Metaverse/Meta-Education Belief Scale

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ABSTRACT

The "metaverse," which bridges augmented and virtual reality as mixed reality and includes technological phenomena such as artificial intelligence, continues to be an agenda topic. It is foreseen that the concept in question will accelerate the changes in education and teaching activities, as in many other fields. In this research, a measurement tool was developed to determine pre-service teachers' and teachers' beliefs about education in the metaverse (meta-education), especially considering the concept of the "metaverse" that entered our lives with the information age. During the development process of the measurement tool, an item pool consisting of 59 items was created by scanning the relevant literature. The opinions of five experts were received for the draft scale. Two items were added to the draft scale, and ten items were removed based on expert feedback. The scale was arranged as 41 items before the application. During the pilot application process, 203 were collected. Exploratory factor analysis (EFA) was used for the scale's construct validity. The EFA result shows that the scale consists of 22 items and a single factor, and 44% of the total variance is explained. The item-rest correlations on the scale ranged from .64 to .77. The Cronbach alpha coefficient of the scale was found to be .90. Based on these findings, the scale can be used to determine adults' beliefs about meta-education.

Keywords: *Information age, metaverse, meta-education (meta-edu), virtual reality, augmented reality, mixed reality.*

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INTRODUCTION

"The Machine is only a tool after all, which can help humanity progress faster by taking some of the burdens of calculations and interpretations off its back. The task of the human brain remains what it has always been; that of discovering new data to be analyzed, and of devising new concepts to be tested."

— Isaac Asimov, I, Robot

When today's digital technologies were seen as a dream, science fiction writers such as Asimov (1950), Gibson (1984), and Stephenson (1992) shaped the present and the future by describing in detail a life different from the one we live in. Today, people have started to live these dreams that were previously established. With digitalization, there have been changes in many sectors, businesses, and social structures. In this process, a rapid digital transformation has started in education and teaching activities. Since the early 2000s, human life has been radically changed by technology, especially the internet, which connects millions of people worldwide and helps with easy access and sharing of information. With the rapid advancement of technology and the decrease in knowledge multiplication time, the styles of accessing and using information are rapidly changing. While face-to-face education is applied in classical education models, models such as distance education, hybrid education, and flipped instruction, which provide time and space flexibility due to developing technology, have been put into practice, especially during the COVID-19 pandemic. These models also applied before the pandemic, started to be used in mass education, especially during the process. The competencies needed to facilitate an isolated life during the COVID-19 pandemic also accelerated the internet and digital transformation and played an essential role in the transition from passive digital use to active digital use, especially in education (Stewart, Watson & Campbell, 2018; WHO, 2020).

With the changing educational activities, the roadmap for effective and efficient education on different platforms has been discussed (Hyun, 2021; Le & Xiong, 2021; Suh & Ahn, 2022). These changes and discussions paved the way for the emergence of a new concept: the metaverse. At this point, examining the conceptual foundations of the metaverse is essential. The concept of the metaverse, known since 1992, has become an area that is heard and studied more frequently, especially with blockchain technology. Mark Zuckerberg changed the name of Facebook to Meta in an October 2021 press release. He drew all attention to the metaverse concept (Meta, 2021) by announcing significant investments in virtual reality. The metaverse can be seen as the sum of many technological developments. Online multiplayer role-playing game-like worlds such as The Sims or Second Life have been around for 20 years, and players spend an average of 20 hours per week in these meta worlds (Morgan, 2022). In the context of this information, it seems inevitable that educational activities will be affected by these developments. The Web 2.0 versus Web 3.0 approach to the metaverse is presented in Table 1 (Morgan, 2022, p. 3).

Table 1. ***Web 2.0 Versus Web 3.0 Approach to the Metaverse***

		Web 2.0	Web 3.0
Platform Characteristics	Example virtual worlds	Second Life, Roblox, Fortnite, World of Warcraft	Decentraland, The Sandbox, Somnium Space, Cryptovoxels
	Organizational structure	Centrally owned. Decisions are based on adding shareholder value	Community governed, generally through a foundation decentralized autonomous organization (DAO)Native tokens are issued and enable participation in governance. Decisions are based on user consensus
	Data storage	Centralized	Decentralized (game assets)
	Platform format	PC/console, Virtual reality (VR)/augmented reality (AR) hardware, Mobile/app	PC, Virtual reality (VR)/augmented reality (AR) hardware, Mobile/app coming soon
	Payment's infrastructure	Traditional payments (e.g., credit/debit card)	Crypto wallets
User Interactions	Digital assets ownership	Leased within platform were purchased	Owned through non-fungible tokens (NFT)
	Digital assets portability	Locked within platform	Transferable
	Content creators	Game studios and/or developers	Community, Game studios and/or developers
	Activities	Socialization, Multi-player games, Game streaming, Competitive games (e.g., esports)	Play-to-earn games, Experiences, (Same activities as Web 2.0, see box on left)
	Identity	In-platform avatar	Self-sovereign and interoperable identity Anonymous private-key-based identities
Commercials	Payments	In-platform virtual currency (e.g., Robux for Roblox)	Cryptocurrencies and tokens
	Content revenues	Platform or app store earns 30% of every game purchased; 70% goes to developer (example model)8	Peer-to-peer; developers (content creators) directly earn revenue from sales. Users/gamers can earn through play or participation in platform governance. Royalties on secondary trades of NFTs to creators

Metaverse is the concept of a persistent, online, 3D universe that combines multiple disparate virtual fields. You can think of it as a future iteration of the internet. The metadata store allows users to work, meet, play, and socialize in these 3D spaces. On the other hand, the metaverse is also expressed as "mixed reality," which bridges virtual reality and augmented reality (Lee et al., 2021; Zhao et al., 2022). Since the metaverse is a very new application area and is at the beginning of its path, there is no single comprehensive definition.

However, the metaverse is seen as a seamless fusion of physical and digital lives, creating a unified, virtual community where one can work, play, transact, overcome physical challenges, and socialize (Damar, 2021a; Gökçe Narin, 2021; Maharg & Owen, 2007; Morgan, 2022; Papagiannidis, Bourlakis, & Le, 2008). Some researchers defined the "metaverse" as a 3D virtual cyberspace blending the physical and digital worlds facilitated by the internet and web technologies and extended reality (XR) (Lee et al., 2021; Zhao et al., 2022). "Although the metaverse is a virtual world, considered as human-centered computing, it indeed shows a significantly positive impact on the real world, especially in terms of accessibility, diversity, equality, and humanity" (Haihan et al. 2021: 2). When we look at the conceptual explanations of the metaverse, it is seen that the educational aspect is a subject that needs to be studied. The number of studies in this area is limited. Education-teaching activities in metaverse environments can be briefly defined as "meta-education."

Despite the increasing interest of researchers in the metaverse, there are limited explanatory and comprehensive studies on the metaverse in the literature, especially on the use of the metaverse in education (Hailhan et al., 2021; Hyun, 2021; Le & Xiong, 2021; Suh & Ahn, 2022). However, in recent years, it has been predicted that interest in the metaverse will increase with the developments in blockchain technology, sensor technology, the advancement of augmented and virtual reality technologies, and the latest statements of South Korea and Facebook founder Mark Zuckerberg (Damar, 2021a: 7). As shown in Table 1, developments related to the metaverse contribute to the formation of a rapid infrastructure. When Table 1 (Morgan, 2022) is examined, the differences between the metaverse usage areas, infrastructures, and user interactions of Web 2.0, which is used today, and Web 3.0, which can be used in more expansive areas in the future, are given. It is predicted that it will have a decentralized, community-based, interactive, and democratic structure that can be owned with Web 3.0 and Metaverse NFT (Non-Fungable Token) (Morgan, 2022). Hainhan et al. (2021) say that the metaverse's representative applications show that it reflects the vision of human-centered computing in a big way, which is very good for society in terms of accessibility, diversity, equality, and humanity.

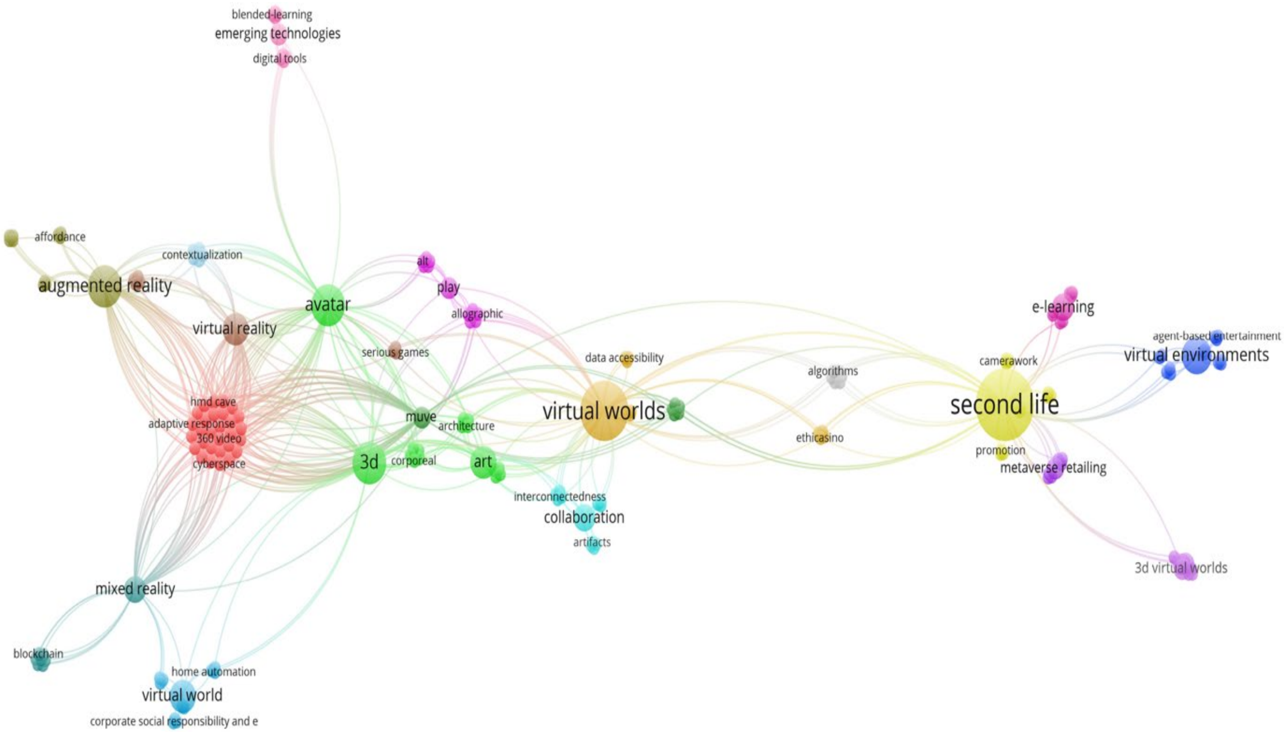

Figure 1. ***Keyword Density, Overlay and Network Visualizations about Metaverse (Damar, 2021a).***

According to the findings from the research of Damar (2021), which compiles the studies on the metaverse, it is seen that the key concepts in Figure 1 and the relationships between them have been reached. In this context, the keywords most associated with the word "metaverse" in the analysis are "second life, virtual worlds, avatars, 3D, augmented reality, virtual reality, virtual environments, art, mixed reality, collaboration, e-learning, multi-user virtual environment (MUVE), open simulator, virtualization, metaverse retailing, haptics, blockchain, industry 4.0," and it can be said that these are the most frequently used keywords in published studies. In addition, according to the results of the research, the keywords "education, higher education, informal education, e-learning, schools, panoramic, museums, exhibition content, virtual excavation, smart maintenance" were also reached. The intense work of virtual or augmented reality studies in educational studies is the reason for this (Damar, 2021a). The frequent use of the concept of "metaverse," which provides convenience in terms of space, time, and access in the information age, accelerated the studies on its active use in education. While video games offer the closest experience to the metaverse, start-ups have started to create the first examples of digital education. Interest and investment in this field have increased with the experience of the metaverse, which makes educational activities that cannot be done physically applicable (Akour et al., 2022). According to Hirsh-Pasek et al. (2015), an application environment conducive to education in digital fields should be based on four principles:

- Learning should be active, not passive, and children learn best in environments that are. This means that a simple swipe did not count as an "active" move in an educational setting.
- The app should be engaging rather than distracting and only include bells and whistles integrated into the narrative of the game, lesson, or storyline. Many of the apps on the market interrupt the storyline with a chance to probe children's vocabulary (e.g., "What else is red or starts with a B?") and include persuasive ads that pop up to distract children from buying a different app.
- The app should tap into something meaningful for the child. There should be some point of connection that will allow children to relate the app's content to what they know rather than starting de novo in a foreign space.
- Finally, the app should encourage social interaction inside or outside of the app space, not just playing solo.

"However, the key to making these apps truly educational requires one additional step. Learning occurs best when the playful activity has a well-articulated learning goal, literacy, or "learning to learn" skills like memory, attention, and flexible thinking" (Hirsh-Pasek et al., 2022). In this context, the metaverse experience has advantages for learners participating in activities, seeing problems from different perspectives, and collaborating (Barry et al., 2015). Despite the widespread belief that metaverse experiences can effectively enhance various skills, research in this area still needs to be completed. Limited studies on Metaverse and education have been found in the relevant literature (Kanematsu et al., 2014; Márquez Díaz et al., 2020; Suh & Ahn, 2022). In addition to these studies, it is seen that there are studies examining different contexts of the concept of the Metaverse in the literature (Maharg & Oven, 2007). For example, Maharg and Oven (2007) carried out a study to understand how it can be used in a certain way in their study titled "Simulations, learning, and the metaverse: changing cultures in legal education" and explained how simulations could be used for educational purposes and how they can be used most effectively with students, how they will affect other areas of the curriculum in the context of laws, and how the Metaverse will be equally effective in all education areas. When the studies are evaluated as a whole, we can say that the studies in this field are at their initial stage.

As a result of the development of technological phenomena such as augmented reality, virtual reality, and artificial intelligence, the "metaverse" stands out as a frequently used concept today. Applications that create a mixed reality context by bridging the Metaverse with augmented and virtual reality will be implemented soon (Le & Xiong, 2021; Suh & Ahn, 2022). This development will likely provide an advantage to students in many educational activities. For example, using the Metaverse in education, individuals can be included in the educational environment they want online without individual differences or disadvantages through their avatars. In the metaverse environment, the gestures and facial expressions of the student's avatar can make virtual participation as influential as face-to-face participation. This situation will promote equality of opportunity by expanding participation in education.

On the other hand, in the transition to education in the Metaverse, it is essential to determine the beliefs of teachers and pre-service teachers regarding this phenomenon in terms of the functioning of the process. In this context, the need to develop a measurement tool has arisen in this study to determine the beliefs of pre-service teachers of education faculty and teachers about meta-education. Determining the beliefs in question will prepare teacher education programs suitable for the new education-teaching approach. This process will facilitate the integration of teachers into possible changes. However, it is seen that there is no study in the literature evaluating adult beliefs that educational activities can be carried out with Metaverse. Based on this need, this study aimed to develop a measurement tool to evaluate teachers and pre-service teachers' beliefs in meta-education.

RESEARCH METHOD

Participants

In the research, a measurement tool was developed to determine adults' perceptions of the concept of the "metaverse," which provides convenience, especially regarding space, time, and access in the information age. The criterion sampling model was taken as a basis for determining the sample. Due to the necessity of the sample being selected in the criterion sample being rich in information (Marshall, 1996), it has been taken into account that pre-service teachers and teachers are the most robust data sources for metaverse education. Within the scope of the research, pre-service teachers studying at education faculties of public universities and teachers working in schools affiliated with the Ministry of National Education were included in the sample. The research data were collected in the 2021–2022 academic year.

There is a need to consider a specific sample for the analyses during the measurement tool development process. Kline (1994: 160) states that 200 samples would be sufficient for EFA and CFA. Crocker and Algina (1986) suggest that 100–200 samples will be sufficient in the measurement tool development process. Child (2006), on the other hand, states that a sample of five times the number of items would be sufficient. Treece and Treece (1982) state that 100 samples will be sufficient for the pilot application in the scale development process, while Crocker and Algina (1986) state that 100–200 samples will be sufficient. In the process of developing the meta-educational belief scale, seven adults were sampled first. Face-to-face interviews on metaverse and education were held with these seven people. Questions such as "What comes to mind when the word "metaverse" is mentioned?" and "How can the metaverse be used in education?" were asked in the talks, and items were prepared for the draft scale with the answers received. In this context, 203 samples were considered for EFA following all three criteria. Of the sample, 89 are men, and 114 are women.

Data Collection Tool

Meta-Education (Meta-Edu) Belief Scale

The researchers developed the meta-education belief scale. Detailed descriptions of the development process are as follows: During the development process, first of all, the related literature was examined. Since the metaverse concept is a current and newly developing phenomenon, domestic and foreign measurement tools were scanned while creating the item pool. While no Turkish measurement tool can be found in the literature, one not Turkish measurement tool has yet to be identified (Suh & Ahn, 2022). As a result of the lack of a sufficient number of meta-education measurement tools in the literature, articles and books on meta-education have been searched (Damar, 2021b; Hyun, 2021; Kanematsu et al., 2014; Maharg & Oven, 2007; Márquez Daz et al., 2020; Suh & Ahn, 2022). Following the scans, the items on the scale were attempted to be identified.

Preparation of the draft scale: After the literature review, the items were created by considering the concepts of metaverse and meta-education. In order to develop the item pool, open-ended questions and opinions on meta-education were obtained from 10 undergraduate-level pre-service teachers and five teachers working in the Ministry of National Education. Using these forms, items were added to the item pool. There are 59 items on the first draft scale. While preparing the items, the five field experts' opinions regarding each item's suitability for meta-education were obtained.

Obtaining expert opinions: The draft scale was presented to expert opinion to ensure content validity and eliminate spelling errors. The draft scale was given to five instructors/teachers who are experts in their fields, and expert opinion was sought. In this process, the draft scale was first examined by a Turkish teacher and an instructor working in Turkish Education. The spelling and syntax errors of the items were corrected, and the items that created blurriness were rewritten. Since the concept of meta-education is new, some words still need to have Turkish equivalents in the item pool. In this context, the opinions of the instructors working in the Turkish Education department regarding these concepts were taken, and their Turkish equivalents were tried to be used whenever possible. The measurement tool was then conveyed to 1 statistician. Seventeen feedbacks given by the expert were examined, and two were not considered appropriate by the authors. The remaining 15 feedbacks were considered, and changes were made to the item pool. Finally, opinions were received from 2 field experts. Opinions were received from 2 lecturers whose branches and expertise are CEIT (computer and instructional technologies) as field experts. After all expert opinions, 21 items were removed from the 59-item scale, and three items were added. The scale consists of 41 items before the application.

Finalizing the scale before the application: A personal information form and introductory information about the scale were added to the draft scale, which was finalized due to expert opinions. Some explanations regarding the usage of the scale and the concept of the metaverse are included in the scale. In addition, only the age and gender information of the participants were requested in the personal information form. The reason for asking for age data is that the sample is intended to be formed only from the Y and Z generations. Since the scale, also known as the Likert scale, was introduced in 1932, many studies have been conducted to determine the number of the most appropriate answer alternatives (Bardakçı, 2009, pp. 7–8).

In the first stage, the Likert number of the scale was structured as three to make it fast. (Preston & Colman, 2000: 12). However, since the sample consisted of adults and 5-point Likert scales were more reliable, experts were consulted again to determine the scale number (measurement and evaluation, statistics), and a 5-point scale (I strongly agree, I partially agree, I moderately agree, I partially disagree, and I strongly disagree) was decided to be used. Köklü (1995: 90) states that two, three, four, six, and seven options can be used in Likert scales, but the five-point scale is the most practical option. When we look at the literature, it is seen that the 5-point scale is reliable (Dillman et al., 2009; Ray, 1980; Fink, 1995).

Application: In applying the scale, first of all, the people to whom the form will be sent were informed. The scale was filled voluntarily. The target audience of the scale is adults who meet the criteria of Generations Y and Z. The pilot application of the scale coincided with the COVID-19 pandemic. For this reason, the scale was applied online instead of face-to-face, adhering to the health measures taken. After the necessary preparations were made, an online measurement tool was first prepared via Google Forms and delivered to the pre-service teachers. Pre-service teachers were informed about the purpose, scope, and how to fill out the measurement tool online, and then they were asked to fill out the measurement tool. There was no time limit for completing each sampling measurement tool, and they were asked to take screenshots when they were filled. After the pilot application, the data were analyzed using appropriate analysis programs. In this context, first of all, the missing data were corrected (incomplete or unfilled forms were excluded from the study), and the data were made suitable for analysis.

Data Collection Process

We collected the data in the fall term of 2022–2023. Research data were collected from teachers and teacher candidates by the researchers themselves. Permission was obtained from the necessary places before data collection. During the application process of the measurement tool, it was determined that the adults were of the Y or Z generation by asking for their ages first. Then, persons in the appropriate age range were determined, and the measurement tool was applied only to this age range. Due to the ongoing pandemic, the data was collected via Google Forms, not face-to-face. The measurement tool uploaded to the Google form was sent to the sample population. In addition, information was given about the purpose, scope, content, filling time, and filling method of each sampling measurement tool. Incomplete or incorrect forms were excluded from the process by examining the collected data.

Data Analysis

The draft scale was examined in the data analysis process to determine the extreme values before the

EFA. Outliers have a large impact on statistical inference. Outliers, therefore, increase the error variance, reduce the power of statistical tests, and cause estimates of bias that can be of considerable interest (Osborne & Overbay, 2004). In this context, the extreme values that increase the range before EFA were determined by Z Score analysis, and these scales were removed from the data set. In this context, the Z score of each form was checked, and form no 117 was found to have extreme value and was excluded from the analysis (Kalaycı, 2016). Therefore, other operations were performed on 203 forms. The sample distribution was examined before the analysis. As a result of the Kolmogorov-Smirnov analysis, it was determined that the sample was usually distributed; that is, the group was homogeneous (p =.200, p >.005). In addition, the assumption of normality was also examined with the Q-Q Plot Chart.

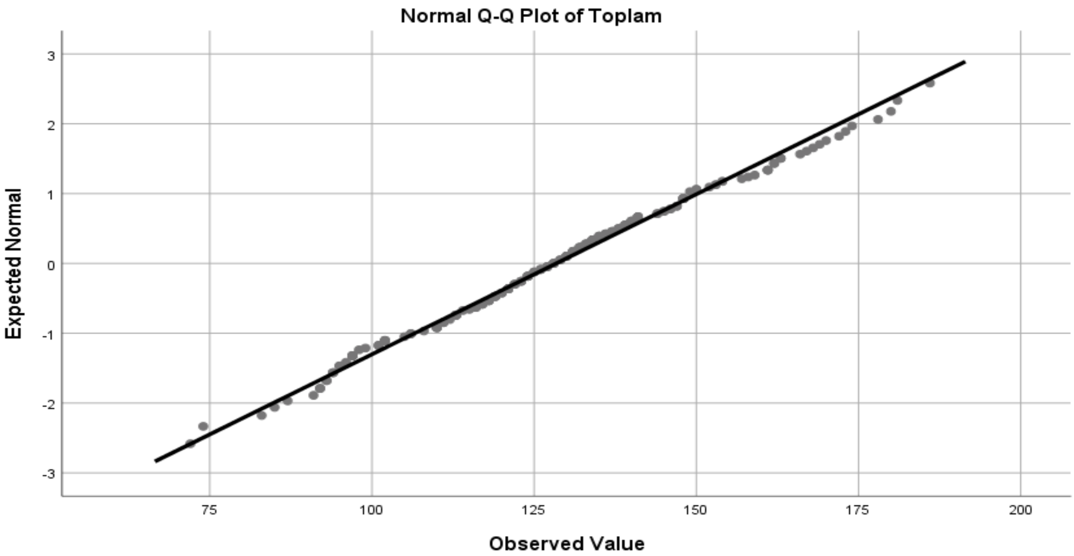

Chart 1. ***Q-Q Plot Chart***

Since the observations spread around a straight line according to the Q-Q Plot Chart in Chart 1, the distribution of the data set is normal.

KMO (Kaiser Meyer Olkin) analysis was performed to determine the suitability of the collected data for exploratory factor analysis (EFA), and the adequacy of the sample was determined for EFA. The scale's validity was examined in two stages: content and structure. Expert opinion was taken on the validity of the content, and EFA was used to determine the construct validity. In determining the reliability of the prepared scale, first, the split-half reliability method was used, and then the Cronbach Alpha reliability method was used to determine the internal consistency. Anova Tukey's Nonadditivity, Hotelling's T-squared, and intraclass correlation coefficient (ICC) analyses were also performed to assess reliability.

FINDINGS

Findings Related to Validity Analysis

The Kaiser-Meyer-Olkin (KMO) test was used to determine whether the data collected within the scope of the study were sufficient for exploratory factor analysis. The KMO value for the sample was determined to be .924 based on the results. Factor analysis requires a KMO value greater than .70 (Seçer, 2013, p. 119). In this context, it can be said that the sample size is suitable for EFA. The results of Bartlett's sphericity test were also less than 0.05 and significant (p =.00). After deciding that the data set was suitable for EFA, validity, and reliability processes were performed. In this context, first, the common factor variances of the items were determined within the scope of exploratory factor analysis. In the first stage, items with item explanation values below .30 (1, 3, 6, 8, 10, 12, 13, 14, 16, 18, 28, 32, 33, and 34) were removed from the measurement tool. After the re-examination, the item factor criterion was increased to .40 to increase the number of items in the measurement tool and its validity and reliability. In the second analysis, items 5, 7, 20, 30, and 37 were removed from the form. After the items were removed, it was determined that the structure explanation values of the items included in the measurement tool varied between .47 and .62.

One-Dimensional Solution and Item Factor Load Values

Principal component analysis (PCA) is a multivariate analysis technique that provides information about the internal relationships of quantitative variables (Abdi & Williams, 2010: 433). In this study, the multidimensional structure of the scale was first examined. Then, the single-factor structure of the scale was evaluated. The one-dimensional structure offers the most optimal solution based on the operations performed. The component matrix table gives information about the distribution of the items among the factors and shows the factor loading values of the items. Since the measurement tool is dimensional, there was no overlap between the items. The factor loading values of the items range from .792 to .546. As the measurement tool is one-dimensional within the scope of EFA, no rotation was performed. The Scree Plot is another way to determine the number of factors in the scale. A slope scree plot is a method used to determine the factor number of the data obtained at the end of factor analysis (Kanyongo Gibbs, 2005, p. 122).

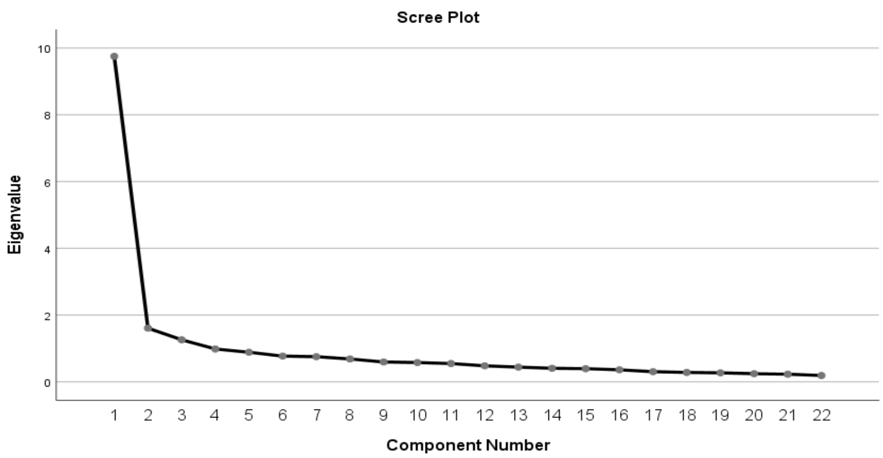

Chart 2. ***Scree Plot Curve***

When we look at the Scree Plot curve in Chart 2, the measuring tool is one-dimensional. For the second dimension, it was decided that the tool would be one-dimensional because the inclination angle was insufficient, and the belief phenomenon could be measured with only one dimension. The ratio of explanation of the total variance of the single determined dimension is presented in the table below.

Table 2. ***Explained Variance***

Component	Initial Eigenvalues			Extraction Sums of Squared Loadings		
	Total	% of Variance	Cumulative %	Total	% of Variance	Cumulative %
1	9.750	44.318	44.318	9.750	44.318	**44.318**
2	1.607	7.305	51.623			
3	1.259	5.724	57.347			
4	.983	4.468	61.815			

When we look at Table 2, we see that the scale is one-dimensional, and this dimension explains 44.31% of the scale. Before the reliability analysis, a total of 19 items were removed from the 41-item draft scale and subjected to reliability analysis with 22 items.

Findings Related to Reliability Analysis

Cronbach's alpha value was checked for the reliability of the measurement tool. Although many techniques are used for reliability, the most used technique in scale development processes and determining internal consistency is the determination of Cronbach's alpha value (Sharma, 2016, p. 271). The Cronbach's alpha value for the measurement tool was determined to be.938 due to the analysis. In this context, it can be said that the scale's internal consistency is reasonable (Seçer, 2013, p. 179). The effects of each item on the Alpha coefficient were examined, and in this context, no item was removed since no item would increase reliability when removed.

Two split-reliability analyses were also used to determine the reliability of the scale. The scale is randomly divided into two halves in split-half reliability analysis, and the correlation value between these two halves is checked (Özbek, 2010, p. 57). According to the results, it is seen that the Spearman-Brown correlation value is .904, and the Guttman split-half value is .905. In this context, the measurement tool's split-half reliability level was determined to be .90. This value is sufficient for the reliability of the scale's two halves (Seçer, 2015, p. 27). Within the context of reliability analysis, Guttman lambda analysis scale values range from .90 to .95.

Anova Tukey's Nonadditivity analysis

Anova Tukey's Nonadditivity analysis was performed to determine that the items in the scale had similar structures and to determine their Nonadditivity and homogeneity. The data for the analysis are shown in Table 3. Looking at Table 3, we can see that the p-value is significant (p.001). In this context, the items that make up the scale contain a homogeneous structure and are related. The Tukey Nonadditivity value is also shown to be p =.00. In this context, the scale does not show a Likert-type additive scale feature (Özdamar, 2013: 565).

Table 3. ***ANOVA with Tukey's Test for Nonadditivity***

			Sum of Squares	df	Mean Square	F	p
Between People			2013.858	202	9.970		
Within People	Between Items		831.829	21	39.611	64.144	.000
	Residual	Nonadditivity	.536	1	.536	.869	.351
		Balance	2619.044	4241	.618		
		Total	2619.580	4242	.618		
		Total	3451.409	4263	.810		
Total			5465.268	4465	1.224		
Grand Mean = 3.219							

Intraclass correlation coefficient (ICC) analysis

ICC analysis gives information about the validity and reliability of the items that make up the measurement tool in terms of its structure. Information on intraclass correlation coefficient (ICC) analysis is shown in Table 4. When the Meta-Education scale is analyzed according to ICC criteria, the scale variances are halved, and the total variances are similar. In this context, the scale is a valid and reliable measurement tool in terms of the order of the questions and their structural features. The test has reliable construct validity in terms of individual questions and mean measures (Özdamar, 2013: 565).

Tablo 4. ***Intraclass Correlation Coefficient Test***

Intraclass Correlation Coefficient							
	Intraclass Correlation[b]	95% Confidence Interval		F Test with True Value 0			
		Lower Bound	Upper Bound	Value	f1	f2	p
Single Measures	.408	.359	.462	16.144	02	4242	.000
Average Measures	.938	.925	.950	16.144	02	4242	.000

Hotelling's T-Squared analysis

The phenomenon of meta-educational belief, which is the phenomenon to be measured, was examined with Hotelling's T-Squared test, which is used to determine the degree of effective measurement with the developed measurement tool. According to the findings, the Hotelling T value is statistically significant (p.001). In this context, it can be said that the scale is effective in measuring the phenomenon of "meta-educational belief." In addition, the scale can be accepted as a strong and unique scale consisting of homogeneous questions (T = 781.514; F (182) = 33.53, p .01).

DISCUSSION AND IMPLICATIONS

In this study, a measurement tool was developed to determine the beliefs of pre-service teachers and teachers about education in the Metaverse (meta-education). For this purpose, an expert's opinion was sought on the items prepared to determine the scope and face validity of the measurement tool. After expert opinion, it was determined that the content validity index was at a sufficient level, and validity and reliability analyses were made. Information on the validity and reliability of the scale in question is presented below.

Before the reliability analysis, Kaiser-Meyer-Olkin (KMO) and Bartlett's sphericity test results were within acceptable (KMO = 0.932; Bartlett's = 0.00) ranges. In addition, the explanatory power of the items to be included in the measurement tool was determined. In the first stage, the items with item explanation values below .30 were removed, and after the re-examination, the items with item factor criteria were below. Forty items were removed because the number of items in the measurement tool is high and to increase its validity and reliability. As a result of the factor analysis performed to determine the construct validity of the measurement tool, the distribution of the items to the factors, the scree plot, and the eigenvalues were examined, and it was decided that the scale would consist of a single factor. This single factor explains 44.32% of the total variance of the scale. The load values of the items that make up the scale vary between .67 and .87. Therefore, the factor weight of the items should be over.30, and items over .50 are considered quite good (Kalaycı, 2016; Sharma, 2016). When the results of factor analysis are considered together, it is possible to conclude that the scale's 22-item single-factor structure has construct validity and produces valid results (Çokluk, Şekerciolu, & Büyüköztürk, 2015; Kanyongo Gibbs, 2005).

In the study, it was determined that the internal consistency (Cronbach's Alpha), Guttman Lambda (between .90 and .95), and test split (.91) reliability coefficients of the scale (.90) were at reasonable levels. According to Kalaycı (2016), if the reliability coefficients are between .40 and .59, the reliability is low; if they are between .60 and .80, the scale is quite reliable; and if they are between .80 and 1.00, the scale is highly reliable. When the study's findings are examined in terms of these criteria, the entire measurement tool developed is likely in the very reliable range.

On the scale, total item correlation values ranged from .64 to .77. When the literature is examined, it is seen that there is different information about the limit ranges of the item-total correlation values. In this study, the limit value stated by Büyüköztürk (2013) was considered. According to the item-total correlation results in the measurement tool, there was no item with a value less than .30. Considering this value, it is possible to say that the items that make up the scale are distinctive.

When we consider the study's findings, this scale can be used to determine the belief in education with Metaverse validly and reliably based on the opinions of teachers and pre-service teachers. In addition to its robust findings, this study has several limitations. It is limited to the fact that the participants are teachers and pre-service teachers and not other adults. The measurement tool could not reach a sufficient sample size for CFA analysis. Our scale is limited in the absence of DFA.

Further studies may focus on the verification of the single-factor structure of this scale in different samples by CFA analysis. This study focused on the meta-educational beliefs of teachers and pre-service teachers. Other studies may be related to different contexts, such as attitude, perception, and self-efficacy. In addition, this newly developed measurement tool can examine the perceptions of different segments of society regarding belief in meta-education. Meta-education is a new concept, and it is essential to establish its conceptual foundations. Other work to be done might be in the direction of filling this gap.

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Appendix-1: Meta-Education Belief Scale (Meta-EBS)*

	ITEMS	Strongly Disagree	Disagree	Moderately agree	Agree	Strongly Agree
1	Educational services made with metaverse are more memorable for students.					
2	Educational services made with metaverse save time.					
3	Students can quickly adapt to the metaverse.					
4	Metaverse facilitates adaptation to changing world conditions.					
5	All kinds of gains are suitable to be given with metaverse.					
6	With metaverse, it is more practical for students to receive feedback.					
7	Metaverse supports students' learning motivation.					
8	Metaverse offers students the opportunity for personalized learning.					
9	Metaverse is an obligation in the digital age.					
10	With the metaverse, students' communication with different cultures will increase.					
11	With the metaverse, it will be easier for students to learn foreign languages.					
12	Metaverse allows teachers to share their experiences with teachers from different countries.					
13	Metaverse can create a focus problem for students.					
14	In the metaverse environment, the gestures and facial expressions of the student's avatar ensure that virtual participation is as effective as face-to-face participation.					
15	Metaverse technology negatively affects mental development.					
16	Metaverse develops students' imaginations.					
17	Metaverse provides equal opportunity in education.					
18	Metaverse prevents different geographical features from affecting education negatively.					
19	With metaverse, students learn at their own pace.					
20	With the metaverse, students gain experience more freely.					
21	Metaverse positively affects the emotional development of students.					
22	Metaverse negatively affects social communication.					

**The measurement tool named "Meta-Education Belief Scale," whose validity and reliability analyses are performed in this article, can be used without permission, provided are cited in scientific studies.*