklere uyum sağlayabilmelerini esas alarak yeniden şekillenmektedir. Bu doğrultuda çağdaş eğitim sistemleri, bireylerin yalnızca bilgiyle donatılmasını değil, aynı zamanda bu bilgiyi işleyebilen, yorumlayabilen ve farklı durumlara uygulayabilen bireyler olarak yetişmesini amaçlamaktadır. Bu süreçte yaratıcılık, yenilikçilik, eleştirel düşünme, iş birliği ve iletişim gibi beceriler, öğrencilerin hem akademik başarıya ulaşmalarında hem de gelecekteki profesyonel yaşamlarında etkin birer birey olarak yer almalarında belirleyici rol oynamaktadır. Günümüz dünyasında bu becerilere sahip bireylerin toplumsal gelişime katkı sağlama potansiyelleri de artmaktadır. Bu araştırma, ortaokul düzeyindeki öğrencilerin 21. yüzyıl öğrenme

ve yenilik becerilerine ilişkin algılarını belirleyebilecek bir ölçme aracı geliştirmeyi amaçlamaktadır. Geliştirilen ölçek aracılığıyla öğrencilerin bu becerilere yönelik öz değerlendirme düzeylerinin ortaya konması, eğitimciler açısından hem sınıf içi uygulamalarda hem de öğretim programlarının yapılandırılmasında yol gösterici veriler sunacaktır.

Yöntem

Bu araştırmada, öğrencilerin 21. yüzyıl öğrenme ve yenilik becerilerine ilişkin algılarını ölçmek üzere geçerli ve güvenilir bir ölçek geliştirmek amacıyla ölçek geliştirme yöntemi kullanılmıştır. Çalışma grubu, Ankara ilinin Yenimahalle ilçesinde bulunan devlet okullarında öğrenim görmekte olan 5., 6., 7. ve 8. sınıf öğrencilerinden oluşmaktadır. Toplamda 630 öğrencinin katılımıyla gerçekleştirilen uygulama, örneklem büyüklüğü açısından ölçek geliştirme çalışmaları için yeterli sayıda katılımcıyı içermektedir. Ölçek geliştirme süreci, öncelikle literatürde yer alan 21. yüzyıl becerileri ile ilgili güncel çalışmaların sistematik incelenmesi ile başlamıştır. Bu aşamada özellikle yaratıcı düşünme, eleştirel düşünme ve iş birliği temalarına odaklanılarak kapsamlı bir madde havuzu oluşturulmuştur. Oluşturulan maddeler, eğitim alanında uzman akademisyenler ve uygulamacıların görüşlerine sunulmuş, bu doğrultuda maddelerin dil ve içerik açısından uyumu sağlanmış ve gerekli düzeltmeler yapılmıştır. Anlaşılabilirliği artırmak amacıyla bazı maddeler ölçekten çıkarılmıştır. Ölçeğin hedef kitlenin dil ve kavrama düzeyine uygun olup olmadığını değerlendirmek amacıyla küçük çaplı bir pilot çalışma yapılmış, pilot çalışmadan elde edilen geri bildirimler doğrultusunda madde sayısı 18'e indirilmiştir. Son aşamada ölçeğin yapı geçerliliğini belirlemek için açımlayıcı faktör analizi (AFA) uygulanmış, ardından doğrulayıcı faktör analizi (DFA) ile faktör yapısının uygunluğu test edilmiştir. Ölçeğin güvenilirliği ise Cronbach Alfa katsayısı ile değerlendirilmiştir.

Bulgular

Geçerlilik ve güvenilirlik analizleri, geliştirilen ölçeğin güçlü bir ölçme aracı olduğunu göstermektedir. Kaiser-Meyer-Olkin (KMO) testi sonucu .89 olarak bulunmuş ve Bartlett'in testinin anlamlı çıkması, veri kümesinin faktör analizi için uygun olduğunu göstermiştir. AFA sonuçları, ölçeğin üç temel faktörden oluştuğunu ve toplam varyansın %55,48'sini açıkladığını ortaya koymuştur.

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DFA analizleri ise modelin yüksek uyum gösterdiğini doğrulamıştır ($\chi^2/df = 1.24$, RMSEA = 0.03, CFI = 0.99, GFI = 0.95, NFI = 0.96, AGFI = 0.93).

Güvenilirlik analizleri, ölçeğin genel Cronbach Alfa değerinin .86 olduğunu göstermektedir. Alt faktörlerin güvenilirlik katsayıları ise yaratıcılık ve yenilikçilik için .95, eleştirel düşünme ve problem çözme için .70, iletişim ve iş birliği için .68 olarak belirlenmiştir. Bu bulgular, ölçeğin öğrencilerin 21. yüzyıl öğrenme ve yenilik becerilerine yönelik algılarını doğru ve güvenilir bir şekilde ölçebildiğini göstermektedir.

Sonuç ve Tartışma

Araştırmanın bulguları, öğrencilerin 21. yüzyıl becerilerine dair algılarını değerlendirmek için güvenilir bir ölçüm aracının geliştirildiğini göstermektedir. Bu ölçek, ortaokul öğrencilerinin öğrenme ve yenilik becerileri hakkındaki algılarını ölçmede etkili bir yöntem sunarak eğitimciler için değerli içgörüler sağlamaktadır. Ölçeğin, P21'in 21. yüzyıl öğrenme modeli gibi uluslararası çerçevelerle uyumlu olması, ölçüm aracının akademik ve profesyonel standartlara uygun olduğunu ortaya koymaktadır.

Özellikle yaratıcılık ve yenilikçilik, eleştirel düşünme ve problem çözme ile iletişim ve iş birliği gibi temel becerileri kapsayan ölçek, eğitim ortamlarının bu becerileri daha iyi destekleyecek şekilde tasarlanmasını sağlayabilir. Gelecekte yapılacak çalışmalar, ölçeğin farklı eğitim bağlamlarında test edilmesini, ülkeler arası karşılaştırmaların yapılmasını ve öğrencilerin algılarının zaman içinde nasıl değiştiğini inceleyen uzun vadeli araştırmaları içerebilir. Bu tür çalışmaların bulguları, eğitim stratejilerini daha da iyileştirme ve öğrencilerin hızla değişen dünya koşullarına daha iyi uyum sağlamasına yardımcı olma fırsatı sunacaktır.

EXTENDED ABSTRACT

Purpose

Education in the 21st century is being reshaped based on the ability of individuals to adapt to rapidly changing global dynamics. Accordingly, contemporary education systems aim not only to equip individuals with knowledge but also to develop their capacity to process, interpret, and apply this knowledge in various contexts. In this process, skills such as creativity, innovation, critical thinking,

collaboration, and communication play a decisive role in students' academic success and their ability to function as effective individuals in their future professional lives. In today's world, individuals possessing these skills also have an increased potential to contribute to societal development. This study aims to develop a measurement tool capable of determining middle school students' perceptions regarding 21st-century learning and innovation skills. Through the developed scale, students' self-assessment levels of these skills will be revealed, providing educators with valuable data to guide both classroom practices and the structuring of curricula.

Method

This study employed a scale development method aimed at creating a valid and reliable measurement tool to assess students' perceptions of 21st-century learning and innovation skills. The study sample consisted of a total of 630 middle school students enrolled in grades 5, 6, 7, and 8 at public schools located in the Yenimahalle district of Ankara. The scale development process began with a comprehensive review of the relevant literature, focusing on themes such as creative thinking, critical thinking, and collaboration to form an extensive item pool. These items were reviewed and revised based on feedback from experts in the field to ensure content validity, clarity, and relevance. Items that were deemed unclear or ambiguous were removed to increase the scale's comprehensibility. Subsequently, a pilot study was conducted to evaluate whether the scale was easily understood by students, and based on the feedback, the final version of the scale was established with 18 items. To test the construct validity of the scale, exploratory factor analysis (EFA) was conducted, followed by confirmatory factor analysis (CFA) to assess the model fit. Additionally, the reliability of the scale was examined using Cronbach's alpha coefficient.

Findings

Validity and reliability analyses indicate that the developed scale is a robust measurement tool. The Kaiser-Meyer-Olkin (KMO) test result was .89, and Bartlett's test confirmed the suitability of the data set for factor analysis. The EFA results revealed that the scale comprised three main factors and explained 55.48% of the total variance. The CFA results confirmed a high model fit ($\chi^2/df = 1.24$, RMSEA = 0.03, CFI = 0.99, GFI = 0.95, NFI = 0.96, AGFI = 0.93). Reliability analysis showed that the overall Cronbach's alpha coefficient of the scale was .86. The reliability coefficients for the sub-dimensions were .95 for

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creativity and innovation, .70 for critical thinking and problem-solving, and .68 for communication and collaboration. These findings demonstrate that the scale can reliably and accurately measure students' perceptions of 21st-century learning and innovation skills.

Conclusion and Discussion

The findings of the study indicate that a reliable measurement tool has been developed to assess students' perceptions of 21st-century skills. This scale provides valuable insights for educators by offering an effective method to evaluate middle school students' perceptions of learning and innovation skills. The alignment of the scale with international frameworks such as the P21 21st Century Learning Model shows that the instrument complies with both academic and professional standards.

The scale, which encompasses key skills such as creativity and innovation, critical thinking and problem-solving, and communication and collaboration, can support the design of educational environments that better foster these competencies. Future research could involve applying the scale in different educational contexts, conducting cross-national comparisons, and carrying out longitudinal studies to examine how students' perceptions evolve over time. Findings from such research would help further refine educational strategies and better equip students to adapt to the rapidly changing global landscape.

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Yazar Katkıları: Yazarlar; bu makalenin araştırılması, yazarlığı ve yayımlanması için eşit düzeyde katkı sağlamışlardır.

Çıkar Çatışması: Yazar(lar); bu makalenin araştırılması, yazarlığı ve yayımlanmasına ilişkin herhangi bir potansiyel çıkar çatışması beyan etmemiştir.

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