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Development and psychometric evaluation of an attitude scale on the use of new media technologies for teacher candidates – Turkish Form (ANMT-TC)

Ruhi Çay^{1*} and Engin Güney²

Abstract

Background There is no valid and reliable measurement tool in Turkey that comprehensively assesses prospective teachers' attitudes toward new media technologies in education, culture, and art. This study aims to develop a valid and reliable 'Attitude Scale Towards the Use of New Media Technologies for Teacher Candidates – Turkish Form'.

Methods The study was conducted in four sequential phases: a pilot study, exploratory factor analysis (EFA), confirmatory factor analysis (CFA), and a test–retest study. A total of 753 teacher candidates (591 female and 162 male) participated in the study. The average age of participants across all four stages was 21.34 (SD = 2.54).

Results Item statistics were calculated during the pilot study. The three-factor, 16-item scale demonstrated satisfactory fit indices with factor loadings ranging from 0.431 to 0.860 during the construct validity phase. Upon examining the final results of the CFA, the goodness-of-fit indices were acceptable (TLI = 0.928, CFI = 0.941, RMSEA = 0.061, SRMR = 0.061). Furthermore, the internal consistency of the ANMT-TC was satisfactory (Cronbach's $\alpha = .84$). The test–retest reliability analysis also showed a positive correlation between the two measurements ($r = .603, p < .01$).

Conclusions The ANMT-TC demonstrates a satisfactory structure with validated validity and reliability among Turkish teacher candidates. The current findings support the idea that ANMT-TC can be used as a valid and reliable measure of effectiveness in the fields of education, culture, and the arts.

Keywords Education, New media technologies, Scale development, Attitude scale

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Background

The use of new media technologies (NMT) is increasing rapidly worldwide. NMT, defined as Web 2.0, encompasses various web-based communication technologies such as blogs, wikis, online social networks, virtual applications, and social media platforms [1, 2]. New media technologies include advanced technologies such as virtual reality and artificial intelligence, which are computer programming-based digital applications and enable interaction processes between humans and machines through these systems (Humprecht et al., 2022). The term "new media" (NM), which emerged as a result of the transformation of traditional media through internet networks and mobile communication tools [4, 9], is characterized by the digital production and distribution of information and interactive forms of communication [6, 7, 8]. New media refers to various forms of media that go beyond the internet and network technologies. Through the internet, mobile phones, and various digital platforms, it continues to expand its influence globally (Han et al., 2024). While these technologies enable individuals to use digital environments freely to develop their cognitive, emotional, cultural, educational, and artistic skills [10], they are also transforming communication and significantly affecting teaching methods and learning processes [11]. Research emphasizes that with digitalization, the use of (NM) environments has increased over the years as access to technological tools has become easier [12]. For example, data from Statista (2024) shows that a significant portion of the world's population (5.52 billion out of 8.08 billion) has internet access, and this population uses NMT at varying rates [13]. Integrated into many areas of life, NMT transforms our way of perceiving life [14, 15, 16] while also increasing screen time. This situation not only creates negative psychological effects in individuals (Peters et al., 2022) but also causes disorders associated with digital addiction [18]. As defined by Ding et al., (2023), this addiction emerges as a process in which forms of consciousness are constructed without the use of force. For instance, recent years have seen an emphasis on depression, anxiety, various mental disorders, and identity issues being products of digital addiction [20, 21, 22, 23, 24], Avci et al, (2025). The opportunities offered by NMT inherently carry a motivation for addiction by their very nature. Many features, such as establishing instant social connections over the internet, unlimited communication opportunities, platforms for freely expressing thoughts and emotions, the construction of fictional identities, instant access to information, and digital entertainment environments, are fundamental elements that fuel the risk of addiction. In addition to indicators of dependency, access to NMT tools has become essential. At this point, approaches to technological developments for creative processes in NMT use emphasize the

importance of lifelong learning skills [26]. When considered pedagogically, NMT enhances interaction by developing technical skills, fostering creative thinking, and strengthening interdisciplinary collaboration. In particular, the digital transformations of recent years have profoundly shaped higher education, both technologically and pedagogically (Tian and Ye, 2025). Similarly, artificial intelligence, which has become integrated into our lives in recent years, necessitates educators to develop themselves holistically. This is because students can create visual compositions using AI applications and NMT tools, address conceptual gaps through simulations and interactive demonstrations, engage in cultural exchange with people from different geographies, and experience intercultural interaction [28]. Therefore, it can be stated that NMT and its components play a role in educational transformation, visual aesthetics, and cultural interactions.

Innovations in educational technologies play a significant role in educational services, visual aesthetics, and cultural communication. A comparison of previous and current literature reveals that NMT (National Educational Technology) continues to influence education, culture, and art. In this context, it is considered important to support the learning processes of prospective teachers in faculties of education within the framework of the Technological Pedagogical Content Knowledge (TPACK) model and to determine their future attitudes, especially in order to respond to the demands of young generations who have been intensely interacting with technology in recent years. Social psychologists are working to uncover the relationship between attitudes and behaviors [29, 30], and research on attitude formation shows that cognitive and affective factors positively influence attitudes [31, 32]. Attitudes are psychological tendencies that reflect the evaluation of a particular entity in a positive or negative light [33, 34]. In attitudes, which comprise cognitive, emotional, and behavioral aspects, the emotional aspect is generally considered the most important, reflecting an individual's feelings and responses. The behavioral aspect represents behavioral intentions, while the cognitive aspect encompasses beliefs and thoughts (Rosenberg and Hovland, 1960). According to attitude formation theory, affective, behavioral, and cognitive factors that an individual possesses also influence attitudes [36, 127]. In the twenty-first century, new technological developments and the focus of educational curricula on current digital problem-solving skills are increasing technology use in educational settings, and, in this context, teachers' attitudes towards technology are of scientific interest [38]. Therefore, the TPACK model is an effective framework for developing future educators in technological

knowledge (TC), pedagogical knowledge (PK), and content knowledge (CK), and for shaping the next generation [39].

From this perspective, the ANMT-TC measurement instrument developed for Turkish pre-service teachers is expected to raise awareness of NMT, which has increasingly become integrated into daily life. Therefore, the ANMT-TC may contribute to the literature by measuring attitudes toward NMT. Recent developments in scale development research have provided various insights into the structural characteristics of measurement instruments (Kabadayı, 2025). In recent years, network analysis has been frequently employed in scale development studies, as it facilitates the understanding of complex relationships among items by visualizing their interconnected structures [41]. In addition, network analysis allows the identification of items' positions within the network structure and enables the examination of different centrality measures, such as item centrality [42]. In this context, network analysis, exploratory factor analysis, and confirmatory factor analysis will be employed to examine the construct validity of the study.

Consequently, a review of the literature indicates that technology presents both opportunities and risks for individuals across various dimensions. This situation highlights the need for a measurement instrument that places technology and pedagogy at the center while addressing educational, cultural, and artistic dimensions holistically, particularly for pre-service teachers who will play a significant role in educating future generations. The present study adopts the attitude formation theory and the TPACK model as its theoretical framework, assuming that pre-service teachers should possess content knowledge, pedagogical knowledge, technological knowledge, and pedagogical content knowledge. From this perspective, measuring pre-service teachers' attitudes toward NMT from educational, cultural, and artistic perspectives may contribute to the existing literature. In summary, this study aims to develop a valid and reliable measurement instrument to assess pre-service teachers' attitudes toward the use of NMT across the educational, cultural, and artistic dimensions.

The role of NMT in education

Parallel to negative effects such as digital addiction, the positive contributions of NMT to learning processes are also significantly addressed in the literature [43]. Within the United Nations' 2030 Sustainable Development Goals, the target of "quality education" requires offering inclusive and equitable opportunities. In line with this goal, NMT is a significant tool for its accessible, equalizing nature [44]. During the COVID-19 pandemic, the role of online education, the internet, and mobile applications highlighted the central importance of NMT in

education [45]. These technologies have transformed the one-way communication structure of traditional media [46] by enabling simultaneous reach to large numbers of participants, providing interactive teaching methods, and creating flexible (asynchronous) learning environments [47]. Research shows that digital learning environments offer advantages over traditional classroom settings, including instant feedback, faster assessment, and increased participation [48, 49]. The integration of digital environments (mobile applications, online training programs, software, etc.) into educators' learning processes enhances students' cognitive and affective learning [50, 51]. Furthermore, increasing students' in-class motivation can facilitate easier adaptation to digital society, both theoretically and practically [52]. This situation parallels the development of digital competencies among teachers and students [53]. However, some studies report that students' academic performance declines due to excessive use of mobile applications [54]. Therefore, it is important to raise awareness of the use of NMT, which has become a vital tool for meeting basic needs, to minimize its negative impacts. Teachers' attitudes towards NMT are a decisive factor in the effective use of existing educational tools. According to attitude formation theory, cognitive, affective, and behavioral assessments shape an individual's perspective on and use of technology [29]. In this context, the TPACK model provides a theoretical framework for teachers to use digital tools for pedagogical purposes, along with their technopedagogical content knowledge [55]. Therefore, measuring prospective teachers' attitudes towards the dialogue between NMT and education is important for the cognitive, affective, and behavioral development of future generations.

New media technologies and new cultural transformations

The transformation brought about by digitalization has also altered cultural phenomena. In addition to traditional culture, habits belonging to digital culture and new lifestyles have emerged [56]. Previous research has focused on the relationship between new media and culture, as well as on the digital transformation of traditional culture [57, 58, 59]. Technological advancements have moved the concept of culture beyond merely reflecting traditions and customs, paving the way for new forms such as new media culture [60], virtual culture [61], and mass culture [62]. In this context, the changes created by new media culture in individuals' daily practices are noteworthy [63]. In particular, NM environments that transcend geographical boundaries contribute to the proliferation of virtual culture by enabling unlimited interaction among individuals (Li et al., 2022). Additionally, it enables individuals to meet fundamental social needs such as self-expression, interaction, and receiving feedback [65]. While this process contains opportunities for

identity construction [66], excessive use or misdirection leads to identity confusion. Indeed, recent findings in the literature reveal that NM environments have become a central tool in fulfilling individual needs such as acquiring information, networking, self-actualization, and self-esteem [67]. When teachers' attitudes towards the cultural changes and transformations created by NMT are examined within the context of attitude theory, it is seen that these attitudes are shaped by cultural context and digital competence level [68]. Research shows that culture moderates the relationship between technology and communication factors [69]. In conclusion, understanding teachers' attitudes toward NMT and cultural context is crucial for achieving successful technology integration in education.

New media technologies and new art forms

In parallel with research revealing the positive and negative factors of NMT in educational and cultural settings, it is observed that NMT also brings about changes in art [70]. Within the scope of the phenomenon of art undergoing transformation alongside advancements in digital technologies [71], comparisons are being made in many aspects between traditional art and new media art (NMA) (e.g., digital art, software art, net art, multimedia art, digital sculpture, robotic art – cybernetic art) [72]. Advancing technologies have enriched people's vision through new forms, and this richness has differentiated new media art in terms of content, presentation, and creativity [73]. Relevant research shows that artists' productions mature when supported by NM tools [74]. These developments have played a significant role in NMT, both in creating artistic products and in enhancing the viewer's perspective on art [75]. Therefore, the importance of digital technologies as a transformative force in teaching and learning has grown from both the artist's and the art viewer's perspectives [76]. Literature reviews indicate that NMT has transformed artworks in production and exhibition and has provided both artists and art viewers with new perspectives. From an educational perspective, current research shows that teachers develop positive attitudes towards digital platforms when digital technology is used in creative arts education [77]. In this context, in the context of arts education, the TPACK framework provides pre-service teachers with a technopedagogical learning space for integrating digital technologies, enabling teachers to create creative and interactive learning environments. This, in turn, can enhance both students' and teachers' attitudes toward digital platforms, from cognitive and affective perspectives [78, 79].

The limitations in measuring NMT

Determining attitudes towards NMT is of critical importance for understanding both the individual and societal

impacts of the technology [80]. Attitude is defined as an individual's tendency to respond to a phenomenon or event [81]. As a psychological construct, attitudes can lead to observable changes in an individual's behavior [82] and consist of three basic components: affective, cognitive, and behavioral [83]. The affective component encompasses an individual's positive or negative feelings toward an object or subject, the cognitive component includes beliefs, thoughts, and knowledge about it; and the behavioral component covers action-oriented tendencies toward the object in question [84]. Especially in the educational context, teachers' attitudes toward a specific field influence the teaching process of that field by shaping their emotional, cognitive, and behavioral readiness levels [85].

Existing scales in the literature generally focus on social media, digital tools, and phone use [86, 87] and include sub-dimensions such as cyberbullying, persistence, competence, and entertainment-oriented use. Recent research also highlights attempts to measure teachers' affective, behavioral, and cognitive attitudes toward technology and artificial intelligence (Ramazanoğlu and Akın, 2025) [89]. Existing studies have focused on developing measurement tools to assess the extent to which teachers are ready for technology and artificial intelligence applications.

In technology integration in education, teachers have a critical role in shaping students' technology-focused learning experiences. However, many teachers struggle to adapt to this transformation due to a lack of necessary skills and self-confidence [90]. One of the main reasons for this situation is the inadequacy of the technological readiness provided to pre-service teachers during their undergraduate education [91]. This inadequacy can lead teachers to feel inadequate at responding to students' needs in the digital age [92].

Furthermore, NMT has led individuals to be more exposed to visual stimuli than to traditional text-based content and has also accelerated the transformation of online artistic expression and aesthetic forms [93]. These developments reveal the multidimensional, multisensory relationship NMT has established with education, culture, and visual aesthetics (art). Teachers who cannot adequately develop themselves from a techno-pedagogical perspective are likely to have difficulty meeting the needs of students who grow up intertwined with technology, virtual culture, and visual stimuli (such as digital games).

In this context, to determine dimensions for assessing teachers' attitudes towards NMT, the Technological Pedagogical Content Knowledge (TPACK) model developed by Mishra and Koehler serves as the basis. The model positions teacher knowledge at the intersection of subject area, pedagogy, and technology dimensions [55]. As

emphasized in the literature, it is important to address teachers' attitudes toward cultural and artistic phenomena holistically, which are closely related to NMT in this framework.

In this respect, the scale developed to measure the effects of NMT on pre-service teachers was structured around three main factors: education, culture, and art. Some studies indicate that teachers' attitudes toward the use of technology in education are relatively low, while their levels of anxiety are high [94, 95]. When examining the dialogue between NMT and culture, research shows that digital platforms expand the boundaries of traditions and customs by increasing the widespread impact of cultural values [96]. Moreover, they contribute to the development of diverse cultural interactions among individuals living in different parts of the world, thereby strengthening communication between people. Consequently, digital culture enables the globalization of the individual [56]. From the perspective of the relationship between technology and art, recent studies emphasize that NMT-supported environments enhance the interaction between art and individuals and contribute to interdisciplinary practices [97].

In this respect, within the artistic environments offered by NMT, individuals reinterpret both themselves and the world through participatory experiences and interactions among individuals, art, and technology [98]. NMT-based art, which actively utilizes digital technologies and interactive media, transforms the audience into the central element of the artwork as a creative domain, thereby expanding the boundaries of art [99]. Research in the literature indicates that art education at the higher education level plays a significant role in individuals' social and global development [100]. In this context, it is evident that studies in the literature adopt a holistic approach, placing education, culture, and art at the center when examining pre-service teachers' attitudes toward the use of NMT tools. However, no comprehensive attitude scale that evaluates NMT from educational, cultural, and artistic perspectives for pre-service teachers has been encountered in the literature. This gap reveals the necessity to develop a valid and reliable measurement instrument capable of assessing these attitudes in a multidimensional manner. Such an instrument carries the potential to contribute to the balanced evaluation of technology and the cultivation of individuals who will benefit society. Therefore, this study aims to develop a scale to measure pre-service teachers' attitudes towards NMT across its educational, cultural, and artistic dimensions.

Rationale for current study

The present study aims to develop a valid and reliable measurement tool to assess trainee teachers' attitudes towards the use of NMT. Today, developments in media technology are a focus of academic research, and teachers play an important role in preparing future citizens for a qualified society [101]. Previous studies have examined attitudes towards media and technology use, including sub-dimensions such as positive, negative, anxiety, and task switching [80, 102], social media addiction [103, 104], the use of social networking sites for collaborative learning [105] and social media and techno-pedagogical content knowledge [106]. Recently, the rate at which consumers use social networking sites to access desired information, make decisions, and make purchases has increased [107]. Research on NMT generally focuses on topics such as social media, addiction, and pedagogical content knowledge. However, no scale has been found that measures trainee teachers' attitudes towards the use of NMT, incorporating the dimensions of education, culture, and art. Research indicates that newly qualified teachers struggle to apply the knowledge they have acquired in the classroom [108], underscoring the need for a thorough understanding of the journey from theory to practice (König et al, 2024). Within this scope, the rationale for the present study lies in determining the attitudes of teachers who will gain their first professional experience towards NMT environments, which have become an important part of our lives, and in contributing to their holistic development by developing a scale consisting of sub-factors of education, culture, and art.

The purpose of the study

In this study, validity and reliability analyses were conducted to develop the "Development and Psychometric Evaluation of the Attitude Scale Towards the Use of New Media Technologies for Pre-service Teachers – Turkish Version (ANMT-TC)" to measure pre-service teachers' attitudes toward the use of NMT. Within the scope of the general aim, answers to the following questions were sought.

1. Does the proposed factor structure of the ANMT-TC demonstrate adequate fit with the empirical data collected from pre-service teachers, as assessed through Exploratory Factor Analysis (EFA) and Confirmatory Factor Analysis (CFA)?
2. Do the ANMT-TC scores and its sub-dimensions demonstrate high internal consistency, as indicated by Cronbach's alpha coefficient and Composite Reliability (CR) values exceeding the recommended threshold of 0.70?

3. Does the network structure of the ANMT-TC items reveal a coherent and theoretically meaningful clustering of attitudes?

Method

Research design

This study is a scale development study conducted using a quantitative research design to evaluate the psychometric properties of the Attitude Scale Towards the Use of New Media Technologies for Pre-service Teachers. The study focuses on the validity and reliability of a scale developed to assess pre-service teachers' attitudes toward the use of new media technologies in Turkey, with an emphasis on the educational, cultural, and artistic components of the TPACK model. In this context, the study was conducted at the Faculties of Education and Fine Arts of two state universities in Northern Turkey during the 2024–2025 academic year.

Participants and sampling

The participants are pre-service teachers studying in the education and fine arts faculties at two different state universities in Turkey. The participants were selected using the convenience sampling method. The participants of the current study were involved in four stages: Pilot, EFA, CFA, and Test–retest. A total of 753 participants participated in the study. Each participant was included in only one stage, ensuring they did not participate in the other stages. The stages and the demographic characteristics of the participants are provided below. For further details, see Table 1.

Phase I. pilot study participants

127 teacher candidates participated in the pilot study. Of the candidates, 97 (72.4%) were female and 30 (27.6%) were male. The average age of the candidates was 21.41 ($SD = 3.59$), with ages ranging from 18 to 39. When examining the average number of participants per department, Turkish Teaching 52.8%; Department of Information Technologies 29%; Science Teaching 8.7%; and Fine Arts Education 9.5%.

Phase II. Exploratory Factor Analysis participants (EFA)

333 teacher candidates participated in the EFA stage. The average age of the candidates was 21.05 ($SD = 2.47$), with an age range of 17–37. Of the candidates, 262 (78.7%) were female, and 71 (21.3%) were male. When examining the average number of participants per department, Psychological Counselling and Guidance accounted for 49.5%; Classroom Teaching 21.3%; Primary School Mathematics Teaching 10.5%; Social Studies Teaching 8.4%; Fine Arts Education 4.8%; Industrial Design 3.3%; and Graphic Design 2.1%.

Phase III. Confirmatory Factor Analysis participants (CFA)

254 teacher candidates participated in the CFA stage. The average age of the candidates was 21.34 ($SD = 2.80$), with ages ranging from 17 to 42. Of the candidates, 199 (78.3%) were female, and 55 (21.7%) were male. The participation rates by department were as follows: Industrial Design 22.4%, Art 18.5%, Turkish Teaching 16.5%, Social Studies Teaching 15.4%, Primary School Mathematics Teaching 9.1%, Science Teaching 7.1%, Guidance and Psychological Counselling 4.7%, Graphic Design 4.3%,

Table 1 Description of the participants

Factor		Total		Pilot		EFA		CFA		Test–Retest	
		N	%	N	%	N	%	N	%	N	%
Sex	Female	591	78.49%	97	72.4%	262	78.7%	199	78.3%	33	84.6%
	Male	162	21.51%	30	27.6%	71	21.3%	55	21.7%	6	15.4%
	Age	21.34		21.41		21.05		21.34		21.54	
Departments	Art							47	18.5%		
	Art and Design							1	0.4%		
	Ceramics							2	0.8%		
	Classroom Teaching					71	21.3%				
	Department of Information Technologies			37	29%						
	Fine Arts Education			12	9.5%	16	4.8%				
	Graphic Design					7	2.1%	11	4.3%		
	Industrial Design					11	3.3%	57	22.4%		
	Psychological Counselling and Guidance					165	49.5%	12	4.7%	39	100%
	Primary School Mathematics Teaching					35	10.5%	23	9.1%		
	Science Teaching			11	8.7%			18	7.1%		
	Social Studies Teaching					28	8.4%	39	15.4%		
	Turkish Teaching			67	52.8%			42	16.5%		
	Visual Communication Design							2	0.8%		

Visual Communication Design 0.8%, Ceramics 0.8%, and Art and Design 0.4%.

Phase IV. test—retest participants

Thirty-nine teacher candidates participated in the test–retest stage. The average age of the candidates was 21.54 ($SD = 1.34$), and the age range was 19–25. 33 of the participants were female (84.6%), and 6 were male (15.4%). The participation rates by department were as follows: Guidance and Psychological Counselling 100%

Data collection procedures

Firstly, permission was obtained from the XXX University Ethics Board Committee and the faculty of education dean's office. Subsequently, permission was obtained from the relevant author to use the measurement instrument. Social desirability bias was taken into account during data collection. Social desirability can be defined as the behaviors and attitudes that participants display to appear favorable or acceptable to others [110]. Accordingly, it was stated that participants' views were respected and approached with tolerance to enable them to express their true attitudes [111]. In this context, it was stated before the data collection process that participation was voluntary. Subsequently, informed consent was obtained from the participants. The risks to participants were minimized by ensuring the confidentiality of demographic and quantitative data obtained in the study. A Google Form was created for the scale items, and data were collected by integrating the form with a QR code. Since the data were gathered during the teaching–learning process, an appointment was arranged in advance with the course instructor, and face-to-face data collection was conducted when student motivation was high.

Content validity of the ANMT-TC

To determine the suitability of the 57-item form created for the ANMT-TC scale, an expert opinion form was prepared. Planning was conducted with 5 academics in art education, 2 in guidance and Psychological Counseling, and 1 in Turkish language education to obtain their opinions. Subsequently, opinions were gathered through an expert opinion form containing options for each item: ("Suitable"), ("Unsuitable"), and ("Your Opinions and Suggestions") [112]. Firstly, consultations were held with experts in the field of art education, and it was determined that 12 out of the 57 items in the original form (I12, I13, I22, I23, I26, I28, I38, I41, I43, I52, I53, I56) were not suitable, and these items were removed from the scale. Subsequently, the opinions of two academic experts in Guidance and Psychological Counseling were obtained on the remaining items, and conceptual revisions were made to 3 items (I10, I17, I25). In the final stage, the 45-item form of the scale was presented to

an expert in Turkish linguistics. The sentence structures of 3 items (I9, I24, I44) were corrected in line with the expert's opinions [113].

Instruments

Attitude scale on the use of new media technologies for teacher candidates – Turkish Form (ANMT-TC)

The measurement tool aims to assess candidates' teachers' attitudes towards the use of new media technologies. The scale consists of three sub-dimensions—education, culture, and art—and 16 questions. CFA results ($CFI = 0.94$, $TLI = 0.93$, $RMSEA = 0.061$ [90% CI: 0.048–0.074], $SRMR = 0.061$). Reliability analyses showed Cronbach's (α) = 0.84 and McDonald's (ω) = 0.84. Two sample items from the measurement tool are as follows: 'I use new media technologies as a tool in my artistic applications' and 'The development and spread of new media technologies improves the quality of human relationships'.

21st century information literacy skills scale

It was developed by Ölçek Kalaycı & Eşgi [114] using a Turkish sample. The scale, which aims to measure the 21st-century information literacy skills of secondary school students and teachers, consists of two sub-factors, namely 'Ability to Use Information and Legal Elements' and 'Accessing and Sharing Information', and 12 items. The DFA results ($CFI = 0.94$, $AGFI = 0.92$, $NFI = 0.91$, $SRMR = 0.03$, $RMSEA = 0.06$, $\chi^2/df = 2.61$) indicated that the two-factor structure of the instrument reflected good model fit. Reliability analyses showed Cronbach's (α) = 0.77 for the first factor and Cronbach's (α) = 0.74 for the second factor. According to these results, both factors can be considered reliable [114]. An example item from the instrument is as follows: 'I evaluate different ideas together for the same information'.

Data analysis and criteria

The quantitative data obtained in the study were analyzed through JASP [115]. In this study, assumptions were first tested, the minimum and maximum scores were examined, and it was determined that there was no missing data. Then, the assumptions of multivariate normality were examined. To determine factors at the EFA stage, maximum likelihood estimation was performed with oblimin rotation (Kabadayı, 2025). In the EFA stage, the KMO criterion (0.8 and above) and Bartlett's sphericity test significance level were used as indicators to assess whether the data were suitable for analysis [116]. In parallel, the scree plot was examined to determine the number of dimensions in the measurement instrument (see Fig. 2). In the CFA stage, $TLI \geq 0.90$, $CFI \geq 0.90$, $RMSEA \leq 0.08$, and

SRMR < 0.05 were considered acceptable fit indices to evaluate the model's adequacy [117]. The test–retest indicated a high level of correlation. As a relatively recent approach, the current study, which utilizes network analysis, presents information by focusing on the position of elements within the network plane. Indeed, in network analysis, where each element represents a node, the relationships between nodes are expressed as edges [118]. Centrality measures such as betweenness, closeness, and strength are frequently reported in network analysis. Closeness is defined as the sum of the shortest paths between nodes. Strength focuses on a node's connections within the network, providing its total strength and indicating its centrality. Finally, betweenness measures the number of shortest paths between nodes that pass through a given node [119].

Results

Four stages have been planned to obtain the findings about the scale (see Fig. 1).

Phase 1: pilot study

In Phase I, a pilot study was conducted to examine the reliability and validity characteristics of the 45-item draft scale. Pre-service teachers completed the 45-item draft scale in the pilot study. Based on the pilot study analysis, five items (I10, I18, I33, I40, I42) performed poorly. The five items had low item-total correlations and were removed from the scale because they reduced reliability. See Table 2 for item statistics.

Phase 2. Exploratory Factor Analysis and network analysis (EFA)

In Phase II, Exploratory Factor Analysis (EFA) was conducted to examine the factor structure of the 40-item draft scale and to evaluate the items' functionality within the scale. The EFA results showed that the items under the psychology sub-dimension had insufficient factor loadings, did not cluster into a single factor, and did not

support construct validity. Therefore, the psychology sub-dimension (9 items) was completely removed from the scale. In this process, each item was removed one by one, following a systematic procedure (Comrey and Lee, 1992). Additionally, items in the education, culture, and art sub-dimensions with factor loadings below 0.40 and/or cross-loading on multiple factors were removed from the scale: education (5 items), culture (5 items), and art (5 items). As a result of these procedures, the scale reached its final structure consisting of 16 items.

When examining the EFA results, the Kaiser–Meyer–Olkin (KMO) and Bartlett's Test of Sphericity were reviewed to assess the suitability of the data for factor analysis. In the current study, the KMO value was 0.83, and Bartlett's Test of Sphericity was significant, $\chi^2 = 1783.16$, $df = 120$, $p < 0.001$. The KMO value indicates that the sample is suitable for factor analysis, and Bartlett's test shows that the correlations among variables are sufficiently high for factor analysis. The scree plot supported a three-factor structure (see Fig. 2). It was determined that after the third factor, the curve leveled off, and a fourth factor did not emerge due to insufficient structural support. The analysis results indicate that the psychology sub-dimension did not make a significant or distinctive contribution to the scale structure. Comrey and Lee (1992), state that factor loadings of 0.32 and above represent an acceptable threshold value. The EFA results indicated that the factor loading of the items in the psychology sub-dimension remained below this threshold. In light of these findings, the psychology sub-dimension did not meet the construct validity conditions, and it was removed from the scale.

Exploratory factor analysis (EFA) was conducted using maximum likelihood estimation, as the assumption of multivariate normality was met, with oblique rotation applied to the factor solution.

The EFA results showed that the eigenvalues of the first, second, and third factors were 4.05, 2.90, and 1.90, respectively. It was determined that the item factor

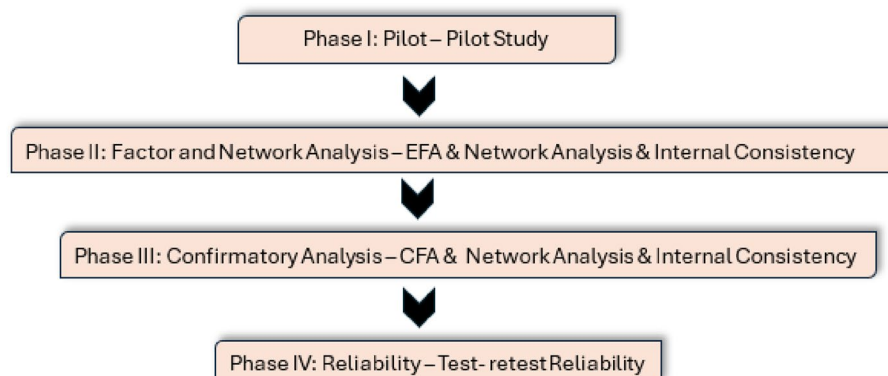


Fig. 1 Phases of the research

Table 2 Item Statistics

Items	Mean	SD	Skewness	Kurtosis
Item 1	3.86	.79	-.75	.90
Item 2	4.31	0.65	-.90	1.65
Item 3	3.37	1.00	-.27	-.50
Item 4	4.25	.60	-.50	1.21
Item 5	4.18	.75	-.87	1.41
Item 6	4.50	.71	-.63	.75
Item 7	3.78	.96	-.52	-.28
Item 8	3.80	.96	-.58	-.21
Item 9	2.62	.96	.72	.25
Item 10	4.10	.71	-1.02	2.47
Item 11	4.20	.65	-.82	2.25
Item 12	3.24	.95	-.25	-.35
Item 13	3.92	.85	-.80	.57
Item 14	2.53	.93	.32	-.38
Item 15	3.41	1.00	-.42	-.51
Item 16	2.89	.98	-.09	-.68
Item 17	2.97	.96	-.21	-.41
Item 18	2.67	1.08	.09	-.95
Item 19	2.45	1.01	.32	-.67
Item 20	3.84	1.00	-.77	.04
Item 21	3.12	1.10	-.30	-.51
Item 22	3.32	.89	-.40	-.32
Item 23	2.88	1.15	.07	-.05
Item 24	2.86	1.12	.13	-.26
Item 25	2.40	1.03	.71	-.26
Item 26	3.07	1.09	-.28	-.85
Item 27	3.42	.97	-.76	.27
Item 28	3.06	0.90	-.46	.09
Item 29	2.43	1.01	.25	-.84
Item 30	3.16	.91	-.30	-.26
Item 31	3.52	1.03	-.46	-.31
Item 32	2.67	.90	.15	-.40
Item 33	3.19	.96	-.50	-.53
Item 34	3.30	.92	-.01	-.50
Item 35	3.18	1.02	-.42	-.65
Item 36	3.55	.98	-.77	.08
Item 37	2.99	1.12	-.12	-.01
Item 38	4.12	.95	-.24	1.43
Item 39	4.21	.81	-.05	1.70
Item 40	1.71	1.69	1.47	1.30

loadings were acceptable. (see Table 3). The final structure of the scale consists of three factors: education (6 items), culture (5 items), and art (5 items).

Factor interpretation and item loadings

As part of the reliability analysis of the scale, AVE (Mean Variance Explained) and CR (Composite Reliability) values were calculated for each factor included in the scale. The online AVE and CR calculation system developed by Aydoğdu [121] was used to perform these calculations. An AVE value greater than 0.50 was considered acceptable for convergent validity, and a CR value greater than

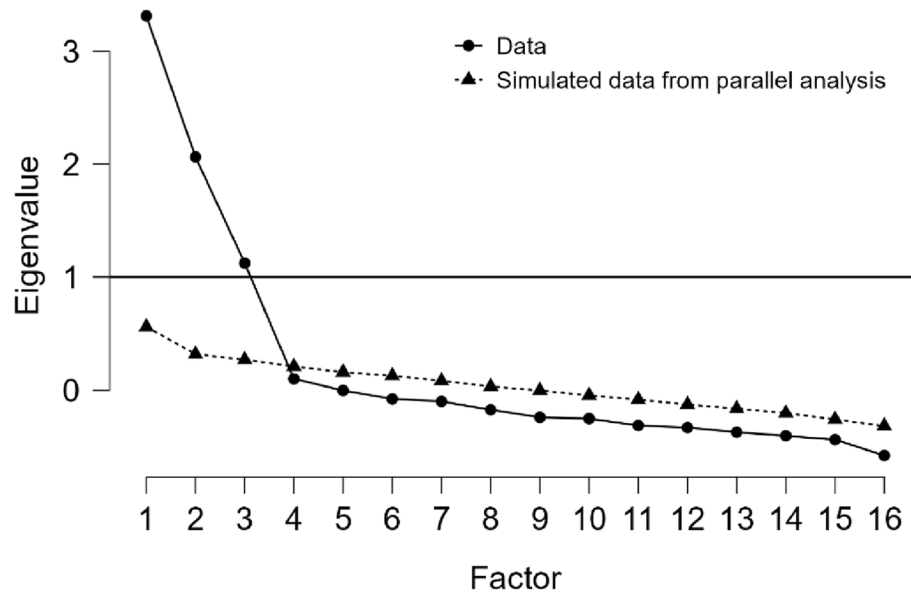
0.70 was considered acceptable for composite reliability (Fornell and Larcker, 1981). The AVE for the education sub-dimension is 0.43, which is below the acceptable threshold, the CR is 0.82, indicating that the composite reliability for this dimension is sufficient. The AVE value for the art sub-dimension was found to be 0.52 and the CR value was 0.84. In the culture sub-dimension, the AVE value was 0.37 and the CR value was 0.74. Although the AVE values for the education and culture sub-dimensions are slightly below the recommended threshold, the CR values being above 0.70 indicate that the dimensions have a moderate level of convergent validity (Fornell and Larcker, 1981).

McDonald's (ω) values were examined for the internal consistency of the scale. In the EFA, the McDonald's (ω) value of ANMT-TC was found to be 0.78 (95% CI [0.75 and 0.81]). Additionally, the internal consistency of three sub-dimensions was examined: McDonald's Omega for education ($\omega=0.85$); McDonald's Omega for art ($\omega=0.80$); and McDonald's Omega for culture ($\omega=0.75$). Network analysis was performed on the network plane for ANMT-TC. The network analysis results show that the resulting factor structure is consistent with the findings on the network plane (see Fig. 3).

M23 demonstrated the highest values in terms of Strength (1.678) and Expected Influence (1.780). This finding indicates that M23 possesses the strongest direct connections within the network and emerges as the most influential variable, exerting the greatest impact on other nodes. M27 had the highest Closeness centrality (2.303). This suggests that M27 can reach all other nodes via the shortest paths, thereby playing a critical role in the flow of information throughout the network. M6 is particularly notable for recording the highest Betweenness centrality value (2.659). This result implies that M6 serves as a bridge among clusters or groups within the network, underscoring its importance in maintaining the network's overall integrity and connectivity. Network analysis results provided supporting evidence for the factor structure shown in the EFA on the network plane. The network analysis also provided additional evidence for the three-dimensional structure established through EFA. It was observed that items within the education sub-dimension (I1, I2, I4, I5, I6, I11), the culture sub-dimension (I14, I16, I17, I18, I19), and the art sub-dimension (I23, I24, I25, I26, I27) exhibited a closely clustered structure in the network plane (see Table 4).

Phase 3. Confirmatory Factor Analysis (CFA), network analysis and correlation analysis

CFA was analysed using maximum likelihood estimation via JASP. At this stage, a 16-item version consisting of three factors was tested. (see Table 5). Upon examining the final results of the study, the goodness-of-fit indices

**Fig. 2** Scree plot**Table 3** EFA item factor loadings

Items	Factor I	Factor II	Factor III
Item 4	.82		
Item 2	.76		
Item 5	.63		
Item 6	.61		
Item 11	.60		
Item 1	.48		
Item 23		.86	
Item 24		.84	
Item 26		.72	
Item 25		.67	
Item 27		.44	
Item 19			.77
Item 18			.61
Item 14			.61
Item 17			.57
Item 16			.47
Eigenvalues	4.05	2.90	1.90

Factor 1 = Education; Factor 2 = Art; Factor 3 = Culture

were acceptable ($\chi^2/df=1.94$, $TLI=0.93$, $CFI=0.94$, $RMSEA=0.061$, $SRMR=0.061$) [123]. Based on these findings, the model shows a good fit to the data. The fit index criteria were revised, and the minimally acceptable level was integrated instead of "good fit." In parallel, the internal consistencies of the three sub-dimensions were examined in the CFA: For education, Cronbach's Alpha ($\alpha=0.84$) and McDonald's Omega ($\omega=0.84$), Cronbach's Alpha ($\alpha=0.78$) and McDonald's Omega ($\omega=0.78$) for art; and Cronbach's Alpha ($\alpha=0.84$) and McDonald's Omega ($\omega=0.85$) for culture. In the CFA, Cronbach's alpha (α) for the NMT attitude scale was found to be 0.84

(95% CI [0.80 to 0.88]), and McDonald's coefficient (ω) was 0.84 (95% CI [0.81 to 0.87]).

When examining correlations between variables, weak positive correlations were observed between education and culture ($r=0.182$, $p<0.05$), and moderate positive correlations between art and culture ($r=0.337$, $p<0.001$). In addition, a moderate positive correlation was found between culture and art ($r=0.359$, $p<0.001$). In addition, ANMT-TC and its sub-dimensions showed high correlations with ANMT-TC: education ($r=0.643$, $p<0.001$), culture ($r=0.758$, $p<0.001$), and art ($r=0.773$, $p<0.001$). (see Table 6).

A moderate positive correlation ($r=0.491$, $p<0.001$) was found between Factor 1 of the 21st Century Literacy Skills Scale and the education sub-dimension of ANMT-TC; an insignificant correlation with culture ($r=0.110$, $p<0.05$); a weak positive correlation with art ($r=0.181$, $p<0.01$); and a moderate positive correlation with the total ANMT-TC score ($r=0.334$, $p<0.001$). Factor 2 showed a moderate positive correlation ($r=0.510$, $p<0.001$) with the education sub-dimension, but no significant correlation with the culture ($r=0.051$, $p<0.05$) and art ($r=0.097$, $p<0.05$) dimensions. However, a weak positive correlation ($r=0.272$, $p<0.001$) was found with the overall ANMT-TC score. In addition, a moderate positive correlation ($r=0.332$, $p<0.05$) was found between ANMT-TC and the 21st Century Literacy Skills Scale.

M2 has the highest Strength value (2.324). This result indicates that M2 has the strongest direct connections with other nodes in the network. Moreover, the relatively high Expected Influence (1.510) value suggests that M2 is an important node with a

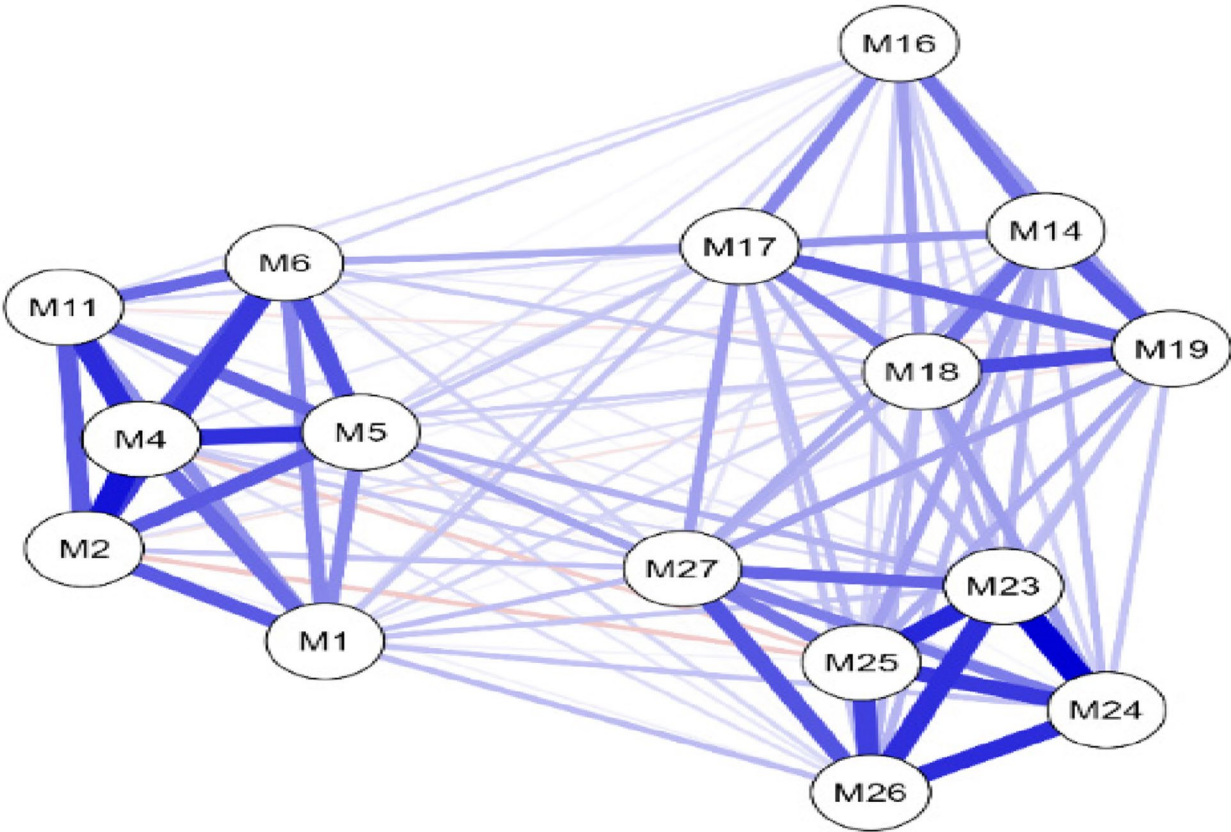


Fig. 3 Network analysis of the scale

Table 4 Centrality measures per variable

Variable	Betweenness	Closeness	Strength	Expected influence
M1	−0.162	−0.621	−0.465	−0.102
M11	−0.162	−0.432	−0.832	−0.869
M14	−0.397	0.139	−0.550	−0.185
M16	−0.867	−2.318	−2.702	−2.065
M17	1.484	0.919	−0.004	0.303
M18	−0.397	−0.339	−0.052	0.261
M19	−0.867	−0.455	−0.753	−1.317
M2	−0.867	−0.642	0.046	−0.676
M23	0.779	1.261	1.678	1.780
M24	−0.632	0.090	0.401	0.657
M25	−0.632	0.477	0.388	−0.833
M26	−0.632	0.235	0.562	0.801
M27	0.779	2.303	1.395	1.532
M4	−0.632	−0.516	0.669	0.001
M5	0.544	−0.029	0.276	0.514
M6	2.659	−0.073	−0.056	0.200

strong impact on other variables within the network. M3 achieved the highest value for Expected Influence (1.866). This finding indicates that M3 is one of the variables exerting the greatest overall influence on other nodes within the network, highlighting its influential role in the network dynamics. In addition, the relatively high Strength (1.342) value further

Table 5 CFA item factor loadings

Items	Factor I	Factor II	Factor III
Item 4	0.45		
Item 2	0.50		
Item 5	0.47		
Item 6	0.43		
Item 11	0.58		
Item 1	0.53		
Item 23		0.78	
Item 24		0.68	
Item 26		0.60	
Item 25		0.69	
Item 27		0.42	
Item 19			0.76
Item 18			0.66
Item 14			0.89
Item 17			0.71
Item 16			0.82

Factor 1 = Education; Factor 2 = Art; Factor 3 = Culture

supports that M3 maintains strong connections within the network structure. M1 had the highest Closeness centrality (1.726). This suggests that M1 can reach all other nodes via shorter paths, indicating that it plays an important role in facilitating the flow of information or influence across the network. M7 recorded

Table 6 Pearson's correlations

Variable	1	2	3	4	5	6	7
(1) Education	-						
(2) Culture	0.182**	-					
(3) Art	0.337***	0.359***	-				
(4) Development and Psychometric Evaluation of an Attitude Scale on the Use of New Media Technologies for Teacher Candidates – Turkish Form (ANMT-TC)	0.643***	0.758***	0.773***	-			
(5) Information Usage and Legal Aspects	0.491***	0.110	0.181**	0.334***	-		
(6) Access to Information and Information Sharing	0.510***	0.051	0.097	0.272***	0.710***		
(7) 21st Century Information Literacy Skills	0.538***	0.092	0.157*	0.332***	0.949***	0.896***	-

* $p < .05$ ** $p < .01$ *** $p < .001$ **Table 7** Centrality measures per variable

Variable	Betweenness	Closeness	Strength	Expected influence
M1	0.799	1.726	0.415	0.721
M10	-1.125	-1.176	-0.024	-0.532
M11	-0.575	-1.149	0.519	0.850
M12	-0.026	-0.227	-0.075	0.115
M13	-0.438	-0.462	-0.198	-0.036
M14	-1.262	-1.092	-1.327	-1.431
M15	1.074	0.176	-0.092	0.094
M16	1.486	0.833	-0.909	-0.915
M2	0.661	0.456	2.324	1.510
M3	-0.026	1.237	1.342	1.866
M4	-1.262	-1.485	-1.342	-1.449
M5	0.661	0.768	-0.519	-0.433
M6	-0.438	-0.101	-0.648	-0.689
M7	1.898	1.339	0.741	0.763
M8	-0.301	0.053	0.806	0.609
M9	-1.125	-0.894	-1.013	-1.044

the highest Betweenness centrality value (1.898). This result implies that M7 acts as a bridge between nodes or subgroups within the network, emphasizing its critical role in maintaining overall connectivity and structural integrity. (see Table 7).

Phase 4: test–retest reliability

ANMT-TC was administered at 4-week intervals to determine test–retest reliability. When the Pearson correlation coefficients were examined, it was revealed that there was a positive correlation between the two times ($r = 0.603$, $p < 0.01$). A positive correlation was found between the two time points for the dimensions of education ($r = 0.688$, $p < 0.01$), culture ($r = 0.656$, $p < 0.01$), and art ($r = 0.587$, $p < 0.01$).

Discussion

In this study, the aim was to develop a valid and reliable scale (ANMT-TC) to measure Turkish pre-service teachers' attitudes toward the use of NMTs. The findings indicate that the 16-item scale is suitable in terms of

psychometric properties. Additionally, the three-factor structure showed acceptable internal consistency and good model fit. The network analysis we conducted to enhance the model's overall robustness confirmed the relationships among variables based on the factor structure identified by EFA and CFA. The network analysis provides complementary insights to the EFA and CFA findings by revealing the structural roles and relational importance of individual items. M23 shows the strongest direct connections, M27 occupies a central position in information flow, and M6 functions as a bridge between clusters, highlighting item interactions beyond the factor structure [42]. Similarly, M2 and M3 emerge as central items with high Strength and Expected Influence, while M1's Closeness and M7's Betweenness support efficient information flow and connectivity between subgroups [42, 124]. These results underscore the added value of integrating network analysis with factor-analytic approaches to better interpret item dynamics and the scale's internal organization. Furthermore, when the calculated AVE and CR values were examined, although the education and culture dimensions fell below the acceptable threshold, the CR values exceeded 0.70, indicating acceptable convergent validity (Fornell and Larcker, 1981). As a result of the analysis, it was revealed that the AVE values for some factors were below the recommended threshold of 0.50. In the literature, it is stated that if the AVE is below 0.50, the explained variance for the items in the relevant structure is insufficient (Fornell and Larcker, 1981). However, it is stated that if the AVE is low, the measurement model is not necessarily invalid [125]. In this context, when the reliability values are examined, it can be said that the measurement properties are at an acceptable level. In addition, the psychology dimension, which was initially included in the study, showed low factor loadings and inadequate fit indices in the EFA analysis. Kline [123] states that in scale development studies, the model will have a more consistent structure as a result of removing factors that are theoretically meaningful but do not show sufficient statistical fit.

In this context, the psychology dimension was removed from the measurement tool. After the psychology dimension was removed, the scale's scope was structured around the education, culture, and art dimensions of NMT. In this regard, the results of the current study showed that ANMT-TC is a valid and reliable instrument for assessing teacher candidates' attitudes towards the use of NMT. Therefore, this study contributed to the field of research by presenting the first scale development study to measure prospective teachers' attitudes towards NMT holistically across the education, culture, and art dimensions. The removal of the psychology dimension indicates a mismatch between the theoretical framework and empirical findings. Although attitudes are conceptualized as comprising cognitive, affective, and behavioral components, these components may not always emerge as distinct factors [126]. Moreover, attitudes can be validly measured through cognitive and behavioral tendencies alone (Gregory and Noto, 2018). Therefore, while excluding the psychology dimension narrows the scale's scope, the education, culture, and art dimensions remain sufficient to assess pre-service teachers' attitudes toward NMT use.

Psychometric properties and the construct validity of ANMT-TC

The analyses in the study showed that the item factor loadings in the EFA ranged from 0.44 to 0.86. In CFA, the loadings ranged from 0.42 to 0.89. It is reported that in scale studies, values of 0.55 or above are considered good for item factor loadings; however, 0.32 is often accepted as the minimum acceptable threshold [128]. When the ANMT-TC is examined, the item factor loadings are generally good, except for items 4, 5, 6, and 27 in the CFA. Items with factor loadings below the threshold may be attributed to the composition of the participant sample. Additionally, they can provide information regarding the scale's sensitivity to diversity [129]. Furthermore, the network analysis results indicated that the 16 items in the three-dimensional ANMT-TC were incorporated at the network level in both the EFA and CFA. In addition, the results of the parallel analysis confirmed the stability of the three-factor structure. Regarding the correlations between the dimensions, it is notable that their positive values are remarkable. When examining the current study's internal consistency and test-retest results, there is supportive evidence for the reliability of ANMT-TC. According to the literature, Cronbach's (α) and McDonald's (ω) values above 0.70 generally indicate an acceptable level of internal consistency (Kabadayı, 2025). In this context, the CR values for the three factors in the EFA (0.84, 0.80, 0.75) and the CR values obtained in the CFA (0.84, 0.78, 0.84) indicate that

the scale has strong internal consistency. Additionally, the AVE values for the factors (0.43, 0.52, 0.37) indicate sufficient construct validity for the second factor ($AVE > 0.50$), while the first and third factors remain below the acceptable threshold. However, since the CR values exceed 0.70 for all three factors, the dimensions' convergent validity is considered acceptable. Differences in the content and scope of measured constructs may lead to nonsignificant or low correlations between measurement instruments (Cheung et al., 2024). In the present study, no significant relationship was found between the *culture and arts* subdimension of the ANMT-TC scale and the *information access* and *information sharing* subdimensions of the 21st Century Information Literacy Skills Scale. This finding may be explained by the 21st Century Information Literacy Skills Scale, focusing primarily on technical and cognitive competencies [114], whereas the ANMT-TC attitude scale measures individuals' affective orientations toward cultural and artistic aspects mediated by NMT. Accordingly, this result may also be associated with differences in the content and scope of the constructs measured by the two instruments, as noted in the literature (Uysal Saraç et al., 2024).

Theoretical contributions and future applications

The generalizability and cross-cultural adaptation of the scale were examined through various studies in the literature, and it can be stated that the ANMT-TC possesses unique characteristics. For instance, a study examining the latent profiles of young teachers' transition to digital integration in Chinese culture identified profiles of high acceptance, anxious acceptance, and ordinary acceptance. In the study, the emergence of the anxious acceptance group (49.0%) is considered a significant finding. Thus, it is emphasized that while many teachers acknowledge the benefits of technology, their anxieties hinder technology integration. Based on this, attention is drawn to teacher professional development (TPD) regarding technology use, highlighting the TPACK model [132]. In this context, ANMT-TC's focus on teacher candidates' attitudes toward the relationship between NMT and education—a current topic—underscores the study's significance.

In Turkish literature, there are also attitude scales developed to examine teachers' attitudes toward technology. For example, the "Self-efficacy Scale of Technology Usage in Education" was developed as a measurement tool for elementary education teachers and consists of 48 items and two factors: "basic skills" and "anxiety" [133]. Similarly, in a study conducted in Turkish culture, a 22-item scale was developed to measure the digital integration skills of adult educators (unlike young teachers), with dimensions including (active participation and

alternative learning environments, assessment and evaluation, professional development, interactive and dynamic content). The study emphasizes the need to assess teacher candidates' ability to use digital technologies in teaching and learning within education faculties. Additionally, it was found that adult educators who received sufficient training scored higher on digital integration skills than those who did not [134]. Based on this, while ANMT-TC shares similarities with scales in the literature in emphasizing the educational importance of digital integration, it differs from other scale studies by also encompassing culture and art and offering a multidimensional field of examination. This can be said to provide a unique structure for ANMT-TC.

Upon examining different studies, it is noteworthy that research often focuses on topics such as teacher candidates' technological competencies [135], attitudes toward technology [136], attitudes toward media and technology use involving sub-dimensions like positive, negative, anxiety, and task-switching [80], social media addiction [103], the use of social networking sites for collaborative learning [105], and social media and techno-pedagogical content knowledge [106]. Recent studies, however, highlight the importance of intercultural interaction resulting from the blending of cultural values and practices, driven by the widespread use of the internet and mobile technologies [96].

A study conducted abroad found that new media environments facilitate intercultural adaptation, enabling students studying in different countries to achieve linguistic and cultural equity in opportunities [137]. Regarding the artistic development of individuals in NMT environments, it is reported that artists can reach wider audiences through virtual platforms such as Instagram, Twitter, and Facebook. In this context, it is emphasized that people enhance their educational and cultural competencies by interacting with art [138].

Previous and recent studies have focused primarily on teachers' general attitudes towards technology. However, the evolving technological landscape necessitates that every teacher develop their cultural and artistic selves, in parallel with pedagogical knowledge, to engage in creative activities within learning environments. In this regard, teachers' attitudes are crucial [139]. Therefore, the current study contributes to the literature by revealing attitudes towards the educational, cultural, and artistic contributions of NMTs.

As a result of this study, a valid and reliable scale (ANMT-TC) comprising three factors and 16 items was developed to assess Turkish pre-service teachers' attitudes toward the use of NMTs in education, culture, and art. Demonstrating the scale's psychometric qualities (validity and reliability) with robust evidence confirms its suitability for use in the field. Consequently, ANMT-TC

can be used as a reliable measure in both national and international literature to assess teacher candidates' attitudes toward NMTs.

Limitations and recommendations

This study has several limitations. First, the scale was administered to pre-service teachers at two state universities in the Central and Eastern Black Sea Region of Turkey, limiting the generalizability of the findings to a broader population. Conducting the study across two regions and two institutions also resulted in imbalances in gender distribution and notable differences in quantitative distributions across departments. These factors may have posed a risk to the generalizability of the findings within the Turkish sample. Accordingly, future studies may enhance generalizability by including participants from diverse geographical regions and ensuring a more homogeneous distribution across departments in the pilot, EFA, and CFA stages.

Another limitation is that measurement invariance across gender could not be examined. In recent years, policy changes in higher education in Turkey have led to a decline in the number of pre-service teachers in faculties of education, resulting in noticeable gender disparities. This imbalance limited the ability to test measurement invariance. Future studies may address this issue by increasing the number of participating universities and ensuring a more balanced gender distribution.

A further notable limitation is the inability to conduct a discriminant validity analysis due to the limited availability of established measurement instruments for NMT in Turkey. While this constitutes a limitation, it also highlights the potential contribution of the present study to the field of NMT within the Turkish context. In addition, the AVE values indicated that the education and culture dimensions were below the acceptable threshold, representing another important limitation. Future research should further examine whether these dimensions and their items function adequately.

Finally, the test-retest correlation was moderate ($r=0.603$), suggesting limited temporal stability of the scale and indicating that the results should be interpreted with caution.

Conclusions

The ANMT-TC attitude scale is a measurement instrument whose validity and reliability have been established for assessing pre-service teachers' attitudes toward NMT. By addressing technology within the framework of new media as a contemporary concept, the scale provides a comprehensive structure for evaluating the use of NMT. In particular, the inclusion of the education, culture, and arts sub-dimensions enables a holistic assessment of pre-service teachers' attitudes toward NMT, thereby

underscoring the study's significance. In this context, the scale could increase pre-service teachers' awareness of the educational, cultural, and artistic uses of NMT. Such awareness is expected to contribute to their ability to use technology-supported instructional environments effectively and consciously in classroom practice once they begin their professional teaching careers.

Abbreviations

ANMT-TC	Development and Psychometric Evaluation of an Attitude Scale on the Use of New Media Technologies for Teacher Candidates – Turkish Form
CFA	Confirmatory factor analysis
EFA	Exploratory factor analysis participants

Supplementary Information

The online version contains supplementary material available at <https://doi.org/10.1186/s40359-026-04587-2>.

Supplementary Material 1.

Supplementary Material 2.

Authors' contributions

Conceptualization: RÇ, EG; Methodology: RÇ, EG; Formal analysis and investigation: RÇ, EG; Writing—original draft preparation: RÇ, EG; Writing—review and editing: RÇ; Funding acquisition: RÇ; Resources: RÇ, EG; Supervision: RÇ, EG.

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Data availability

The datasets generated during and/or analysed during the current study are available from the corresponding author on reasonable request.

Declarations

Ethics approval consent to participate

This study was performed in line with the principles of the Declaration of Helsinki. Approval was granted by the Research Ethics Committee of Recep Tayyip Erdoğan University (Date 17 March 2024/No 2024/161). Informed consent was obtained from all individual participants included in the study.

Consent for publication

Not applicable.

Competing interests

The authors declare no competing interests.

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