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Metaverse Perception Scale Development and Validation

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Abstract

The metaverse, perceived as the next phase of the Internet, promises to transcend mere upgrades by integrating transformative technologies such as artificial intelligence, virtual reality, and blockchain, which form the foundations of its structure. However, the absence of a standardized scale to assess perceptions of the metaverse poses a considerable limitation to studies in social science on this topic. This study developed a measurement tool that can be used in social science investigations to address this gap. Working with experts in the field, we created a pool of items encompassing six dimensions and 67 items. Exploratory factor analysis examined the data collected from 209 participants, and the confirmatory factor analysis assessed data from 247 participants. The proposed scale comprises 25 statements and six dimensions: (i) anxiety, (ii) education, (iii) entertainment, (iv) psychosocial effect, (v) knowledge-sharing, and (vi) business.

Keywords

metaverse, metaverse scale, scale development, metaverse perception, metaverse usage

Introduction

Our experience of the Internet is currently evolving. The emerging technology that integrates real and digital environments in an online three-dimensional virtual reality setting is conceptually defined by the term "metaverse." The origins of the term can be traced back to science fiction literature, including *Snow Crash* (Stephenson, 2008), which describes future worlds where individuals can wholly live their lives in virtual settings. However, the contemporary definition of the metaverse focuses on creating enduring, immersive, and interconnected virtual spaces that accommodate multiple simultaneous users, enabling real-time communication and dynamic interactions with digital elements (Britannica, 2022). The impact of the metaverse will extend beyond entertainment and gaming and may affect various facets of daily life, including social interactions (Lee et al., 2021). As the infrastructure for the metaverse becomes more accessible and cost-effective, the potential for its integration into different areas of people's lives increases (Bibri & Jagatheesaperumal, 2023; Cheng, 2023; Dwivedi et al., 2022; Kiaer, 2024; Tan & Salo, 2021). This evolution will create new applications for the technology and cause a surge in its adoption (Far et al., 2023), yielding a proliferation of diverse and innovative technologies that will redefine our lives and further drive down accessibility costs (Saradha, 2023).

By providing a fully immersive reality that can run parallel to our physical world, the metaverse is transforming our digital experiences. Although still in its nascent stages, within the metaverse, users can shop like they do in the physical world, experience sports they have not had the opportunity to experience in real life, visit new places that would normally be beyond their means, and interact with businesses, people, and AI chatbots on a never-before-imagined scale (Qiu et al., 2022). Moreover, researchers, industry leaders, and policymakers are already exploring potential usage areas and debating how the metaverse may impact our lives. In one study, Hwang and Chien (2022) examined the possible impact of the metaverse on the field of education. They

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Data Availability Statement included at the end of the article

describe how its implementation could produce substantial educational advantages, especially in medicine, nursing, health education, military education, language learning, and applied sciences, and, training using the metaverse can reduce costs and lower risks to students compared to real-life situations. By offering a wide range of interactive learning environments and game-based structure, the metaverse can also increase students' motivation and promote active participation (Díaz, 2020; Nurhidayah et al., 2020). Furthermore, it will help to overcome the limitations of the 2D learning environment (Mystakidis, 2022). Although they may initially encounter some technical difficulties, students easily adapt to the new learning environment and eventually improve their problem-solving skills. It was also reported that students are more satisfied with their learning experience in the metaverse and find these types of educational programs more attractive than classroom-based learning (Suh & Ahn, 2022). The metaverse's interactive and engaging nature increases its potential to impact our education system beyond our current vision (Belmonte et al., 2022), most notably benefiting scientific disciplines and technology-based industries.

The metaverse has the potential to transform the healthcare industry by providing innovative solutions in several key areas, including delivering telemedicine services and training healthcare professionals. The immersive environment of the metaverse can be used for virtual medical training, enabling healthcare professionals to perform complex procedures and surgeries without risking patients or requiring expensive physical resources (Han & Oh, 2021). The Proteus effect—where individuals adapt their behavior to match their virtual avatars (Qiu et al., 2022) —may also affect our approach to healthcare and change the healthcare sector globally (Navarro et al., 2020; Rheu et al., 2020). Because increased use of the metaverse may change people's real-world practices, the Proteus effect could be used to promote healthy lifestyles, and emphasize the benefits of wellness and preventive care. The emergence of the metaverse and the impact of the Proteus effect on public behavior within healthcare education and telemedicine services will represent a significant advancement in the integration of technology with public health interventions.

Regarding businesses, the metaverse offers significant entrepreneurial and commercial opportunities (Kim, 2021) and can be considered a "new marketing universe" (Hollensen et al., 2023). Its use may provide a strategic advantage to brands by facilitating rapid interactions and transactions with their consumers (Barrera & Shah, 2023), in addition to helping them reach their target market easily and efficiently. From a social dynamics perspective, the metaverse can reshape social interactions, ideologies, power relations, societal structures, and communication practices (Bojic, 2022; Mamychev, 2022). The metaverse enables individuals to transcend physical barriers to communicate and interact with people from different locations around the globe (Dwivedi et al., 2022; Kiaer, 2024). The borderless environment can increase cultural exchange, collaboration, and understanding among diverse groups of people, bringing them closer to each other. Therefore, the transformative influence of the metaverse on interpersonal connections and societal dynamics should not be overlooked, and such benefits highlight its potential to redefine our online experiences and reshape society (Cui & Du, 2023). We should not only recognize these profound societal impacts but also critically consider the key technological innovations driving this transformation. The "metadatabase" is becoming a key part of the current technological revolution, along with other technologies, including the blockchain, virtual reality, augmented reality, artificial intelligence, and the Internet of Things (Yang et al., 2022). The developing metaverse has attracted considerable attention from various international companies and governments and is expected to reach a transaction volume of USD 800,000,000 in 2024 (Blomberg, 2022).

This remarkable technological evolution that is exemplified by the metaverse parallel universes will have widespread societal impacts and profound effects on businesses and economies. These impacts, therefore, underscore the imperative need for robust academic research, especially in the social sciences, to understand and navigate the complexities brought about by this digital age. As the concept of the metaverse progresses from theory to practical implementation, questions regarding concerns for individuals, businesses, and advertisers are inevitable. While the metaverse presents businesses with unique opportunities to expand their consumer base and develop relationships with potential customers in the digital space, customers and advertisers face novel issues that require careful consideration. Hence, although this evolving environment warrants investigation, there is a notable gap in the literature regarding specific measurement scales developed explicitly for this new area of study. This lack of measurement tools presents a significant challenge yet provides researchers with the opportunity to develop innovative research techniques to facilitate in-depth analyses in this evolving field. A novel standardized measurement tool should be developed to capture the complexity and multidimensional nature of the metaverse and how it is perceived by both users and non-users. Such a measurement tool will enable comprehensive research, facilitate analysis of the metaverse's impacts, and enable management to make informed decisions about how to benefit from its use. In sum, the emergence of the metaverse requires interdisciplinary research and collaboration across various fields of

science and technology. This collaboration is essential to fully understand and exploit the potential of the metaverse because it combines elements of natural, social, cognitive, and cyber sciences to create a new and dynamic digital environment. However, current studies in the literature are limited and focus mainly on the use of the metaverse in education.

One measurement tool was developed by Belmonte et al. (2022) to evaluate students' educational experiences in the metaverse. The scale consisted of eight dimensions: interaction with technology, intrinsic possibilities, accessibility and management, interaction, interest, motivation, learning, and netiquette. In separate studies, Erol et al. (2023) and Vural and Başaran (2022) respectively developed scales to measure beliefs about education and perceptions of non-fungible token (NFT) technology. Another scale was developed by Süleymanoğulları et al. (2022) and was based on four metaverse dimensions: technology, digitalization, social, and lifestyle. Their scale aimed to assess individuals' attitudes and behaviors toward the metaverse in various aspects of their lives, including technology usage, digitalization, social interactions, and lifestyle choices. However, the measurement items fail to fully encompass the breadth and depth of the dimensions claimed by the authors. Notably, because the few relevant studies in the literature focus on specific aspects of the metaverse—such as education and technology—they do not comprehensively analyze specific perceptions of the metaverse. Therefore, in this study, a metaverse perception scale was developed to fill this research gap and provide a holistic assessment of people's perceptions of the metaverse and its impact. The scale provides a nuanced understanding of the effects of the metaverse on individuals' perceptions and behaviors.

This novel measurement tool will not only facilitate in-depth research in multiple domains such as education, social sciences, business, medicine, engineering, tourism, and healthcare but also provide insights into the multifaceted impact of the metaverse on society. Moreover, this new measurement tool facilitates a standardized assessment of people's perceptions of the metaverse and provides a clear path for advances in metaverse research. By comparing perceptions across different groups and contexts, valuable insights into how metaverse universes are perceived and experienced in various settings are generated and can be used to shed light on the multifaceted societal impacts caused by increased use of the metaverse.

Purpose of the Study

Because uptake of the metaverse is gaining traction in many fields, from education to marketing, it is essential to develop an overview of people's perceptions of its use and practical implications to identify and meet individuals' expectations and needs. This study, therefore, developed a measurement tool for determining individuals' perceptions of the metaverse and aimed to assess its validity.

Table 1. Dimensions and Sources.

Dimension	Sources
Anxiety	Qiu et al. (2022) and Lee et al. (2021)
Education	Belmonte et al. (2022), Díaz (2020), and Hwang and Chien (2022)
Entertainment	Kim (2021) and Suh and Ahn (2022)
Psychosocial Effect	Cui and Du (2023) and Mamychev (2022)
Knowledge-sharing	S. M. Park and Kim (2022) and Süleymanoğulları et al. (2022)
Business	Hollensen et al. (2023) and Barrera and Shah (2023)

All the items were developed by authors specifically for this study based on theoretical insights into metaverse-related dimensions and expert reviews. Due to the novelty of the metaverse as a research area, as explained previously, existing scales were unable to comprehensively analyze specific perceptions of the metaverse, which required an original approach to item development. The scale items aimed to assess the participants' perceptions of the metaverse in six areas (Table 1):

i) Anxiety: the metaverse may present potential challenges concerning the psychological well-being of the users, especially youth. Overusing or excessive engagement with virtual environments may lead to identity confusion between an avatar and a real-life personality, as well as isolation from the physical world. These concerns reflect the broader anxieties about the psychological effects of immersive technologies (Lee et al., 2021; Qiu et al., 2022).
ii) Education: the metaverse holds significant promise for educational innovations by offering interactive and gamified environments that can boost student motivation and engagement (Belmonte et al., 2022; Díaz, 2020), especially in fields such as medicine, engineering, and tourism, which may benefit from metaverse-enabled training by reducing risks and costs compared to real-world scenarios (Hwang & Chien, 2022). Moreover, reports show higher satisfaction of students with metaverse-based learning compared to traditional classrooms (Belmonte et al., 2022).
iii) Entertainment: in the metaverse, entertainment is predicted to be transformed into real-life-like

experiences due to more immersive virtual experiences (Kim, 2021). The ability to explore new places, experience virtual sports, and seamlessly switch between games enhances its appeal as a primary entertainment platform (Suh & Ahn, 2022).

iv) Psychosocial Effect: the metaverse may significantly impact psychosocial dynamics by fostering self-confidence and enabling safer social interactions. It also promotes collaboration and cultural exchange across geographic boundaries, reshaping societal structures and interactions (Cui & Du, 2023; Mamychev, 2022). Such effects highlight its potential to redefine interpersonal connections in the digital age.

v) Knowledge-sharing: the metaverse is anticipated to become a hub for global collaboration and rapid information exchange. Professionals may share their ideas and expertise and engage in cross-cultural projects that are facilitated by the borderless nature of virtual environments (S. M. Park & Kim, 2022; Süleymanoğulları et al., 2022).

vi) Business: the metaverse is seen as a growing commercial place with opportunities for digital marketing and entrepreneurship. Contrary to regular websites, in virtual spaces, businesses can efficiently interact with customers in real-time as in the physical world, but with minimal capital to establish significant ventures (Barrera & Shah, 2023; Hollensen et al., 2023). Economic forecasts predict its transaction volume to reach substantial figures, emphasizing its economic relevance (Blomberg, 2022).

Importance of the Study

The COVID-19 pandemic accelerated the digitization of many aspects of our lives and increased the importance of virtual worlds. Virtual worlds are emerging as a new alternative to the physical world (Lee et al., 2021), and augmented reality and virtual reality technologies have paved the way for the formation of the metaverse. In 2021, important announcements regarding the Facebook app attracted attention worldwide because they were made within the metaverse, helping the concept reach wider audiences (Aburbeian et al., 2022). In the current body of literature, existing studies related to the metaverse are mainly conceptual (reviews) and qualitative, although these studies have been conducted in different disciplines (Duan et al., 2021; Kim, 2021; Kye et al., 2021; S. M. Park & Kim, 2022; Sparkes, 2021; Stokel-Walker, 2022), they are primarily focused on the field of education (Narin, 2021). These studies mainly used qualitative research methods—such as semi-structured questions, interviews, observations, and audio and video recordings (Díaz et al., 2020; Nurhidayah et al., 2020). Only a few studies have developed measurement scales, specifically those assessing the use of the metaverse in education (Belmonte et al., 2022; S. Park et al., 2021; Süleymanoğulları et al., 2022). Therefore, this study contributes to the literature by developing a quantitative measurement tool to record perceptions of the metaverse universe, which can be used in future projects across different fields of research.

Given the possible significant impacts of the metaverse on businesses, economies, and people's social lives, research that utilizes robust social science research techniques is necessary. The creation of a standardized measurement tool that can capture the complexity and multidimensional nature of the metaverse was essential to ascertain how individuals perceive the metaverse and investigate the antecedents and consequences of their perceptions. The flexibility of the tool lies not only in helping researchers understand the effects of the metaverse on individuals and society but also in formulating strategies for its future development and regulation. The measurement tool provides a standardized technique to evaluate people's perceptions regarding the metaverse and compare perceptions across different groups and contexts, providing valuable insights into how the metaverse is perceived and experienced.

This tool can help businesses better understand how consumers think, feel about, and interact with the metaverse. With these insights, businesses can design more targeted marketing strategies, develop products that align with consumer needs, and connect with their audience more effectively in virtual environments. Additionally, the tool can help identify important factors like consumer anxiety, preferences for knowledge-sharing, and expectations around entertainment, enabling businesses to fine-tune their offerings for different groups. For educational institutions, it can provide valuable information about students' perceptions, which can then be used to create better learning environments that address their needs and concerns. The scale works as a self-assessment tool for individuals, giving them a clearer understanding of their relationship with the metaverse and helping them engage with these technologies more meaningfully and productively.

Materials and Methods

Scale Development

This study utilizes the scale development steps outlined by DeVellis (2022, pp. 73–115), which can be summarized as follows:

1. Clear identification of the construct that is to be measured.
2. Creation of an initial item pool.
3. Determination of the scale type.
4. Evaluation of the initial item pool by experts.
5. Addition of specific structures and items to the pool for validity.
6. Initial field application of the revised item pool.
7. Item analysis and revision.
8. Optimization of the scale length.

After completing the above steps, the final version of the scale was used to collect data for cross-testing of the item pool using exploratory and confirmatory factor analyses, and validity and reliability tests.

Process

In the scale development process, the metaverse was initially examined as a concept, and a literature review was conducted to determine the scope and framework to be used in the development of the envisaged measurement tool. Based on the studies identified in the literature review, it was determined that the scale should consist of a total of six dimensions: (i) anxiety, (ii) education, (iii) entertainment, (iv) psychosocial effect, (v) knowledge-sharing, and (vi) business.

A pool of items was established to encompass the six dimensions, each comprised of three to five items. For each dimension, an item pool was generated with a minimum of three times the number of planned items (DeVellis, 2022), with a minimum of 12 items in each dimension. We also selected experts based on their knowledge of the metaverse spaces. A total of 14 professors from the computer sciences, sociology, business, and physiology departments of three universities were consulted. Of these, consensus was reached with 10 experts. The remaining four were not included in the final review due to their relatively limited knowledge of the metaverse compared to the others. In addition to field experts, five language experts were consulted based on their experience in academic writing and psychometric scale development experiences. Consequently, 83 items (more than 12 items generated for the Psychosocial Effect dimension) were presented to the 10 experts for review. All 10 experts were professors from the following domains: two from the domain of computer sciences, two from sociology, four from business, and two from physiology.

After amending the items based on the experts' feedback, the 83-item pool was sent to five language experts to assess the content and language validity (DeVellis, 2022; Lynn, 1986). Expert evaluations on items are usually obtained using a four-item ranking scale ranging from 1 (not suitable at all) to 4 (very suitable; Waltz & Bausell, 1981); however, in this study, we asked the experts to evaluate each item on a scale between 1 and 10 (1 = not suitable at all, and 10 = perfect) to make the selection process much more stringent. The four-item ranking method was modified because it includes items with an average score of three or higher, resulting in a loss of sensitivity. In the modified evaluation method, the items were graded from 1 to 10, and items with an average of 7.5 or higher were included in the scale, which produced a more stringent selection process. The item content validity index (I-CVI) and the scale content validity index (S-CVI) were calculated during the evaluation phase. Based on the expert opinions, items with an I-CVI lower than 7.5 were removed, some items were combined, and some items were reworded to improve clarity. As a result, the number of items in the item pool was reduced to 67, and the scale dimensions were unaltered.

A pilot study was conducted with the participation of 74 people who were reached by a convenient sampling method. In the questionnaire, a free-text entry space was provided underneath each of the 67 items so participants could comment on each item. These 74 people ranged in age from 26 to 45, with 18 being master's students, 13 doctoral students, and the remaining 23 individuals primarily academics affiliated with the universities where the authors are employed. The feedback was evaluated and shared with the experts, and agreed-upon changes were made before the main field study was initiated. During the field study, we asked the participants ($n = 209$) to assess their metaverse knowledge using a scale of 1 to 5 (1: very limited; 2: limited; 3: moderate; 4: good; and 5: very good). Exploratory factor analysis (EFA) was performed on the data, and reliability analyses were performed to determine the internal consistency of the items. During the field study, the items in the questionnaire were mixed in order to prevent items measuring the same dimension from appearing one after the other, so the participants had to think about each item before responding. Three items were rephrased and strategically placed within the scale to identify and mitigate contradictory responses. Responses containing any of these three items that deviated beyond ± 1 were excluded from the analyses, resulting in the removal of 17 completed questionnaires.

The EFA and reliability tests were carried out using SPSS 26.0 software. A two-tailed test was used in all statistical analyses, with the significance level set at 0.5. The Kaiser–Meyer–Olkin (KMO) sample adequacy test and Bartlett's Test of Sphericity were used to test the suitability of the data set for factor analysis (Carpenter, 2018). Although a KMO value greater than 0.50 and a significant result in the Bartlett test are sufficient (Carpenter, 2018; Fields, 2002; Sarstedt & Mooi, 2014), we only

accepted KMO values greater than 0.70 (Sarstedt & Mooi, 2014). Principal component analysis (PCA) with no rotation method was used to determine the number of factors. PCA was then performed using the direct Oblimin rotation (Oblimin with Kaiser normalization rotation) method. Additionally, correlation values for each item were assessed, and a correlation threshold value of .90 was accepted (Sarstedt & Mooi, 2014).

The determinant value was also assessed. Tabachnick and Fidell (2013) stated that the closeness of the determinant to zero in the correlation matrix formed between items signifies the presence of a multicollinearity problem. Therefore, the determinant value threshold was set to 0.0001, serving as the criterion for multicollinearity (Field, 2018, p. 560). For discriminant validity, each item was grouped under a single factor, ensuring no cross-loading of factors and confirming that the correlation with another factor in the correlation matrix was less than 0.70 (Field, 2018, p. 560). The threshold value for each item's factor loading was set to 0.50, and items below 0.50 were removed from the analysis. In reverse image correlation, .50 was accepted as the critical value, and statements below this value were removed (J. F. J. Hair et al., 2010). The average variance extracted (AVE) of each scale is considered acceptable when AVE $\geqslant$ 0.50. The composite reliability (CR) should be $\geqslant$ 0.70 and also greater than the square root of AVE (Field, 2018; Fornell & Larcker, 1981; J. F. J. Hair et al., 2010; J. F. Hair et al., 2022).

The determination of the number of factors was based on several criteria, including Eigenvalue (Eigenvalue $>$ 1), examination of the visual scree plot, and ensuring the relevance of items grouped under each factor. Each dimension was named according to the items clustered under it. Cronbach's alpha values were interpreted as follows: perfect if $>$.90, excellent if between .80 and .90, good if between .70 and .80, acceptable if between .60 and .70, and not acceptable if $<$.60 (Aslan et al., 2020). Confirmatory factor analysis (CFA) was performed using a different sample in the AMOS statistical program to confirm the dimensions obtained by EFA (Cabrera-Nguyen, 2010).

Sampling

The study population was composed of people over 18 years old living in Türkiye. The convenience sampling method, which allowed efficient data collection from participants with varying familiarity with the metaverse, was employed due to its practicality in exploratory research where initial validation of a new scale is prioritized. The convenience sampling method may introduce sampling bias, which is mitigated by ensuring diversity in demographics, including education levels and professional backgrounds. The questionnaires were distributed in electronic form. A brief explanation of the metaverse and a video were included in the survey forms, and links to websites were provided for those who wanted to read more in-depth information. The surveys were distributed between December 5, 2023, and January 30, 2024. A total of 226 surveys were collected, and following EFA, 17 responses were excluded due to incomplete or contradictory answers. Hence, the EFA was performed on 209 completed surveys. Data for the CFA were collected between February 8, 2024, and March 2, 2024. A total of 271 surveys were returned, and 14 were excluded due to incomplete or contradictory answers. The CFA was conducted on data from 247 completed surveys.

According to MacCallum et al. (1999) and Thompson (2004), a sample size of 60 is sufficient if the factor loadings are $\geqslant$0.60, and a sample size of 100 to 200 is sufficient if factor loadings are ˜0.50. Therefore, the factor loadings are the essential criteria, not the sample size. This was discussed in a meta-study by Carpenter (2018) that assessed 600 scale-development articles and found that 54 out of the 600 studies used sample sizes of $\leqslant$ 100, and 108 studies employed sample sizes of 101 to 200. Furthermore, when considering the minimum sample size as the ratio of the number of cases (N) to the number of model parameters requiring statistical estimates (q), the recommended sample size-to-parameter ratio (N:q) is 20:1 (Kline, 2010). Additionally, according to J. F. J. Hair et al. (2010), the sample size should be 10 times the number of items of the largest formative structure or 10 times the number of variables in the model (whichever is larger), although the path coefficient and significance levels should also be considered. In this case, the minimum sample size was calculated as 155 participants, with a minimum path coefficient of $\geqslant$0.20 and a significance level of $\geqslant$5%. Hence, the obtained sample size of 209 was deemed to be sufficient for the EFA, and that of 247 was sufficient for the CFA. The average age of the participants in the EFA was 34.39 years, and in the DFA, it was 34.65 years. The demographic characteristics of the participants are given in Table 2.

Results and Discussion

Exploratory Factor Analysis (EFA)

In the first run, the KMO value was 0.915, the chi-square value was 9,610.967 (p = .000), and the determinant value was 2.303×10^{-30}, considerably smaller than the threshold value of 0.0001. Consequently, it was concluded that there was multicollinearity among the items, and the anti-image matrix was employed to identify the items to be removed from the analysis. After determining and removing the items individually (the analysis was repeated after each removal), the number of items in the

Table 2. Demographics of the Participants.

Demographics	Value	EFA		CFA	
		Frequency	%	Frequency	%
Gender	Male	95	45.5	101	40.9
	Female	114	54.5	146	59.1
Age	18–25	76	36.4	80	32.4
	26–35	47	22.5	51	20.6
	36–45	41	19.6	60	24.3
	46 and over	45	21.5	56	22.7
Education level	High school	9	4.3	50	20.2
	University	107	51.2	119	48.2
	Graduate school	93	44.5	78	31.6
Marital status	Married	131	62.7	109	44.1
	Single	78	37.3	138	55.9
Knowledge about the metaverse	Very limited	7	3.3	46	18.6
	Limited	48	23.0	54	21.9
	Moderate	60	28.7	86	34.8
	Good	78	37.3	42	17.0
	Very good	16	7.7	19	7.7
Total		209		247	

pool was reduced to 53 (from the initial 67). At this stage, the KMO value was 0.914, the chi-square value was 6,921.674 (df = 1,275 and p = .000), and the determinant value was 2.717×10^{-4}, higher than the threshold value of 0.0001. In addition, the items with bivariate correlation values >.80 were removed to prevent multicollinearity (Field, 2018, p. 686).

During the EFA process, items with the closest and highest factor loadings under two factors were sequentially removed, and the analysis was repeated each time. Subsequently, items with factor loadings < 0.50 were individually removed, starting from the lowest factor loading, and the analysis was repeated after each removal. Items that were categorized under a factor other than the planned one were identified and removed one at a time and the analysis was repeated after each removal. In the final run, the KMO value was 0.892, the chi-square value was 3,404.883 (df = 325, p = .000), and the determinant value was 3.55×10^{-8}. The EFA analysis revealed a six-dimensional scale structure (Table 3) and was visually verified by a scree plot (Figure 1).

Furthermore, throughout the factor analysis process, the regression scores for the scales were saved as variables, and correlation analysis was run, and results are reported in Table 4.

As shown in Table 3, the average within-factor correlation value was .203, much lower than the overall mean value of .611.

The analyses revealed that the scale produced in this study satisfies both convergent and discriminant validity criteria, as well as reliability criteria.

Confirmatory Factor Analysis (CFA)

The following fit indices and their acceptable levels were adopted to assess model fitness: discrepancy over the degree of freedom (CMIN/df) is acceptable if ⩽ 3 (Kline, 2010) and reasonable if ⩽ 5 (Marsh & Hocevar, 1985). A goodness of fit index (GFI) value >0.8 is acceptable (Baumgartner & Homburg, 1996; Doll et al., 1994), a value ⩾ 0.9 indicates a reasonable fit (Hu & Bentler, 1999), while ⩾ 0.95 is deemed to be an excellent fit (Kline, 2010; West et al., 2012). For the adjusted goodness of fit index (AGFI), a value >0.8 is acceptable (Baumgartner & Homburg, 1996; Doll et al., 1994), while a value ⩾ 0.9 indicates a reasonable fit (Tabachnick & Fidell, 2013). In the comparative fit index (CFI), a value ⩾ 0.9 is acceptable (Fan et al. (1999), while a value ⩾ 0.95 indicates a reasonable fit (Kline, 2010; West et al., 2012), and a value of 1 indicates a perfect fit (Hu & Bentler, 1999).

The Tucker–Lewis Coefficient (TLI) value (also known as Bentler–Bonett non-normed fit index [NNFI]) ranges from 0 to 1. A value that is close to 1 represents a very good fit, with 1 demonstrating a perfect fit (Bentler & Bonett, 1980; Tucker & Lewis, 1973). When the standardized root mean squared residual (SRMR) value and the root mean square error of approximation (RMSEA) value are ⩽ 0.08, this signifies an acceptable fit (Hu & Bentler, 1999; Kline, 2010).

The CFA was performed using the AMOS statistical software package, as shown in Figure 2, and the results are reported in Tables 5 and 6.

As shown in Table 5, the standardized regression weights of all items were found to be above the threshold

Table 3. Factor Loadings of the Items..

Items	1	2	3	4	5	6
S32 (Metaverse'te oyunların daha keyifli olacağını düşünüyorum)	**0.741**	0.152	−0.113	0.111	0.124	0.014
S28 (Metaverse'ün eğlenmek için ideal bir ortam olacağını düşünüyorum)	**0.732**	−0.030	0.094	0.039	−0.024	0.162
S36 (Metaverse'te bir oyundan diğerine geçebilme imkanı hoşuma gider)	**0.703**	−0.114	0.076	0.109	−0.079	0.063
S44 (Metaverse'teki oyunlarda daha fazla etkileşim olacaktır)	**0.689**	0.003	0.386	0.016	−0.060	−0.050
S30 (Hayal ettiğim herşeyi yaşabildiğim Metaverse'ün, beni gerçek dünyadan uzaklaştırcağını ve olumsuz etkileyeceğini düşünüyorum)	−0.021	**0.886**	−0.014	0.087	0.026	−0.073
S31 (Metaverse'te çok fazla zaman harcarsam, avatarım ve gerçek kişiliğim arasında kimlik karmaşası yaşayacağımı düşünüyorum)	−0.012	**0.885**	−0.007	0.049	0.000	0.103
S29 (Metaverse gerçeklik algımı etkileyeceği için psikolojimi bozacağını düşünüyorum)	0.079	**0.834**	−0.027	−0.025	0.080	−0.181
S40 (Metaverse'te fazla zaman geçirmemin, beni gerçek dünyada yalnızlaştıracağını düşünüyorum)	0.003	**0.765**	0.058	−0.073	−0.164	0.080
S48 (Metaverse'te gerçek kişiliğimi bulabileceğimi düşünüyorum)	−0.103	0.071	**0.848**	0.093	0.084	0.051
S47 (Metaverse daha özgüvenli olmamı sağlayacaktır)	0.089	−0.063	**0.800**	−0.011	−0.051	0.113
S49 (Metaverse'te arkadaşlıkların daha az riskli olacağını düşünüyorum)	−0.015	−0.011	**0.748**	0.030	0.120	0.064
S46 (Metaverse'te tanımadığım insanlardan ihtiyaç duyduğum yardımı alabileceğime inanıyorum)	0.152	−0.015	**0.735**	−0.010	0.178	−0.041
S62 (Metaverse'te sanal arazi satın alım-satımı yapabileceğimi düşünüyorum)	0.076	−0.017	−0.031	**0.884**	−0.061	−0.083
S60 (Metaverse'te kullanılan sanal ürünler için para harcayabilirim)	−0.039	0.075	−0.028	**0.779**	−0.027	0.159
S63 (Metaverse'te az bir sermaye ile çok büyük bir işletme kurabileceğimi düşünüyorum)	0.162	−0.044	0.002	**0.755**	0.095	−0.098
S61 (Metaverse'te satılan fiziki (gerçek) ürünler için para harcayabilirim)	−0.148	0.018	0.170	**0.717**	0.019	0.072
S64 (Metaverse iş dünyasında, gerçek dünyadaki işimden daha çok kazanç elde edebileceğimi düşünüyorum)	0.187	−0.004	−0.054	**0.706**	0.193	0.002
S02 (Metaverse'te farklıülkelerden insanlarla bilgi paylaşımının mümkün olacağını düşünüyorum)	−0.011	−0.033	−0.004	0.086	**0.856**	0.055
S01 (Metaverse'te tecrübeli kişilerle ortak proje yapma imkanı olacağını düşünüyorum)	0.030	−0.056	0.089	0.054	**0.786**	−0.017
S04 (Metaverse ile bilgi paylaşımı ve bilgiye erişimin çok daha hızlı ve etkin olacağını düşünüyorum)	0.080	−0.054	0.065	0.045	**0.750**	0.003
S03 (Metaverse'te mesleki tecrübelerimi başkalarıyla paylaşabileceğimi düşünüyorum)	−0.023	0.034	0.127	−0.075	**0.734**	0.159
S15 (Metaverse'te verilecek olan herhangi bir eğitimin faydalı olacağını düşünüyorum)	−0.013	−0.069	−0.043	−0.018	0.161	**0.800**
S17 (Metaverse'te eğitim almanın, öğrenmeyi kolaylaştıracağını düşünüyorum)	0.033	−0.061	0.038	0.112	0.035	**0.792**
S13 (Metaverse'ün tıp, mühendislik, turizm gibi uygulamalı eğitimler için faydalı olacağını düşünüyorum)	0.052	0.087	0.079	−0.058	−0.026	**0.787**
S21 (Metaverse ile kaliteli eğitimin yaygınlaşacağını düşünüyorum)	0.193	−0.109	0.114	0.187	0.038	**0.564**
Cronbach alpha	**0.855**	**0.872**	**0.784**	**0.876**	**0.849**	**0.852**
AVE	**0.513**	**0.712**	**0.615**	**0.594**	**0.613**	**0.551**
CR	**0.808**	**0.908**	**0.864**	**0.879**	**0.863**	**0.828**

Note. Dimensions: 1-Entertainment; 2-Anxiety; 3-Psychosocial effect; 4-Business; 5-Knowledge-sharing; 6-Education. **Bold** values indicate the items that load most strongly onto each respective factor, representing their corresponding dimension.

value (>0.50). Moreover, all fit indices of the refined six-factor model—comprising knowledge-sharing, business, entertainment, psychosocial effect, education, and anxiety—demonstrated a satisfactory fit with the data, as shown in Table 6.

The internal consistency and validity of the final six-factor solution are shown in Table 7. The Fornell–Larcker (1981) criterion, which compares the construct correlation value with the square root of the AVE and the maximum shared squared variance (MSV), was used to assess the

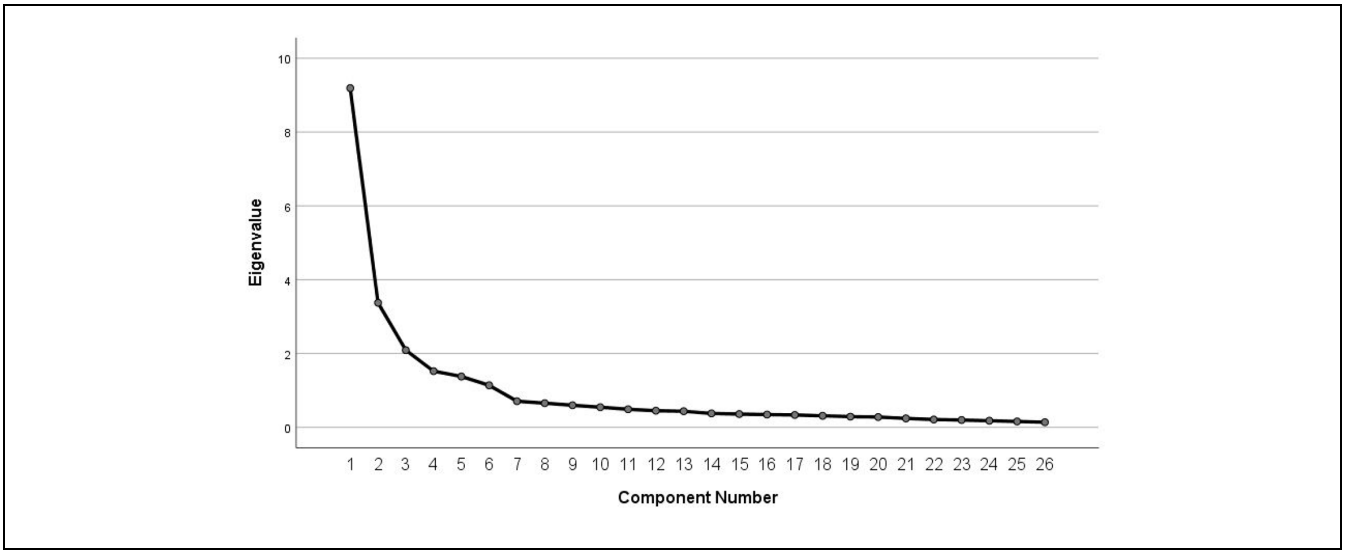

Figure 1. Scree plot.

Table 4. Scale Correlations.

Factor	1	2	3	4	5	6	Overall
Average within-factor correlation	0.549	0.631	0.665	0.580	0.650	0.589	0.611

discriminant validity. The MSV value should be smaller than the CR value (J. F. J. Hair et al., 2010). Additionally, according to the Fornell–Larcker (1981) criterion, discriminant validity is established if the square root of the AVE of a construct is greater than the correlation between that construct and any other constructs. Furthermore, the maximum H reliability value (MaxR(H) should be higher than the CR value. As shown in Table 7, for all constructs, the AVE values were >0.5; CR values were >0.7; square roots of the AVE values were >0.7; MSV values were smaller than the CR values; and the MaxR(H) values were greater than the CR values.

Since all the assessed criteria were satisfied, the newly developed six-dimensional scale was deemed to be valid measurement tool.

Correlation and MultiGroup Analyses

The correlation of the developed scale's dimensions was checked using the participants' demographics and the other dimensions, as shown in Table 8.

As shown in Table 8, the metaverse knowledge of the participants positively correlated with the scale's entertainment, education, and knowledge-sharing dimensions. Moreover, the entertainment dimension of the scale positively correlated with all scale dimensions except for the anxiety dimension. This finding shows that participants who perceive the metaverse as an entertainment platform have less anxiety. Notably, the anxiety dimension is negatively correlated with both the education and business dimensions of the scale. Hence, participants who perceive the metaverse as useful for business or education are less likely to report feelings of anxiety.

Although the education dimension is positively correlated with participants' age, education level, and metaverse knowledge level, as well as the dimensions of metaverse knowledge, entertainment, education, and knowledge-sharing, it is negatively correlated with the anxiety dimension. This suggests that the perception of the metaverse in education increases in line with participants' age, education level, and metaverse knowledge. The perception of the metaverse in the knowledge-sharing dimension increases as the participants' education and metaverse knowledge levels increase. Furthermore, the business dimension is positively correlated with all the scale dimensions except for the anxiety dimension.

Comparisons

We compared the statistical significance of the mean differences between genders using an independent sample *t*-

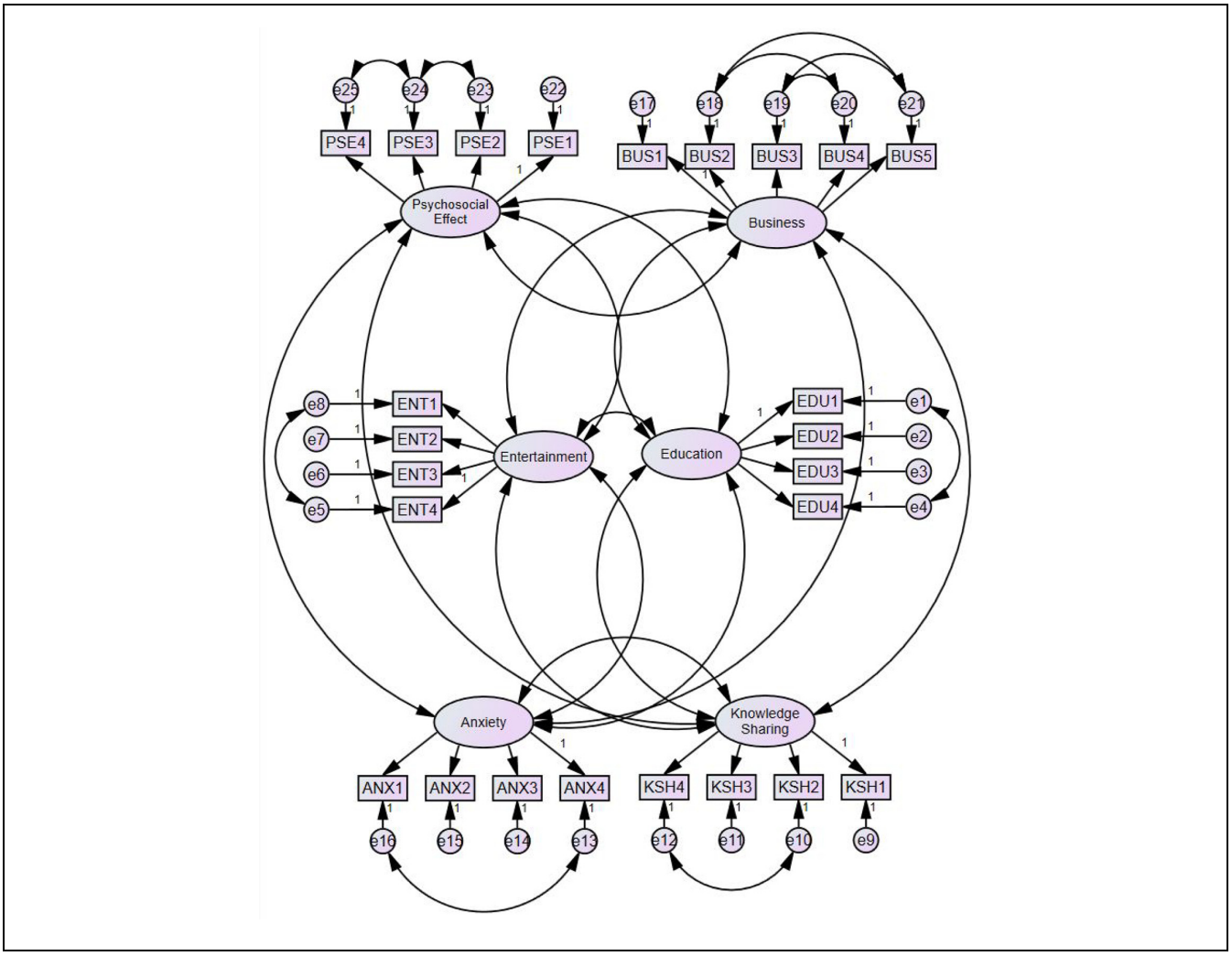

Figure 2. Research model.

test. The significance of the mean differences among age, education level, and metaverse knowledge groups was assessed using one-way ANOVA, followed by least significant difference (LSD) and Games–Howel post-hoc tests.

Gender

The mean differences among genders were significant only in the knowledge-sharing dimension ($M_{\text{male}} = 3.8550$; $M_{\text{female}} = 3.6259$; $\Delta M = 0.22915$; $SD = 0.09953$; $p = .022$) of the novel metaverse perception scale. This finding suggests that men exhibit a stronger inclination toward knowledge-sharing behaviors within the metaverse context compared to women.

Age

The mean differences were significant only in the education ($f(3,243) = 8.824$; $p = .000$) and knowledge-sharing dimensions ($F(3,243) = 5.601$; $p = .001$), as shown in Table 9.

In the education and knowledge-sharing dimensions, the Post-Hoc LSD test for multiple comparisons revealed significant differences in the mean values of participants aged $\leqslant 25$ years compared to all other age groups ($p = .000$ for all differences). Additionally, the mean values across the age groups indicate that the perceived usefulness of the metaverse increases with age. However, in the knowledge-sharing dimension, participants aged $\geqslant 46$ years were not significantly different to those aged $\leqslant 25$ years.

Table 5. Standardized Regression Weights (Default Model).

Path			Estimate
EDU1 (Metaverse'te verilecek olan herhangi bir eğitimin faydalı olacağını düşünüyorum)	<---	Education	0.884
EDU2 (Metaverse'te eğitim almanın, öğrenmeyi kolaylaştıracağını düşünüyorum)	<---	Education	0.883
EDU3 (Metaverse ile kaliteli eğitimin yaygınlaşacağını düşünüyorum)	<---	Education	0.675
EDU4 (Metaverse'ün tıp, mühendislik, turizm gibi uygulamalı eğitimler için faydalı olacağını düşünüyorum)	<---	Education	0.867
ENT4 (Metaverse'teki oyunlarda daha fazla etkileşim olacaktır)	<---	Entertainment	0.723
ENT3 (Metaverse'te bir oyundan diğerine geçebilme imkanı hoşuma gider)	<---	Entertainment	0.814
ENT2 (Metaverse'te oyunların daha keyifli olacağını düşünüyorum)	<---	Entertainment	0.881
ENT1 (Metaverse'ün eğlenmek için ideal bir ortam olacağını düşünüyorum)	<---	Entertainment	0.836
KSH1 (Metaverse'te farklıülkelerden insanlarla bilgi paylaşımının mümkün olacağını düşünüyorum)	<---	Knowledge_Sharing	0.851
KSH2 (Metaverse'te tecrübeli kişilerle ortak proje yapma imkanı olacağını düşünüyorum)	<---	Knowledge_Sharing	0.793
KSH3 (Metaverse ile bilgi paylaşımı ve bilgiye erişimin çok daha hızlı ve etkin olacağını düşünüyorum)	<---	Knowledge_Sharing	0.760
KSH4 (Metaverse'te mesleki tecrübelerimi başkalarıyla paylaşabileceğimi düşünüyorum)	<---	Knowledge_Sharing	0.715
ANX4 (Metaverse'te fazla zaman geçirmemin, beni gerçek dünyada yalnızlaştıracağını düşünüyorum)	<---	Anxiety	0.705
ANX3 (Metaverse gerçeklik algımı etkileyeceği için psikolojimi bozacağını düşünüyorum)	<---	Anxiety	0.792
ANX2 (Metaverse'te çok fazla zaman harcarsam, avatarım ve gerçek kişiliğim arasında kimlik karmaşası yaşayacağımı düşünüyorum)	<---	Anxiety	0.824
ANX1 (Hayal ettiğim herşeyi yaşabildiğim Metaverse'ün, beni gerçek dünyadan uzaklaştırcağını ve olumsuz etkileyeceğini düşünüyorum)	<---	Anxiety	0.982
BUS1 (Metaverse'te kullanılan sanal ürünler için para harcayabilirim)	<---	Business	0.798
BUS2 (Metaverse'te satılan fiziki (gerçek) ürünler için para harcayabilirim)	<---	Business	0.777
BUS3 (Metaverse'te sanal arazi satın alım-satımı yapabileceğimi düşünüyorum)	<---	Business	0.856
BUS4 (Metaverse iş dünyasında, gerçek dünyadaki işimden daha çok kazanç elde edebileceğimi düşünüyorum)	<---	Business	0.701
BUS5 (Metaverse'te az bir sermaye ile çok büyük bir işletme kurabileceğimi düşünüyorum)	<---	Business	0.793
PSE1 (Metaverse'te tanımadığım insanlardan ihtiyaç duyduğum yardımı alabileceğime inanıyorum)	<---	Psychosocial_Effect	0.511
PSE2 (Metaverse'te arkadaşlıkların daha az riskli olacağını düşünüyorum)	<---	Psychosocial_Effect	0.588
PSE4 (Metaverse daha özgüvenli olmamı sağlayacaktır)	<---	Psychosocial_Effect	0.673
PSE3 (Metaverse'te gerçek kişiliğimi bulabileceğimi düşünüyorum)	<---	Psychosocial_Effect	0.992

Table 6. Model Fit Indices.

Model Fit Indices	Acceptable level	Model
χ^2/df	<3	1.729
GFI	>0.80	0.879
AGFI	>0.80	0.842
RMSEA	<0.08	0.055
SRMR	<0.08	0.069
TLI	>0.90	0.944
CFI	>0.90	0.953

Education Level

The mean differences were significant in the entertainment ($f(2,244) = 4.449$; $p = .013$), education ($f(2,244) = 1.574$; $p = .000$), and knowledge-sharing dimensions ($f(3,244) = 4.989$; $p = .008$) of the scale.

The mean values of the entertainment, education, and knowledge-sharing dimensions are given in Table 10, and the post-hoc test results are shown in Table 11.

The post-hoc LSD tests for multiple comparisons indicated significant differences among participants who completed graduate school compared to all other education level groups. Specifically, participants who completed graduate school demonstrated significantly higher perceptions of the metaverse for entertainment compared to other education-level groups. Furthermore, the perception of the metaverse for entertainment increased as the level of education increased. Similar findings were observed for the education and knowledge-sharing dimensions, where participants who completed graduate

Table 7. Indicators of Internal Consistency and Validity, and Factor Correlations for the Six-Factor Final Model..

Construct	CR	AVE	MSV	MaxR(H)	1	2	3	4	5	6
1- Psychosocial effect	0.796	0.511	0.304	0.984	0.715					
2- Education	0.899	0.692	0.445	0.917	0.551	0.832				
3- Entertainment	0.888	0.665	0.445	0.898	0.444	0.667	0.816			
4- Knowledge-sharing	0.862	0.610	0.416	0.871	0.390	0.645	0.577	0.781		
5- Anxiety	0.899	0.692	0.069	0.970	-0.138	-0.180	-0.263	-0.065	0.832	
6- Business	0.890	0.619	0.279	0.897	0.495	0.524	0.528	0.497	-0.153	0.787

Note. CR = Composite Reliability; AVE = Average Variance Extracted; MSV = Maximum Shared Squared Variance; MaxR(H) = Maximum H Reliability.

Table 8. Correlations.

Variables	1	2	3	4	5	6	7	8	9	10
1- Age	1									
2- Gender	−0.062	1								
3- Education Level	0.461**	−0.008	1							
4- Metaverse Knowledge	0.124	−0.181**	0.178**	1						
5- Entertainment Dimension	0.042	−0.043	0.181**	0.394**	1					
6- Anxiety Dimension	0.045	0.080	−0.033	−0.020	−0.200**	1				
7- Education Dimension	0.267**	−0.043	0.273**	0.237**	0.633**	−0.131*	1			
8- Psychosocial Effect Dimension	−0.004	−0.061	0.082	−0.016	0.425**	−0.106	0.478**	1		
9- Knowledge-Sharing Dimension	0.096	−0.146*	0.194**	0.314**	0.519**	−0.059	0.608**	0.439**	1	
10- Business Dimension	0.058	−0.120	0.086	0.201**	0.459**	−0.135*	0.494**	0.581**	0.492**	1

Note. The values presented are Pearson Correlation Coefficients.
*Correlation is significant at the .05 level (two-tailed).
**Correlation is significant at the .01 level (two-tailed).

Table 9. Means and Standard Deviations of the Education and Knowledge-Sharing for the Age Groups.

		Education		Knowledge-Sharing	
Age	*N*	*M*	*SD*	*M*	*SD*
25 and below	80	3.400	0.880	3.488	0.799
Between 26 and 35	51	3.873	0.853	3.936	0.731
Between 36 and 45	60	4.017	0.659	3.921	0.596
46 and Over	56	3.938	0.740	3.634	0.851
Total	247	3.769	0.832	3.719	0.775

Note. *M* = mean; *SD* = standard deviation.

school exhibited significantly different perceptions compared to other education level groups, with perceptions generally increasing with higher education levels.

Metaverse Knowledge

The mean differences were significant in all dimensions except anxiety and psychosocial effect dimensions. The F statistics are as follows: entertainment dimension ($f(4,242) = 11.846$; $p = .000$), education dimension ($f(4,242) = 3.619$; $p = .007$), business dimension ($f(4, 242) = 4.580$; $p = .001$), and knowledge-sharing dimension ($f(3,242) = 6.921$; $p = .000$).

The mean values of the entertainment, education, knowledge-sharing, and business dimensions of the scale are given in Table 12, and the post-hoc test results are shown in Table 13.

Regarding the perception of entertainment in the metaverse, participants with a very good level of metaverse knowledge differed from all other groups.

Table 10. CM-TABLE-LABELMeans and Standard Deviations of the Entertainment, Education, and Knowledge-Sharing for the Education Levels.

		Entertainment		Education		Knowledge-sharing	
Education level	*N*	*M*	*SD*	*M*	*SD*	*M*	*SD*
High school and below	50	3.365	0.871	3.490	0.970	3.520	0.923
University	119	3.492	0.954	3.670	0.830	3.664	0.757
Graduate school	78	3.801	0.783	4.099	0.614	3.929	0.650
Total	247	3.564	0.899	3.769	0.832	3.719	0.775

Note. *M* = mean; *SD* = standard deviation.

Table 11. Post-Hoc Test Results of the Entertainment, Education, and Knowledge-Sharing for the Education Levels.

Dimension	I	J	I-J	*SD*	*p*
Entertainment	High school and below	University	-0.1266	0.1494	0.398
		Graduate school	-0.4363*	0.1606	0.007
	University	High school and below	0.1266	0.1494	0.398
		Graduate school	-0.3097*	0.1292	0.017
	Graduate school	High school and below	0.4363*	0.1606	0.007
		University	0.3097*	0.1292	0.017
Education	High school and below	University	-0.1802	0.1350	0.183
		Graduate school	-0.6094**	0.1451	0.000
	University	High school and below	0.1802	0.1350	0.183
		Graduate school	-0.4292**	0.1167	0.000
	Graduate school	High school and below	0.6094**	0.1451	0.000
		University	0.4292**	0.1167	0.000
Knowledge-sharing	High school and below	University	-0.1439	0.1285	0.264
		Graduate school	-0.4095*	0.1381	0.003
	University	High school and below	0.1439	0.1285	0.264
		Graduate school	-0.2656*	0.1111	0.018
	Graduate school	High school and below	0.4095*	0.1381	0.003
		University	0.2656*	0.1111	0.018

Note. *M* = mean; *SD* = standard deviation. ; *$p < 0.05$; **$p < 0.01$

Table 12. Means and Standard Deviations of the Entertainment, Education, Knowledge-sharing, and Business for the Metaverse Knowledge Groups.

		Entertainment		Education		Knowledge-Sharing		Business	
Metaverse knowledge	*N*	*M*	*SD*	*M*	*SD*	*M*	*SD*	*M*	*SD*
Very limited	46	3.0435	0.9239	3.4891	0.8579	3.4130	0.9563	2.5913	0.9352
Limited	54	3.3843	0.7503	3.6528	0.7716	3.5324	0.7038	2.3259	0.7812
Moderate	86	3.6337	0.8222	3.7994	0.7773	3.7587	0.6411	2.8814	0.9257
Good	42	3.8155	0.8714	3.9702	0.7695	3.9405	0.6645	2.9667	0.9265
Very good	19	4.4605	0.7230	4.1974	1.0593	4.3158	0.8158	3.0000	1.1509
Total	247	3.5638	0.8990	3.7692	0.8315	3.7186	0.7745	2.7296	0.9435

Note. *M* = mean; *SD* = standard deviation.

Similarly, participants with metaverse knowledge were classed as very limited, and they also differed from other groups. No statistically significant difference was found between participants with limited and moderate knowledge or between moderate and good knowledge. The perception of entertainment increases as knowledge of the metaverse increases. In terms of the perception of education and knowledge-sharing in the metaverse,

Table 13. Post-Hoc Test Results of the Entertainment, Education, Knowledge-sharing, and Business for the Metaverse Knowledge Groups.

I	J	Entertainment		Education		Knowledge-Sharing		Business	
		I-J	*SD*	I-J	*SD*	I-J	*SD*	I-J	*SD*
Very limited	Limited	−0.34078*	0.1663	-0.16365	0.1634	-0.11936	0.1484	0.26538	0.1840
	Moderate	−0.59024*	0.1514	−0.31029*	0.1488	−0.34568*	0.1351	-0.29009	0.1675
	Good	−0.77200*	0.1769	−0.48111*	0.1738	−0.52743*	0.1579	-0.37536	0.1957
	Very good	−1.41705*	0.2260	−0.70824*	0.2221	−0.90275*	0.2017	-0.40870	0.2501
Limited	Very limited	0.34078*	0.1663	0.16365	0.1634	0.11936	0.1484	-0.26538	0.1840
	Moderate	-0.24946	0.1439	-0.14664	0.1414	-0.22631	0.1284	−0.55547*	0.1592
	Good	−0.43122*	0.1705	-0.31746	0.1676	−0.40807*	0.1522	−0.64074*	0.1887
	Very good	−1.07627*	0.2211	−0.54459*	0.2172	−0.78338*	0.1973	−0.67407*	0.2446
Moderate	Very limited	.59024*	0.1514	0.31029*	0.1488	0.34568*	0.1351	0.29009	0.1675
	Limited	0.24946	0.1439	0.14664	0.1414	0.22631	0.1284	0.55547*	0.1592
	Good	-0.18176	0.1560	-0.17082	0.1533	-0.18176	0.1393	-0.08527	0.1727
	Very good	−0.82681*	0.2101	-0.39795	0.2064	−0.55707*	0.1875	-0.11860	0.2325
Good	Very limited	0.77200*	0.1769	0.48111*	0.1738	0.52743*	0.1579	0.37536	0.1957
	Limited	0.43122*	0.1705	0.31746	0.1676	0.40807*	0.1522	0.64074*	0.1887
	Moderate	0.18176	0.1560	0.17082	0.1533	0.18176	0.1393	0.08527	0.1727
	Very good	−0.64505*	0.2292	-0.22713	0.2252	-0.37531	0.2045	-0.03333	0.2536
Very good	Very limited	1.41705*	0.2260	0.70824*	0.2221	0.90275*	0.2017	0.40870	0.2501
	Limited	1.07627*	0.2211	0.54459*	0.2172	0.78338*	0.1973	0.67407*	0.2446
	Moderate	0.82681*	0.2101	0.39795	0.2064	0.55707*	0.1875	0.11860	0.2325
	Very good	0.64505*	0.2292	0.22713	0.2252	0.37531	0.2045	0.03333	0.2536

Note. *M* = mean; *SD* = standard deviation.; *$p < 0.05$

participants with very limited knowledge about the metaverse differed significantly from all other groups except those who have limited knowledge. Those with limited knowledge differed only from those with good and very good knowledge. Participants with moderate and good knowledge are distinguished only from those with very limited knowledge, and those with very good knowledge are distinguished from those with limited and very limited knowledge. However, in terms of knowledge-sharing, they differed from those with moderate knowledge.

The perception of business in the metaverse appears contradictory. While participants with very limited knowledge about the metaverse did not differ considerably from other groups, those with limited knowledge differed from all other groups except the very limited knowledge group. All other groups are only distinguished from those with limited knowledge. This outcome may be attributed to a lack of awareness about business opportunities in the metaverse among the general population.

Conclusion

While the metaverse, a convergence of technologies like artificial intelligence and virtual reality, has captured the collective imagination, there remains a considerable need for discovery and understanding, particularly among social scientists. Consequently, we have taken the required initial step and developed a measurement tool that evaluates participants' knowledge, perceptions, expectations, and thoughts concerning the metaverse. Such a measurement tool will benefit academic researchers, practitioners, and policymakers. The advantages of this particular measurement scale are several and include the following: (i) gaining insight into how people perceive metaverse spaces and what they expect from them; (ii) enabling content providers to produce, develop, and design content in line with these expectations; (iv) facilitating the emergence of new initiatives and potential investment areas to meet these expectations; and (v) assisting in determining the direction and form of social interactions, including business, education, and entertainment.

The proposed "metaverse perception scale" was developed by examining the metaverse concept in detail, and a literature review was conducted to determine the scope and framework of the intended measurement tool. The literature review identified six dimensions, namely: (i) anxiety, (ii) education, (iii) entertainment, (iv) psychosocial effect, (v) knowledge-sharing, and (vi) business. A pool of 83 items was constructed to measure these six dimensions and presented to experts for review. Based on

expert feedback, some items were removed, some were merged, and the pool was reduced to 67 statements while retaining the six dimensions.

Considering the influence of metaverse environments, the study population consisted of adults aged 18 and above. The research project enrolled 209 participants using a convenience sampling method for Exploratory Factor Analysis and 332 participants for confirmatory factor analysis. The final result was a measurement tool comprising six dimensions and 26 statements. Given the absence of similar studies in the literature, direct comparisons were not possible. However, it is our hope that the current study will serve as a starting point for future research.

The original metaverse scale items that were developed in this study are given below, and the English translations are provided in italics:

Anxiety (ANX)
Hayal ettiğim herşeyi yaşayabildiğim Metaverse'ün, beni gerçek dünyadan uzaklaştıracağını ve olumsuz etkileyeceğini düşünüyorum. *I fear that the metaverse, where all my dreams can come true, might distance me from the real world and affect me negatively.*
Metaverse'te çok fazla zaman harcarsam, avatarım ve gerçek kişiliğim arasında kimlik karmaşası yaşayacağımı düşünüyorum. *I worry that spending too much time in the metaverse could cause confusion between my avatar and my real personality.*
Metaverse gerçeklik algımı etkileyeceği için psikolojimi bozacağını düşünüyorum. *I think the metaverse may disturb my psychological well-being by affecting my perception of reality.*
Metaverse'te fazla zaman geçirmemin, beni gerçek dünyada yalnızlaştıracağını düşünüyorum. *Spending excessive time in the metaverse, I believe, may lead to isolation in the real world.*
Education (EDU)
Metaverse'te verilecek olan herhangi bir eğitimin faydalı olacağını düşünüyorum. *I believe any education offered in the metaverse would be beneficial.*
Metaverse'te eğitim almanın, öğrenmeyi kolaylaştıracağını düşünüyorum. *I think receiving education in the metaverse will facilitate learning.*
Metaverse'ün tıp, mühendislik, turizm gibi uygulamalı eğitimler için faydalı olacağını düşünüyorum. *I believe the metaverse will be beneficial for practical education in fields like medicine, engineering, tourism, etc.*
Metaverse ile kaliteli eğitimin yaygınlaşacağını düşünüyorum. *I believe the metaverse will contribute to the widespread availability of quality education.*
Entertainment (ENT)
Metaverse'te oyunların daha keyifli olacağını düşünüyorum. *I think games in the metaverse will be more enjoyable.*
Metaverse'ün eğlenmek için ideal bir ortam olacağını düşünüyorum. *I believe the metaverse will be an ideal environment for entertainment.*
Metaverse'te bir oyundan diğerine geçebilme imkanı hoşuma gider. *I would enjoy the ability to switch from one game to another in the metaverse.*
Metaverse'teki oyunlarda daha fazla etkileşim olacaktır. *Games in the Metaverse will have more interactive features.*
Psychosocial Effect (PSE)
Metaverse'te gerçek kişiliğimi bulabileceğimi düşünüyorum. *I feel I can discover my true self in the metaverse.*
Metaverse daha özgüvenli olmamı sağlayacaktır. *The metaverse will boost my confidence.*
Metaverse'te arkadaşlıkların daha az riskli olacağını düşünüyorum. *I consider friendships in the metaverse to be less risky.*
Metaverse'te tanımadığım insanlardan ihtiyaç duyduğum yardımı alabileceğime inanıyorum. *I believe I can seek and find the help I need from strangers in the metaverse.*
Knowledge-Sharing (KSH)
Metaverse'te farklıülkelerden insanlarla bilgi paylaşımının mümkün olacağını düşünüyorum. *I think the metaverse will enable information sharing with people from various countries.*
Metaverse'te tecrübeli kişilerle ortak proje yapma imkanı olacağını düşünüyorum. *I foresee opportunities to collaborate on projects with experienced individuals in the metaverse.*
Metaverse ile bilgi paylaşımı ve bilgiye erişimin çok daha hızlı ve etkin olacağını düşünüyorum. *I anticipate that the metaverse will make information sharing and access quicker and more efficient.*

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Metaverse'te mesleki tecrübelerimi başkalarıyla paylaşabileceğimi düşünüyorum. *I think the metaverse will provide me with a platform to share my professional experiences with others.*
Business (BUS)
Metaverse'te sanal arazi satın alım-satımı yapabileceğimi düşünüyorum. *I envision being able to trade virtual land within the metaverse.* Metaverse'te kullanılan sanal ürünler için para harcayabilirim. *I am willing to spend money on virtual products in the metaverse.* Metaverse'te az bir sermaye ile çok büyük bir işletme kurabileceğimi düşünüyorum. *I think I can build a substantial business in the metaverse with minimal capital.* Metaverse'te satılan fiziki (gerçek) ürünler için para harcayabilirim. *I can see myself purchasing physical (real) products sold in the metaverse.* Metaverse is dünyasında, gerçek dünyadaki işimden daha çok kazanç elde edebileceğimi düşünüyorum. *I believe that in the metaverse's business realm, I may earn more than in my real-world job.*
Deleted Items
Metaverse'te verilen konserlere katılmak zevkli olacaktır. *Attending concerts held in the metaverse will be enjoyable.* Metaverse'te hiç bilmediğim sporları deneyimleme imkânına sahip olabileceğimi düşünüyorum. *I think I will have the opportunity to experience sports I have never tried before in the metaverse.* Metaverse'te eğlence etkinliklerine katılmak güzel olacaktır. *Participating in entertainment activities in the metaverse will be nice.* Metaverse'te çok yüksek teknolojinin gerekeceğini düşünüyorum. *I think the metaverse will require very advanced technology.* Metaverse'te görmek istediğim yerleri görebileceğimi düşünüyorum. *I believe I will be able to see the places I want to visit in the metaverse.* Metaverse'te yer alan eğlencenin asla gerçeğinin yerini tutmayacağını düşünüyorum. *I think the entertainment in the metaverse will never replace the real thing.* Metaverse'ün gerçek dünyadaki eğlence anlayışını olumsuz etkileyeceğini düşünüyorum. *I think the metaverse will negatively affect the concept of entertainment in the real world.* Metaverse'ün bana hayal ettiğim herşeyi yapma imkanı sağlayacağını düşünüyorum. *I believe the metaverse will provide me the opportunity to do everything I imagine.* Metaverse'te verilecek olan herhangi bir eğitimin yetersiz olacağını düşünüyorum. *I think any education provided in the metaverse will be inadequate.* Metaverse'te fiziki sınırlar olmadan dünyanın her yerinden eğitim alabileceğimi düşünüyorum. *I believe I can receive education from anywhere in the world without physical boundaries in the metaverse.* Metaverse akranların birbirilerine eğitim konusunda yardımcı olmalarını sağlayacaktır. *The metaverse will enable peers to assist each other in educational matters.* Metaverse sayesinde kaliteli eğitime erişimin daha az maliyetli olacağını düşünüyorum. *I believe access to quality education in the metaverse will be more cost-effective.* Metaverse'te diğer ülkelerden kişilerle aynı sınıfta eğitim almanın faydalı olacağını düşünüyorum. *I believe it will be beneficial to take classes with people from other countries in the metaverse.* Metaverse'te verilecek eğitimlerin gerçeğinin yerini tutmayacağını düşünüyorum. *I think the education provided in the metaverse will not replace the real experience.* Metaverse'te korkularımın üzerine gidip onları yenebilme imkanım olacaktır. *I will have the opportunity to confront and overcome my fears in the metaverse.* Metaverse'te benzer sorunlara sahip insanlarla sorunlarımı paylaşabileceğimi düşünüyorum. *I believe I can share my problems with people who have similar issues in the metaverse.* Metaverse'te kendimi kişisel ve ruhsal yönlerden geliştirebilme imkânı bulacağıma inanıyorum. *I believe I will find the opportunity to develop myself personally and spiritually in the metaverse.* Gerçek hayatta yapamadıklarımı Metaverse içinde gerçekleştirmek beni mutlu edecektir. *It will make me happy to achieve what I cannot in real life within the metaverse.* Metaverse'te uzmanlardan çok daha rahat ve kolay psikolojik destek alabileceğimi düşünüyorum. *I believe I can receive much easier psychological support from experts in the metaverse.* Metaverse ve neden olabileceği toplumsal sorunlar beni korkutmaktadır. *The metaverse and its potential societal problems frighten me.* Metaverse'in neden olduğu belirsizlik beni korkutuyor. *The uncertainty caused by the metaverse scares me.* Metaverse'te güçlü dostluklar kurabileceğime inanıyorum. *I believe I can form strong friendships in the metaverse.* Metaverse'te daha geniş arkadaş gruplarına ulaşabileceğime inanıyorum.

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I believe I can reach broader friend groups in the metaverse.
Metaverse'te daha fazla sosyal etkinliğe katılma imkanım olacağını düşünüyorum.
I think I will have more opportunities to participate in social activities in the metaverse.
Metaverse'te farklı kültürleri tanıma imkanımın olacağını düşünüyorum.
I think I will have opportunities to get to know different cultures in the metaverse.
Metaverse ile uzaktaki dostlarımla bile sosyalleşme imkânım olacağını düşünüyorum.
I believe I will even have the chance to socialize with distant friends in the metaverse.
Metaverse'te zaman ve maliyet sınırlaması olmadan arkadaşlarımla istediğim zaman sosyalleşebilirim.
In the metaverse, I can socialize with my friends whenever I want without time and cost constraints.
Metaverse'te sosyal hayatta yapmayı istediğim herşeyi yapabileceğimi düşünüyorum.
I believe I can do everything I want in my social life in the metaverse.
Metaverse'te kendimi çok daha rahat ifade edebileceğimi düşünüyorum.
I believe I can express myself much more comfortably in the metaverse.
Metaverse'te gerçek dünyadaki gibi rol yapmak zorunda olmayacağımı düşünüyorum.
I believe I won't have to act a role like in the real world in the metaverse.
Metaverse'te birçok ücretsiz ve faydalı bilgi olduğunu düşünüyorum.
I think there is a lot of free and useful information in the metaverse.
Metaverse ile bilginin üretim sürecinin daha hızlı olacağını düşünüyorum.
I think the knowledge production process will be faster in the metaverse.
Metaverse ile bilginin üretiminin daha az maliyetli olacağını düşünüyorum.
I think the production of knowledge will be less costly in the metaverse.
Metaverse'ün bilgi kirliliğine neden olacağını düşünüyorum.
I believe the metaverse will cause information pollution.
Metaverse'te gerçek dünyaya oranla daha çok ürüne ve daha hızlı ulaşabileceğime inanıyorum.
I believe I can access more products and faster compared to the real world in the metaverse.
Metaverse'teki mağazaların daha ekonomik olacağını düşünüyorum.
I believe the stores in the metaverse will be more economical.
Metaverse'te göreceğim reklamları seçebileceğime inanıyorum.
I believe I can choose the advertisements I will see in the metaverse.
Metaverse'te bankacılık işlemlerinin daha güvenli olacağını düşünüyorum.
I believe banking transactions will be safer in the metaverse.
Metaverse'te kullanılacak kriptoparaların güvenilir olacağını düşünüyorum.
I believe the cryptocurrencies used in the metaverse will be reliable.
Metaverse'te oyunlar için çok para harcayabilirim.
I might spend a lot of money on games in the metaverse.
Metaverse'te kurduğum işletmede başarısız olduğum taktirde zararımın daha az olacağını düşünüyorum.
If my business fails in the metaverse, I believe my losses will be less (compared to the real life businesses).
Metaverse'in girişimcilik için güzel fırsatlar sunacağını düşünüyorum.
I believe the metaverse offers great opportunities for entrepreneurship.

Limitations

While marking an essential step in scale development, the present study must be viewed in light of several limitations. The sample size, although adequate for exploratory and confirmatory analyses, may not fully represent the broader population, thus potentially limiting the generalizability of the findings. The sample population also lacks diversity in some demographic areas, emphasizing the need for caution when using the proposed scale to assess diverse groups.

Although the construct validity of the scale was carefully considered during its design, it may not fully capture the complexity of the underlying theoretical concept of the metaverse. Additionally, some concerns about content validity may exist, and future studies should explore whether all facets of the construct have been adequately covered. Statistical decisions made during the factor analysis process, including the selection of factors and rotations, may have influenced the findings. Thus, they must be carefully scrutinized during future applications of the scale. Although the reliability test results were within acceptable ranges, additional long-term testing for test-retest reliability is recommended.

Cultural and linguistic limitations should also be noted. The scale was developed within a specific cultural and linguistic context, and its applicability across diverse cultural settings has not been explored. Translation and cross-cultural validation are essential next steps. Although potential biases in item development and selection were minimized through rigorous review, the possibility of subtle biases cannot be entirely ruled out. The

scale's length was optimized for comprehensive assessment, but future research might explore the potential influence of the scale's length on respondent fatigue. The study did not engage in extensive external validation across different samples and settings, a vital phase for understanding the broader applicability of any scale. Moreover, the lack of technological diversity in administration methods may have introduced a specific form of bias. This possibility, therefore, warrants further exploration. Lastly, while ethical considerations were adhered to, the scale development process was constrained by certain financial and resource considerations that may have influenced the scope of the study.

In conclusion, while this study provides a valuable foundation for studying perceptions of the metaverse, the above limitations highlight the need for continued research, refinement, and validation of the proposed scale. Future studies that address these issues will further strengthen the utility and applicability of this measurement tool across diverse contexts and among different populations.

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Statements and Declarations

Institutional Review Board Statement

This study was conducted with the approval of Çağ University (Turkiye) Ethics Committee (approval number: E-81570533-050.01.04-2300000411).

Informed Consent Statement

Informed consent was obtained from all subjects involved in the study.

Author Contributions

Conceptualization, SS, KÖ, and MA; methodology, MA, KÖ, and SS; software, MA and KÖ; validation, MA, KÖ, and SS; formal analysis, MA and KÖ; investigation, MA, KÖ, and SS; resources, MA, KÖ, and SS; data curation, KÖ, SS, and MA; writing—original draft preparation, SS, MA, and KÖ; writing—review and editing, SS and MA. All authors have read and agreed to the published version of the manuscript.

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Data is available upon request.

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