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Psychometric features of the emergency remote teaching attitude scale and an example application

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Abstract

Existing research shows that emergency remote teaching (ERT), which has become mandatory with the COVID-19 Pandemic, has unique aspects and provides differentiating experiences for teachers and learners. This research aims to develop a scale to measure the attitudes of the teaching staff working in higher education towards ERT; besides the validity and reliability proofs, to make a sample application with the developed scale. For this purpose, the validity and reliability proofs of the *Emergency Remote Teaching Attitude Scale (ERTAS)* according to the Classical Test and Item Response Theories were determined in line with the data collected from 878 teaching staff working in the state and foundation universities throughout Turkey. ERTAS has three sub-dimensions measuring *Affective, Behavioral, and Cognitive* dimensions with a total of 22 items. According to the literature, the fit indexes of the ERTAS obtained from Confirmatory Factor Analysis are acceptable. It was determined that the attitudes measured by the sub-dimensions of ERTAS according to gender, seniority, and their interaction did not change. The teaching staff experienced that ERT relieved them of their teaching responsibility in line with the flexibility, accessibility, the facilitation of the presentation of visual and auditory content. Some suggestions have been made regarding the use of ERTAS.

Keywords: Emergency Remote Teaching Attitude Scale (ERTAS), scale development, Item Response Theory (IRT), measurement invariance

1. Introduction

1.1. Introduce the problem & describe relevant scholarship

Distance teaching, which is mandatory and urgently included in education life with the COVID-19 Pandemic, features that cannot be evaluated in distance education

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applications with a history of almost 300 years (Bozkurt et al., 2020; Bozkurt & Sharma, 2020); with its technological, pedagogical, economic and social problems (Akpolat, 2021; Almaiah et al., 2020; Bulut, 2021; Cain et al., 2020; Dolmaci & Dolmaci, 2020; Drane et al., 2020; Hussein et al., 2020; Mishra et al., 2020; Mohammadi et al., 2021; Montacute, 2020; Usta & Donmez, 2021; Thomas & Rogers, 2020; Omodan, 2020; Owusu-Fordjour et al., 2020), it still maintains its *mandatory* presence in the lives of instructors and learners. With the call of UNESCO, in order to control the spread of COVID-19, to close schools, to suspend face-to-face education, and to continue curriculum-based teaching and learning "remotely through a mix of technologies" has become a part of education in the world in 2020 with the support of "governmental agencies. international organizations, private sector partners and civil society" (UNESCO, 2020).

Due to the pandemic, the prevailing value in educational activities is "sustaining" (Sułkowski, 2020); in order to ensure sustainability until the crisis is over, a new approach has been made with Emergency Remote Teaching (ERT), which produces a "temporary solution" in this context (Leonardi, 2020). It focuses on the minor destruction of the process, in which "face-to-face is provided with online modes" (Bawa, 2021) education ecosystem has been tried to be created (Hodges et al., 2020). Thus, instead of the activities of long-term, systematic, theoretical basis, appealing to a specific target audience, and planned and programmed distance education, face-to-face education with ERT is tried to be provided via internet access (Akyurek, 2020; Barbour et al., 2020; Bozkurt & Sharma, 2020) can be considered the birth of a new teaching/learning system. Although the spread of the pandemic through schools has been brought under control with ERT, the application is for instructors creates situations such as developing content for online or offline courses, recognizing and using the technology that ERT is offered, evaluating the effectiveness and efficiency of the system, evaluating learning outcomes, increasing workload and managing ethical issues in the digital world (Abad-Segura et al., 2020; Adedoyin & Soykan, 2020; Anderson & Simson, 2007; Blumenstyk, 2020; Kocaoglu & Tekdal, 2020; Kulikowski et al., 2021; Marinoni et al., 2020; Mishra et al., 2020; Osman, 2020; Sarı, 2020; Senel & Senel, 2021). Similarly, ERT learners faced situations such as having internet access, financial problems, self-regulation for participation in learning activities, taking responsibility, developing technological communication skills, coping with stress, and receiving limited family support (Ferri et al., 2020; Larcher et al., 2020; Leung & Chu, 2020; Sangster et al., 2020; Sumardi & Nugrahani, 2021; Willems et al., 2019; Xie et al., 2020). It is therefore likely that both teachers and learners have developed positive and negative attitudes towards ERT.

Attitude is about the way a person handles a problem or situation. Attitude has cognitive, affective, and behavioral components. While the cognitive component of the attitude is formed by "interest, belief, thought and knowledge" towards the situation or object (Giner-Sorolla, 1999, p. 443), the emotional component provides positive or

negative thinking. The behavior component of attitude governs behaviors related to a situation or object (Rosenberg & Hovland, 1960 cited by Zanna & Rempel, 1988, p. 316).

Attitude is psychometric with its psychological and sociological aspects (DeVellis, 2011), so it is “measurable” as a phenomenon (Andrich & Luo, 2003, p. 406). As a matter of fact, there are attitude scales developed about distance education in the literature (for example, Arslan et al., 2019; Clark, 1993; Halder, 2012; Junior et al., 2018; Kisla, 2016; Mishra & Panda, 2007; Uzun et al., 2013;..). Similarly, there are attitude scales prepared for ERT. For instance, Alodail (2016), Arslan (2021), Celik and Uzunboylu (2020), Romero-Martinez et al. (2020), Tzafilkou et al. (2021), Yurdal et al., 2021, .. prepared attitude scales to measure students' attitudes towards distance learning within the scope of ERT. In the scale prepared by Alqabbani et al. (2020) to evaluate the "readiness" of instructors regarding ERT during the COVID-19 period, together with "readiness, perceived effectiveness, satisfaction, anxiety" which constitute the conceptual framework of ERT, six items are measuring the "Attitude". Similarly, Tzivinikou et al. (2020) also developed an attitude scale to evaluate special education teachers' attitudes towards ERT.

1.2. Aim of the research

It was concluded that there are a limited number of measurement tools in the field that measure instructors' attitudes, especially towards ERT. In this context, this research aims to develop the ERT attitude scale for instructors, obtain validity and reliability evidence, and make a sample application with the developed scale.For this purpose, the validity and reliability proofs of the *Emergency Remote Teaching Attitude Scale (ERTAS)* developed by the researchers were tested according to the classical test and Item Response Theories (IRT); the measurement invariance according to gender, seniority, the field of science and whether there is a difference in attitude for some of these independent variables were examined.

2. Method

This research is a descriptive study aiming to determine the psychometric properties of the ERTAS. It is also a survey-type study with the dimension of comparing attitudes towards ERT according to gender and seniority.

2.1. Participants

The research teamconsists of teaching staff (doctor assistant, lecturer, assistant professor doctor, associate professor, professor) working at universities in Turkey. Participants were reached through official letters sent through their universities and their e-mail addresses on the Turkish Higher Education Council (HEC) website. Candidate scale items were submitted electronically (via Google Document Form). The

teaching staff who voluntarily participated in the research formed the sample of the research. The descriptive descriptions of them are shown in Table 1.

Table1. Demographic characteristics of the participating teaching staff

Variable		Number (N)	Percent (%)
Gender	Female	421	47.9
	Male	457	52.1
Teaching	Dr. Assistant	62	7.1
Staff's	Lecturer	232	26.4
Academic	Assistant Prof. Dr.	262	29.8
Titles	Associated Prof. Dr.	175	19.9
	Prof. Dr.	147	16.7
Seniority	Less than 5 Years	152	17.3
	6-10 Years	234	26.7
	11-15 Years	188	21.4
	16 Years and Above	304	34.6
Teaching	Theoric	366	41.7
Content	Theoric, Internship	80	9.1
	Theoric, Laboratory	30	3.4
	Application (Practical Application)	12	1.4
	Laboratory	3	0.3
	Internship	4	0.5
	Theoric, Practice (Practical Application)	236	26.9
	Theoric, Practice (Practical Application), Internship	102	11.6
	Theoric, Application (Practical Application), Laboratory	30	3.4
	Theoric, Laboratory, Internship	6	0.7
	Practice (Practical Application), Internship	1	0.1
	Theoric, Practice (Practical Application), Laboratory, Internship	8	0.9
Science Area	Education Science	306	34.8
	Science & Mathematics	52	5.9
	Philology	29	3.3
	Fine Arts	27	3.1
	Law	4	0.5
	Theology	12	1.4
	Architecture, Planning and Design	10	1.1
	engineering	82	9.3
	Health Sciences	121	13.8
	Social, Human and Administrative Sciences	178	20.4
	Sports Sciences	14	1.6
	Basic Sciences	1	0.1
	Tourism	2	0.2
	Applied Sciences	1	0.1
	Foreign languages	12	1.3
	Agriculture, Forestry and Aquaculture	27	3.1
Total		878	100

2.2. Data collection tool

The researchers developed the data collection tool. It was fed from three sources to create an item pool. The first source is the literature review. There are many publications on emergency distance education in the literature. Secondly, previously developed measurement tools for distance education and their items were examined. Finally, 35

academicians were asked three open-ended questions for questioning their experiences and feelings while doing ERT during the pandemic period, and items were added to the item pool from the answers obtained.

The candidate measurement tool was created to develop ERTAS, was presented to three educational technologies, one educational program and teaching, and one measurement and evaluation academician for expert opinion. The items were rearranged with the feedback received. The candidate measurement tool was given its final form before the trial application.

The candidate measurement tool included 45 items. These items are structured in a 10-point Likert structure. The candidate measurement tool included positive and negative sense items for ERT. As a result of the factor and reliability analyzes made after the trial application, the measurement tool showed a structure consisting of 3 sub-factors and 22 items. Details on this construct are presented in the findings section.

2.3. Ethics committee and data collection permissions

Ethics committee decision dated 07/04/2021 and numbered 09/11 was taken from the Republic of Turkey Giresun University Social Sciences, Science and Engineering Sciences Research Ethics Committee for this research. In line with this decision, the analysis was carried out with the data collected in line with the application permissions obtained due to the official correspondence made to all universities in Turkey by the same university.

2.4. Analysis of data

No missing value was detected in the data. The suitability of the data file for factor analysis was tested with Kaiser Meyer Olkin (KMO) and Bartlett's Test of Sphericity. The multivariate normal distribution of the variables in the data file was tested with the Mardia test (Korkmaz et al., 2014). The data conformed to the multivariate normal distribution. The principal axis factoring (PAF) method was chosen as the factor determination method. This method is preferred over principal component analysis, especially when a scale is developed for the first time and its theoretical background is unclear (Warner, 2008). Possible factorizations that will occur in the factor analysis were tested with the "Oblim Axis Rotation" due to the high correlation between the sub-dimensions (Hair et al., 2014). The CFA evidence obtained in the study was analyzed with fit indices. The reference values of fit indices (fit-index) determined for DFA were “0.05≤RMSEA≤0.08 acceptable” for RMSEA, “0≤RMSEA≤0.05 excellent” (Brown, 2015; Tabachnick & Fidell, 2013), for TLI and CFI indexes “ 0.95 and above is excellent” (Brown, 2015; Harrington, 2009), “2≤X2/sd≤5 is acceptable”, “0≤X2/sd” for chi-square/degree of freedom ≤2 perfect” intervals were used (Kline, 2005; Tabachnick & Fidell, 2013).

Data were analyzed for validity and reliability with Item Response Theory (IRT). When the answer set is graded (for instance, Likert Type), it is necessary to examine the assumptions of unidimensionality and local independence in the validity and reliability examinations with IRT. In this study, unidimensionality was tested with EFA, and the assumption of local independence was tested with the Q3 statistic (Yen, 1993). IRT calibrations were provided with the "mirt v.1.30" package in the R v.4.0.5 software (Chalmers, 2012).

Measurement invariance was carried out through the "lavaan" package (Rosseel, 2012). Measurement invariance was carried out according to the teaching staff's seniority, science fields, and gender. The measurement model seen in Figure 1 was tested separately with CFA according to the science fields and gender of the teaching staff. Chi-square/degree of freedom, RMSEA, CFI, and TLI were used as CFA fit indices. For measurement invariance after CFA; "configural invariance (equal form)"; "metric invariance (equal factor loadings)", "scalar invariance (equal indicator intercepts)" and "strict factorial invariance (equal indicator error variances)" were tested sequentially. In tests of measurement invariance, ΔCFI was taken as $\leq .01$ since Cheung and Rensvold (2002) and Chen (2007) stated that the criterion for ΔCFI should be less than or equal to .01.

MANOVA was used when examining attitudes towards ERT by gender and seniority. MANOVA is a parametric test preferred when there are multiple outcome variables (total scores from sub-dimensions of ERTAS in this study). As the details are explained in the findings section, since the measurement invariance could not be ensured according to the scientific field of the teaching staff, a comparison analysis was not made according to this variable.

3. Findings

This section presents proof of the validity and reliability of ERTAS determined under the classical test and IRT.

3.1. Validity and reliability evidence of ERTAS according to Classical Test Theory

The data file was randomly split into two. The data of 401 academicians were used for Exploratory Factor Analysis (EFA), and the data of 477 academicians were used for Confirmatory Factor Analysis (CFA).

In the trial practice of EFA I3, I4, I5, I8, I10, I11, I13, I14, I15, I18, I20, I21, I23, I24, I25, I26, I28, I31, I33, I35, I41, I43, and I45 items were excluded from the measurement tool because they showed low item-total correlation. The remaining 22 items were grouped under three sub-scales. The scale under which the items are placed, the amount

of variance explained by each scale, the name of the scale given by the researchers, and the information it provides are shown in Table 2 below.

Table2. EFA Results of ERTAS

Items		Name of Sub-dimensions AFFECTIVE		BEHAVIORAL		COGNITIVE		Explained Variance	Explanation
		Factor Loads After Varimax Rotation	Corrected Item-Total Correlation	Factor Loads After Varimax Rotation	Corrected Item-Total Correlation	Factor Loads After Varimax Rotation	Corrected Item-Total Correlation		
I39	If I were authorized, I would abolish ERT. (*)	0.760	0.694					19.657	AFFECTIVE Includes emotions regarding ERT.
I38	ERT is a disappointment for me. (*)	0.751	0.723						
I40	With ERT, nothing can be taught to the student. (*)	0.711	0.701						
I37	I'm uncomfortable being forced to ERT. (*)	0.667	0.660						
I42	University students cannot be trained with ERT. (*)	0.609	0.623						
I7	Even when I hear ERT, I get depressed.(*)	0.557	0.574						
I9	If I had a choice, I would not want to use ERT. (*)	0.534	0.656						
I17	ERT facilitates the use of audio content.			0.731	0.614			19.102	BEHAVIORAL Includes behaviors related to content presentation in ERT applications.
I16	ERT facilitates the use of visual content.			0.696	0.595				
I32	Being able to add as much course content as I want to ERT motivates me.			0.652	0.709				
I29	ERT offers me several opportunities to teach.			0.630	0.742				
I34	I feel relieved that I will be able to use the content I prepared for ERT in the following years.			0.611	0.577				
I27	It never deleted the content of records I created for ERT, motivates me to do the best.			0.556	0.601				
I19	To make my lessons with ERT accessible,			0.546	0.622				

	comforting me about my responsibility to teach.						
I12	The flexibility of space provided by ERT relaxes me.	0.512	0.566				
I1	My students will gain more qualified information with ERT.			0.717	0.649	16.750	COGNITIVE Includes interest, belief, thought and knowledge about the use of ERT.
I22	ERT facilitates the acquisition of course outcomes.			0.688	0.766		
I6	I believe that ERT increases the academic success of my students.			0.632	0.700		
I2	ERT content (live lectures, videos, links…) is interesting for my students.			0.570	0.654		
I36	I believe ERT is an effective way to train students.			0.570	0.746		
I44	ERT fits well with the meaning of the concept of "university" and the training it offers.			0.536	0.678		
I30	With ERT, I can take into account the individual differences of my students regarding learning.			0.525	0.533		
Kaiser-Meyer-Olkin = 0.946 Bartlett's Test of Sphericity = 5653.293; df = 231; p<.05			Total Expained Variance			55.499	

KMO value was 0.946, and Bartlett's value was 5653.293, p<.05. According to the literature, these values indicate that the data file is suitable for EFA (Cokluk et al., 2010; Field, 2018; Tabachnick & Fidell, 2013). The factor loading values of the items are between 0.760 and 0.512. The item-total correlations are between 0.766 and 0.533. This value is quite a high factor load and item-total correlation values.

The first measure is the "Affective" dimension of ERT, consisting of 7 items (all of them with negative meaning). If this dimension is to be used independently, a high score from this dimension indicates negative feelings about ERT. If a total score is obtained from the scale, this dimension should be scored in reverse. A minimum of 7 and a maximum of 70 points can be obtained from this dimension.

The second measuring is the "Behavioral" dimension consisting of 8 items. A minimum of 8 and a maximum of 80 points can be obtained from this dimension. The third is

composed of 7 items evaluating the "Cognitive" dimension. A minimum of 7 and a maximum of 70 points can be obtained from this dimension.

The variance explained by the three dimensions together is 55% (55,499). The Cronbach's Alpha reliability coefficient for the three dimensions separately and the whole scale is given in Table 3.

Table3. Cronbach Alpha reliability level of ERTAS sub-dimensions

Scale/Sub-Dimensions	Cronbach Alpha
F1: Affective	0.898
F2: Behavioral	0.891
F3: Cognitive	0.897
ERTAS (whole)	0.947

It was determined that the reliability values for all three sub-dimensions were very close to 0.90, and the reliability value for the whole scale was 0.947. According to Nunnally and Bernstein (1994), sufficient reliability should be at least 0.70 and above. The factor structure determined in EFA was tested with CFA. The resulting diagram is shown in Figure 1.

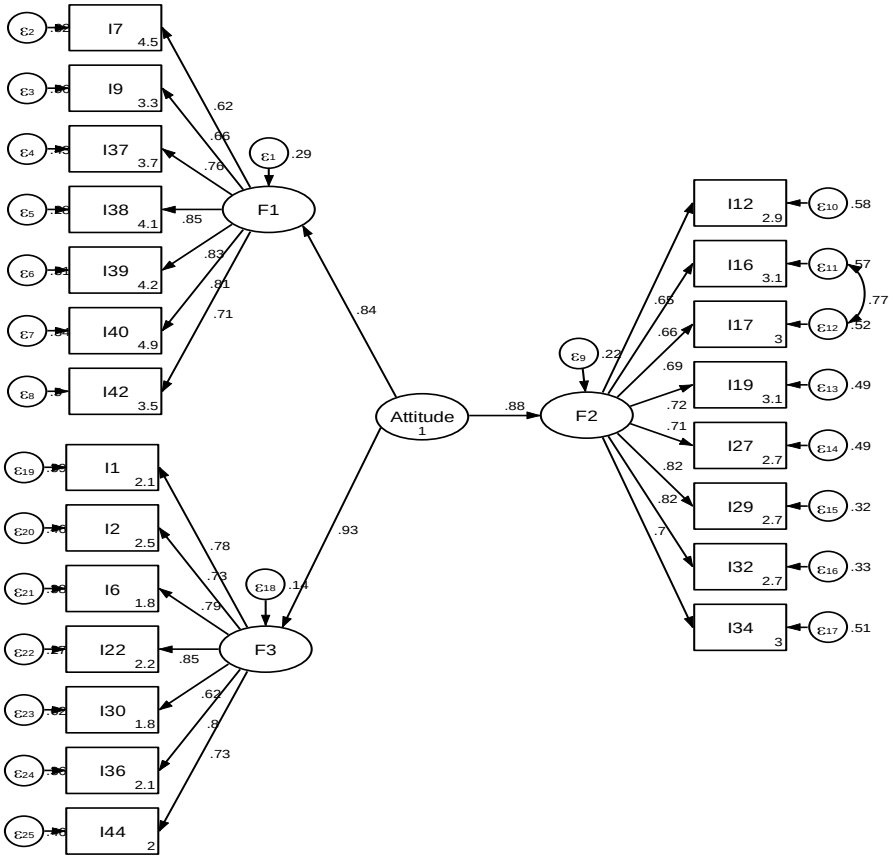

Figure1. CFA diagram of ERTAS

As seen in Figure 1, ERTAS was confirmed by secondary level CFA. The fit indices for CFA are shown in Table 4.

Table 4. DFA fit indexes of ERTAS

Chi-Square	df	Chi-Square/df	RMSEA	CFI	TLI	SRMR
588.112	205	2.869	0.062	0.946	0.939	0.037

The fit indices obtained are at an acceptable level according to the literature. In this state, it can be said that the measurement model of the 22-item 3-dimension ERTAS determined in the EFA was confirmed.

3.2. ERTAS validity and reliability evidence by IRT

Evidence of validity and reliability was searched according to IRT based on the scores obtained by academics from ERTAS. Analyzes were carried out through a data file containing data from 477 teaching staff and searching for evidence of CFA. To apply IRT, certain assumptions need to be examined. The first of these assumptions, unidimensionality, was examined by EFA. In the structure of ERTAS, which was determined as 22 items and 3 dimensions as a result of EFA, each sub-dimension was considered independent, and IRT analysis was performed. Local independence was determined through the Q3 statistic proposed by Yen (1993). According to the Q3 test, it was determined that no item impairs local independence among the 7 items in the first dimension of the scale (F1: Affective). Item calibrations for the items in this dimension were determined with the IRT and Generalized Partial Credit Model (GPCM). According to GPCM, S_χ2, degrees of freedom, RMSEA and level of significance statistics of the items were determined. The results are shown in Table 5.

Table5. Item fit-indexes by IRT for the Affective dimension

Items	GPCM			
	S_χ^2	df	RMSEA	p
I7	95.628	103	0.000	0.684
I9	124.940	106	0.019	0.101
I37	105.408	90	0.019	0.128
I38	68.691	73	0.000	0.621
I39	75.840	75	0.005	0.451
I40	83.155	70	0.020	0.135
I42	102.930	104	0.000	0.511

RMSEA is one of the indexes examined for compliance in IRT analysis. The limit value for RMSEA is 0.080, and below this value indicates item compliance. According to the

item fit-indexes statistics in Table 5, the RMSEA values of the items are less than 0.08. According to this result, it was decided that the scale structure reached by EFA provided model fit for the "Affective" dimension according to GPCM. Standard errors were estimated with the "a" and "b" parameters of the items whose model fit was determined according to GPCM. The results are shown in Table 6.

Table6. Item parameters and standard error values according to GPCM for the Affective dimension

Items	a (SE)	b1 (SE)	b2 (SE)	b3 (SE)	b4 (SE)	b5 (SE)	b6 (SE)
I7	0.620(0.066)	-2.545(0.493)	-0.753(0.367)	-1.858(0.339)	0.278(0.270)	-0.405(0.267)	0.170(0.238)
I9	0.630(0.066)	-0.316(0.267)	-0.103(0.288)	-0.824(0.281)	1.247(0.312)	0.310(0.326)	0.679(0.310)
I37	1.036(0.106)	-0.999(0.206)	-0.770(0.194)	-0.707(0.176)	0.188(0.166)	0.430(0.176)	0.648(0.179)
I38	1.945(0.218)	-1.095(0.157)	-1.189(0.146)	-0.834(0.113)	-0.059(0.102)	-0.043(0.101)	0.693(0.101)
I39	1.853(0.213)	-1.203(0.166)	-0.982(0.161)	-1.195(0.147)	-0.288(0.104)	0.000(0.106)	0.119(0.107)
I40	1.635(0.178)	-1.779(0.234)	-1.432(0.188)	-1.164(0.148)	-0.537(0.116)	-0.132(0.110)	0.085(0.108)
I42	0.756(0.078)	-1.022(0.234)	-0.234(0.232)	-0.505(0.229)	0.602(0.240)	0.450(0.253)	0.807(0.252)

Iteration = 45, Log-Lik. = -5260.642, p<.05

Estimates made according to GPCM (LogLikelihood, p<.05) prove the consistency of the scale items. Item trace lines are shown in Figure 2.

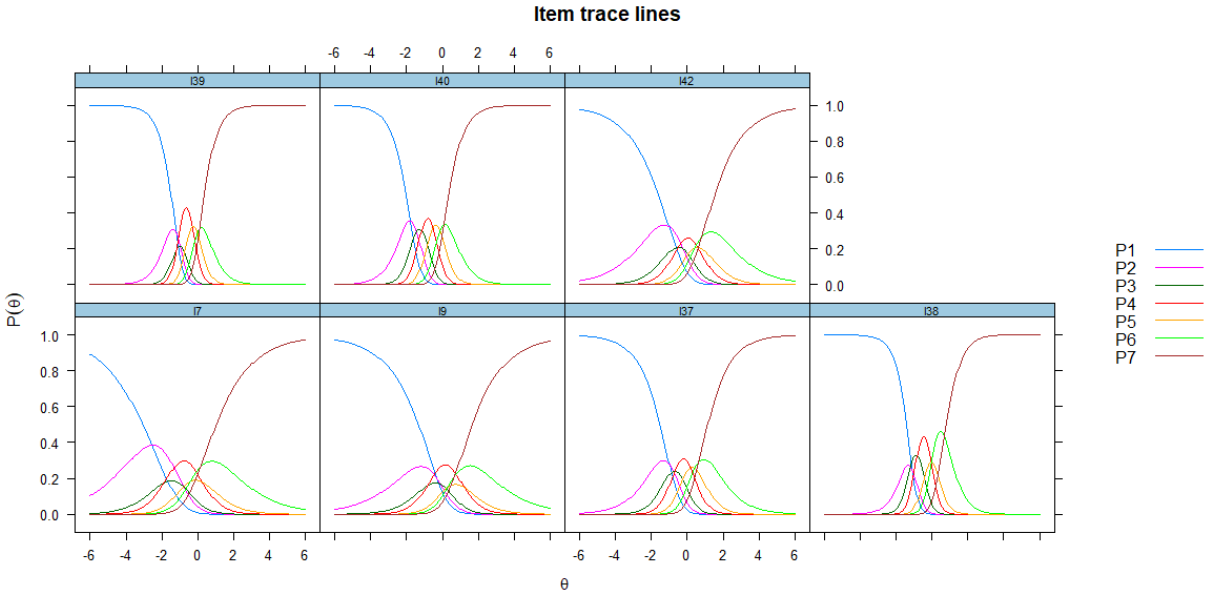

Figure2. Trace lines of Affective dimension items

According to the item trace lines in Figure 2, it is seen that Affective dimension items, together with their options, work for different attitude levels and are distinctive. However, the answers were generally stacked above 7 degrees, not all 10 degrees worked. Item information functions are shown in Figure 3.

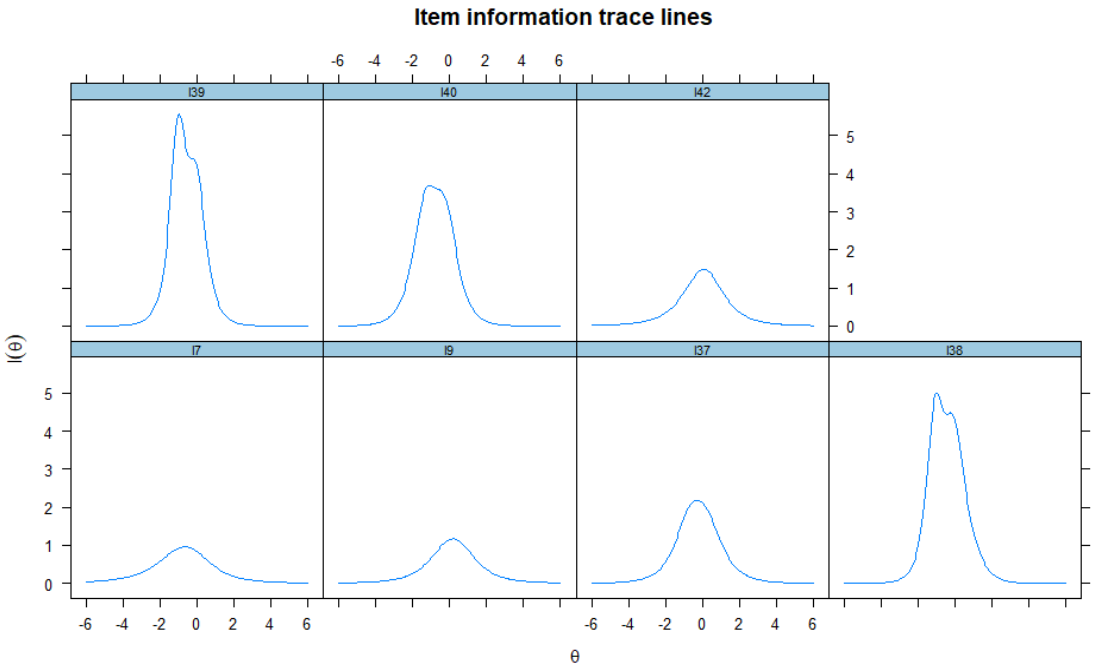

Figure3. Information trace lines of Affective dimension items

When the item information trace lines of the ERTAS Affective dimension items were examined, it was determined that the least informative items were I7, I9, I37, and I42. The test infographic of the ERTAS Affective dimension is shown in Figure 4.

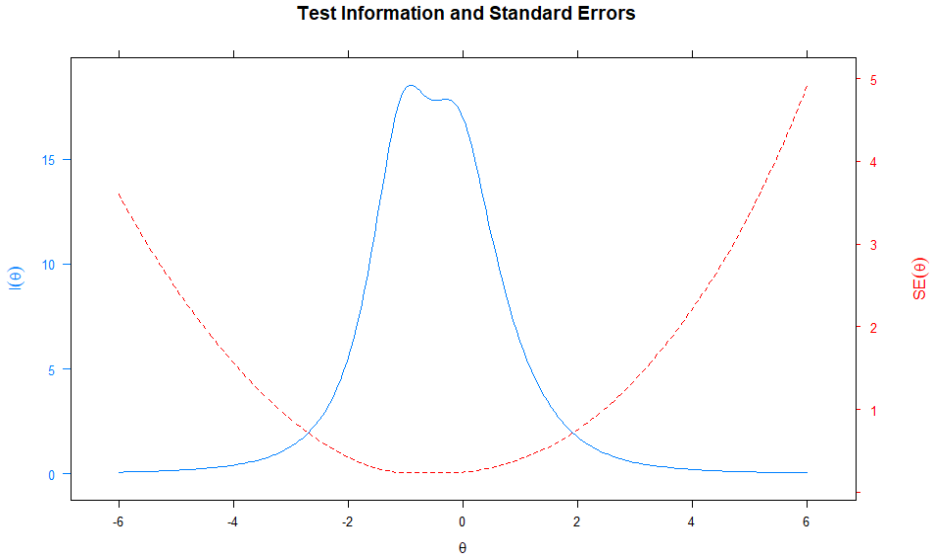

Figure 4. The test infographic of the ERTAS Affective dimension

Figure 4 shows that the ERTAS Affective dimension is a dimension for ERT that provides information about negative emotions. The level at which the dimension gives the best information is between -2 and 2. The scale provides the best information for individuals with negative emotions in this range. The marginal reliability coefficient of the ERTAS Affective dimension was calculated as 0.898. This value is very close and consistent with the reliability value obtained by Cronbach Alpha.

According to the Q3 test, it was determined that no item impairs local independence among 8 items in the second dimension (F2: Behavioral). According to the GPCM of the items in this dimension, S_χ2, degrees of freedom, RMSEA and level of significance statistics were determined. The results are shown in Table 7.

Table7. Item fit-indexes by IRT for the Behavioral dimension

Items	GPCM			
	S_χ^2	df	RMSEA	p
I12	104.847	99	0.011	0.325
I16	92.305	84	0.014	0.251
I17	101.502	87	0.019	0.137
I19	93.956	91	0.008	0.395
I27	95.921	92	0.009	0.369
I29	74.838	77	0.000	0.549
I32	97.610	81	0.021	0.101
I34	96.268	92	0.010	0.360

According to item fit-indexes statistics, the RMSEA values of the items are less than 0.08. According to this result, it was decided that the scale structure reached by EFA provided model compatibility in the Behavioral dimension according to GPCM. Standard errors were estimated with the "a" and "b" parameters of the items whose model fit was determined according to GPCM. The results are shown in Table 8.

Table8. Item parameters and standard error values according to GPCM for the Behavioral dimension

Items	a (SE)	b1 (SE)	b2 (SE)	b3 (SE)	b4 (SE)	b5 (SE)	b6 (SE)
I12	0.703(0.075)	-1.264(0.424)	-1.548(0.374)	-1.137(0.298)	-0.965(0.247)	0.044(0.212)	0.084(0.210)
I16	1.140(0.129)	-1.796(0.313)	-1.536(0.242)	-0.947(0.188)	-0.840(0.161)	-0.142(0.132)	0.651(0.135)
I17	1.241(0.141)	-1.600(0.266)	-1.319(0.219)	-1.172(0.177)	-0.547(0.137)	-0.042(0.125)	0.775(0.132)
I19	1.010(0.104)	-1.666(0.334)	-1.391(0.273)	-1.377(0.219)	-0.579(0.162)	-0.104(0.148)	0.691(0.152)
I27	0.914(0.095)	-1.403(0.276)	-0.651(0.258)	-1.612(0.245)	-0.036(0.165)	0.199(0.167)	1.448(0.201)
I29	1.489(0.151)	-1.476(0.193)	-1.096(0.157)	-0.898(0.130)	-0.044(0.110)	0.399(0.116)	1.375(0.147)
I32	1.439(0.154)	-1.559(0.196)	-0.911(0.160)	-0.923(0.143)	-0.261(0.115)	0.282(0.115)	1.291(0.143)
I34	0.925(0.095)	-1.930(0.337)	-0.891(0.273)	-1.589(0.247)	-0.388(0.171)	-0.099(0.161)	0.927(0.170)
Iteration = 50, Log-Lik. = -5946.032, p<.05							

Estimates made according to GPCM (LogLikelihood, p<.05) prove the consistency of the scale items. Item trace lines are shown in Figure 5.

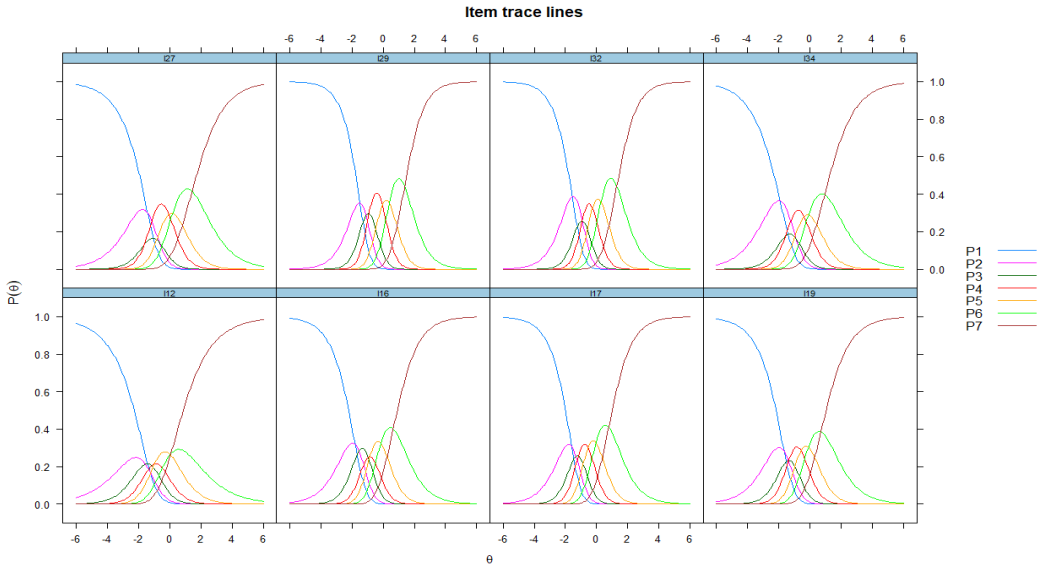

Figure5. Trace lines of Behavioral dimension items

According to the item trace lines in Figure 5, it is seen that the items in the Behavioral dimension, together with their options, work for different attitude levels and are distinctive. However, the answers were generally stacked above 7 degrees, not all 10 degrees worked. Item information functions are shown in Figure 6.

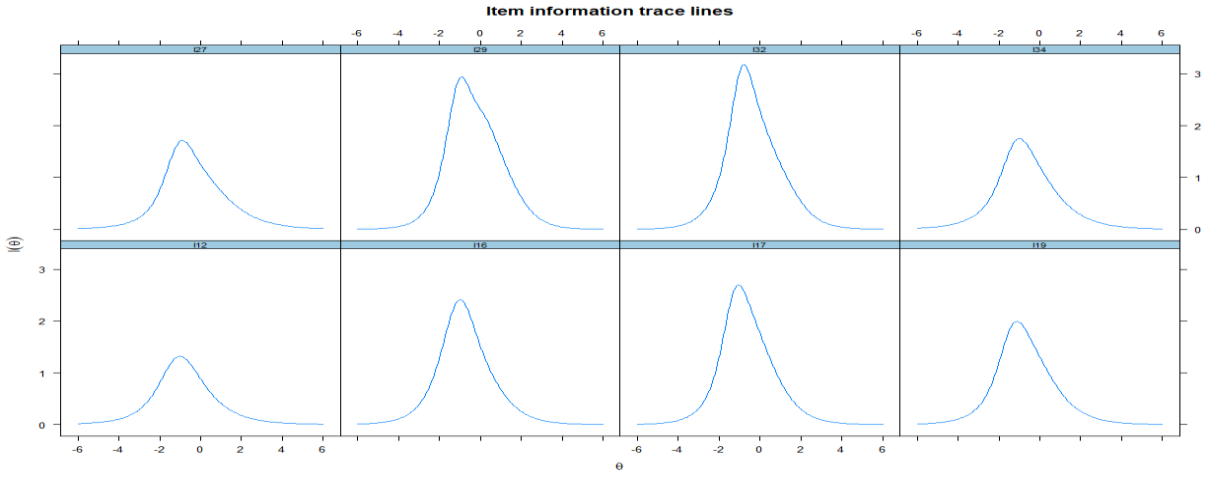

Figure6. Information trace lines of Behavioral dimension items

When the information trace lines of the Behavioral dimension items were examined, it was determined that the least informative items were I12, I19, I27, and I34. The test infographic of the ERTAS Behavioral dimension is shown in Figure 7.

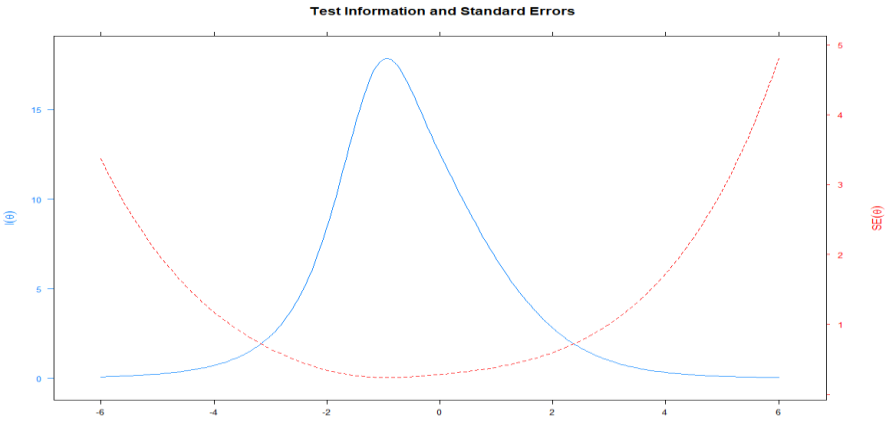

Figure7. The test infographic of the ERTAS Behavioral dimension

Figure 7 shows that the Behavioral dimension provides information about the behavior of teaching staff regarding content presentation in ERT applications. The level at which the dimension gives the best information is between -3 and 1. For individuals with attitudes in this range, the scale provides the best information. The marginal reliability coefficient of the ERTAS Behavioral dimension was calculated as 0.902. This value is slightly higher than the reliability value obtained by Cronbach Alpha.

According to the Q3 test, it was determined that no item impairs local independence among 7 items in the third dimension (F3: Cognitive). Item calibrations of the items in this dimension were determined with GPCM. According to GPCM, S_χ2, degrees of freedom, RMSEA and level of significance statistics of the items were determined. The results are shown in Table 9.

Table9. Item fit-indexes by IRT for the Cognitive dimension

Items	GPCM			
	S_χ^2	df	RMSEA	p
I1	57.690	70	0.000	0.853
I2	86.354	81	0.012	0.321
I6	96.744	69	0.029	0.055
I22	64.358	62	0.009	0.394
I30	86.533	93	0.000	0.669
I36	82.734	77	0.013	0.307
I44	96.628	90	0.012	0.297

According to item fit-indexes statistics, the RMSEA values of the items are less than 0.08. According to this result, it was decided that the scale structure reached with EFA provides model compatibility for the Cognitive dimension, according to GPCM. Standard errors were estimated with the "a" and "b" parameters of the items whose model fit was determined according to GPCM. The results are shown in Table 10.

Table10. Item parameters and standard error values according to GPCM for the Cognitive dimension

Items	a (SE)	b1 (SE)	b2 (SE)	b3 (SE)	b4 (SE)	b5 (SE)	b6 (SE)
I1	1.459(0.147)	-0.959(0.134)	-0.485(0.120)	-0.018(0.110)	-0.972(0.131)	1.469(0.173)	2.419(0.281)
I2	1.017(0.101)	-1.548(0.232)	-0.968(0.189)	-0.625(0.161)	0.368(0.148)	0.975(0.173)	2.032(0.255)
I6	1.471(0.101)	-1.503(0.117)	-0.161(0.114)	0.352(0.115)	1.325(0.159)	1.434(0.195)	2.541(0.307)
I22	1.902(0.201)	-1.419(0.131)	-0.572(0.101)	-0.121(0.095)	0.479(0.100)	1.032(0.122)	1.516(0.154)
I30	0.618(0.065)	-0.672(0.230)	0.311(0.246)	0.395(0.266)	1.207(0.316)	1.028(0.353)	3.148(0.552)
I36	1.219(0.123)	-1.122(0.160)	-0.467(0.144)	-0.035(0.142)	0.166(0.139)	1.196(0.162)	1.904(0.229)
I44	0.924(0.092)	-0.610(0.194)	-0.559(0.188)	-0.275(0.171)	1.090(0.202)	0.926(0.228)	1.541(0.267)
Iteration = 55,		Log-Lik. = -5225.369,		p<.05			

Estimates made according to GPCM (LogLikelihood, p<.05) prove the consistency of the scale items. Item trace lines are shown in Figure 8.

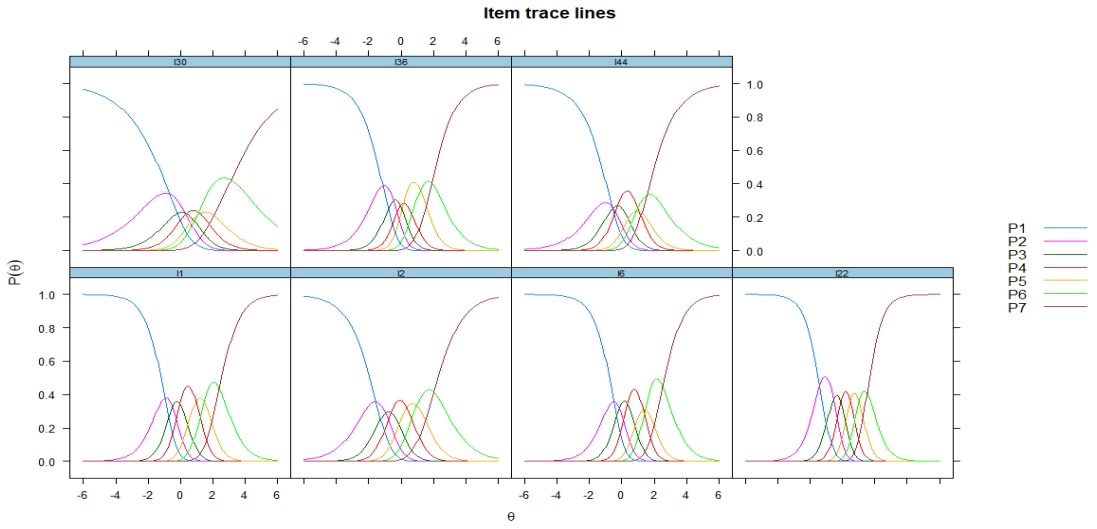

Figure 8. Trace lines of Cognitive dimension items

According to the item trace lines in Figure 8, it is seen that the items in the Cognitive dimension, together with their options, work for different attitude levels and are distinctive. However, the answers were generally stacked above 7 degrees, not all 10 degrees worked. Item information functions are shown in Figure 9.

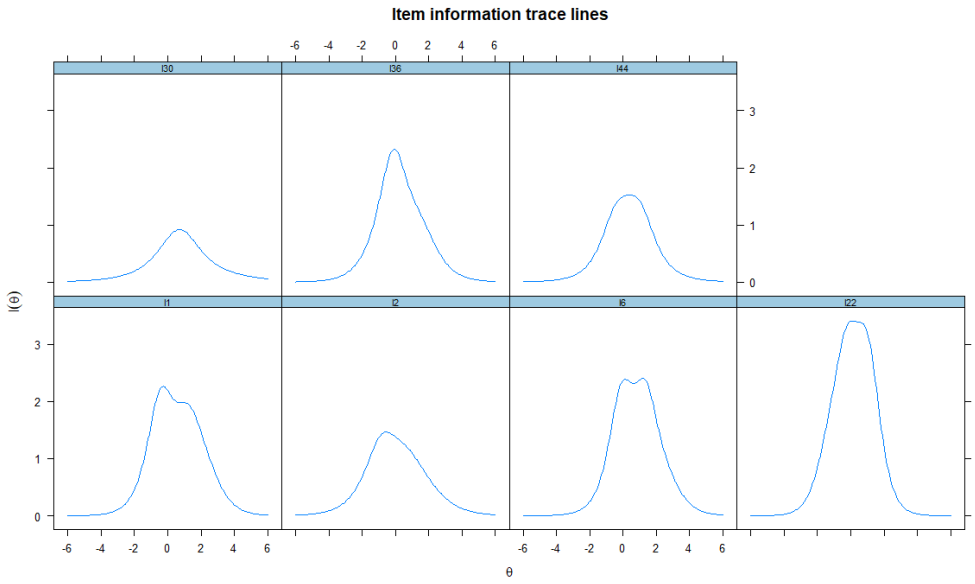

Figure 9. Information trace lines of Cognitive dimension items

When the information trace lines of the Cognitive dimension items were examined, it was determined that the least informative items were I2, I30, and I44. The information function of the cognitive dimension is shown in Figure 10.

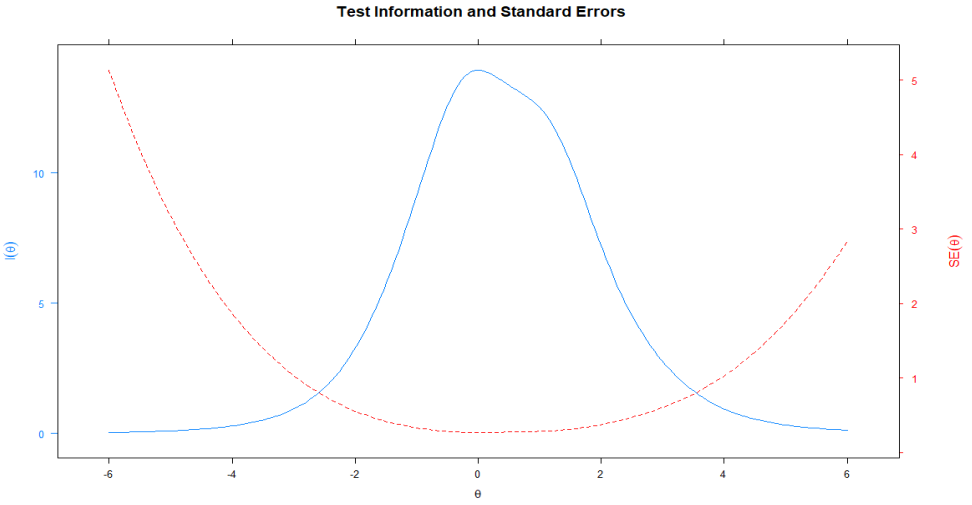

Figure10. The test infographic of the ERTAS Cognitive dimension

Figure 10 shows that the cognitive dimension provides information about interest, belief, thought and knowledge about ERT use. The level at which the dimension gives the best information is between -2 and 2. For individuals with attitudes in this range, the scale provides the best information. The marginal reliability coefficient of the cognitive

dimension was calculated as 0.908. This value is slightly higher than the reliability value obtained by Cronbach Alpha.

3.3. Evidence of measurement invariance for ERTAS

The measurement model in Figure 1 was tested separately for teaching staff those with seniority of fewer than 5 years, 6-10 years, 11-15 years, and 16 years and more. The three-dimension structure works within the framework of acceptable CFA fit indices according to the literature. The invariance of ERTAS was tested for teaching staff of different seniority. For this, configural, metric, scalar, and strict (strict) invariance were tested respectively. In the obtained results, fit indices and ΔCFI values were examined. The results are summarized in Table 11.

Table11. Measurement invariance data for seniority

Measurement invariance	RMSEA	CFI	TLI	ΔCFI
Configural	0.073	0.850	0.834	
Metric	0.074	0.847	0.838	0.003
Scalar	0.072	0.845	0.846	0.002
Strict	0.072	0.844	0.843	0.001

ERTAS operates in the same factor structure for different seniority levels. Findings for Metric, Scalar, and Strict invariance showed that the ΔCFI value was less than 0.01. Accordingly, the invariance of ERTAS has been proven in terms of factor structure and factor loads among teaching staff with seniority of fewer than 5 years, 6-10 years, 11-15 years, and 16 years or more.

The invariance of ERTAS by gender was tested. The results are summarized in Table 12.

Table12. Measurement invariance data for gender

Measurement invariance	RMSEA	CFI	TLI	ΔCFI
Configural	0.080	0.883	0.885	
Metric	0.079	0.884	0.885	0.001
Scalar	0.078	0.881	0.884	0.003
Strict	0.078	0.881	0.883	0.000

ERTAS operates in the same factor structure for male and female teaching staff. Findings for Metric, Scalar, and Strict invariance showed that the ΔCFI value was less than 0.01. Accordingly, there was no invariance between men and women in terms of ERTAS factor structure and loadings.

Measurement invariance was also tested for teaching staff in different science areas (health, education, science & mathematics, agriculture, forestry, and aquaculture science). However, variance-covariance matrices were not found to be positively defined, and results could not be obtained. In this case, it cannot be said that the ERTAS works in the same structure and invariably for teaching staff working in the different science areas.

3.4. Attitudes of teaching staff towards ERT

Descriptive statistics and attitude levels towards ERT were examined through the data file created by the answers of 477 teaching staff where CFA was conducted. The results are given in Table 13.

Table13. Attitudes of teaching staff towards ERT

Items	N	Mean (Std. Deviation)	Median (Min-Max)
Affective dimension			
With ERT, nothing can be taught to the student.	477	2,69(1,696)	2(1-7)
If I were authorized, I would abolish ERT.		2,95(1,890)	3(1-7)
Even when I hear ERT, I get depressed.		3,05(1,759)	3(1-7)
ERT is a disappointment for me.		3,25(1,865)	3(1-7)
I'm uncomfortable being forced to ERT.		3,70(1,944)	4(1-7)
University students cannot be trained with ERT.		4,08(1,981)	4(1-7)
If I had a choice, I would not want to use ERT.		4,26(2,029)	4(1-7)
Behavioral dimension			
ERT offers me several opportunities to teach.	477	4,48(1,660)	5(1-7)
Being able to add as much course content as I want to ERT motivates me.		4,58(1,705)	5(1-7)
It never deleted the content of records I created for ERT, motivates me to do the best.		4,58(1,704)	5(1-7)
I feel relieved that I will be able to use the content I prepared for ERT in the following years.		4,94(1,652)	5(1-7)
ERT facilitates the use of audio content.		5,01(1,648)	5(1-7)
To make my lessons with ERT accessible, comforting me about my responsibility to teach.		5,08(1,623)	5(1-7)
The flexibility of space provided by ERT relaxes me.		5,10(1,736)	5(1-7)
ERT facilitates the use of visual content.		5,14(1,623)	5(1-7)
Cognitive dimension			
I believe that ERT increases the academic success of my students.	477	2,91(1,583)	3(1-7)
With ERT, I can take into account the individual differences of my students regarding learning.		3,05(1,702)	3(1-7)
My students will gain more qualified information with ERT.		3,32(1,564)	3(1-7)
ERT fits well with the meaning of the concept of "university" and the training it offers.		3,53(1,797)	4(1-7)
I believe ERT is an effective way to train students.		3,68(1,751)	4(1-7)
ERT facilitates the acquisition of course outcomes.		3,74(1,697)	4(1-7)
ERT content (live lectures, videos, links…) is interesting for my students.		4,03(1,612)	4(1-7)
ERTAS Sub-dimensions		Mean (Std. Deviation)	Median (Min-Max)
Affective		23,99(10,407)	24(7-49)
Behavioral		38,93(10,251)	40(8-56)
Cognitive		24,25(9,314)	24(7-49)

When the items are examined, it is seen that the teaching staff scores the Behavioral dimension, which is one of the dimensions of ERTAS, with relatively high scores from the Affective and Cognitive dimensions. As a matter of fact, the teaching staff experienced that ERT relieved them of their teaching responsibility in line with the flexibility of the space provided by ERT, its easy accessibility, as well as the facilitation of the presentation of visual and auditory content. However, at this point, it is not possible to say that the teaching staff has entirely positive attitudes for the Behavioral sub-dimension of ERTAS. While a Likert response set between 1 and 10 was prepared for the answers to each item in ERTAS, the teaching staff scored all scale items between 1 and 7 degrees.

When the items with the lowest arithmetic mean are examined, it is observed that these items are generally included in the Affective and Cognitive dimensions. Considering that the Affective dimension items contain negativities, it is understood that the teaching staff has experienced that students can be taught something with ERT. They are not demoralized by ERT, and they do not think that ERT should be abolished. According to the teaching staff, ERT has no enhancing effect on students' academic achievement, but ERT can teach something. However, ERT is not practical for university teaching.

3.5. Attitude towards ERT by gender and seniority

The possible differentiation status of the total scores of the Affective, Behavioral and Cognitive dimensions of ERTAS for gender and seniority variables was analyzed by MANOVA. The results are given in Table 14.

Table14. Differences in ERTAS sub-dimensions according to gender and seniority

Effect		Value	F	Hypothesis df	Error df	p
Gender	Pillai's Trace	0,010	1,575	3	467	0,195
Seniority	Pillai's Trace	0,027	1,438	9	1407	0,166
Gender * Seniority	Pillai's Trace	0,027	1,441	9	1407	0,165

The main effects of MANOVA were gender ($F(3\text{-}467)=1.575$, $p>.05$), seniority ($F(9\text{-}1407)=1.438$, $p>.05$), and gender*seniority variables interaction ($F(9\text{-}1407)=1441$, $p>.05$) it was determined that there was no significant difference in the sub-dimensions of ERTAS.

4. Conclusion, discussion and recommendations

In this study, the classical test and IRT results of ERTAS, which was developed to measure the attitudes of teaching staff towards ERT, emerged out of necessity to continue educational activities during the COVID-19 Pandemic period, were examined. Findings show that the scale is validated with 22 items and three sub-dimensions called "Affective, Behavioral and Cognitive". The Cronbach's Alpha reliability values of the sub-dimensions of ERTAS are around 0.90 (Affective: 0.898; Behavioral: 0.891; Cognitive: 0.897), and 0.95 for the entire scale. This level of reliability is described as "high" (Field, 2002). Karasar (2012) states that the measurement tool's reliability coefficient approaching 1 is good and sufficient. According to the analyzes made in line with the classical test theory, the factor loading values of the items are between 0.760 and 0.512. The item-total correlations are between 0.766 and 0.533. These values are quite a high factor load and item-total correlation values. The variance explained by the three dimensions of ERTAS together is 55% (55,499). The $\chi 2$ (205) value obtained according to the CFA results shows that the three-dimension structure of the scale has an acceptable level of fit according to the $\chi 2/df$ (2.869), RMSEA (0.062) fit indices (Gokkus et al., 2016). The marginal reliability coefficients calculated in the context of IRT are around 0.90 for the subscales (Affective: 0.898; Behavioral: 0.902; Cognitive: 0.908). According to Nunnally and Bernstein (1994), sufficient reliability should be at least .70 and above. Thus, it was evaluated that the reliability values of ERTAS were high in the context of both theories.

The most informative items of the Affective dimension are: "ERT is a disappointment for me; If I were authorized, I would abolish ERT; With ERT, nothing can be taught to the student". The most informative items of the Behavior dimension are "ERT facilitates the use of visual content; ERT facilitates the use of audio content; ERT offers me several opportunities to teach; Being able to add as much course content as I want to ERT motivates me". For Cognitive dimension "My students will gain more qualified information with ERT; I believe that ERT increases the academic success of my students; ERT facilitates the acquisition of course outcomes; I believe ERT is an effective way to train students". Among the highly informative items of ERTAS, some statements measure the teaching staff's emotions about ERT, their behavior regarding the presentation of the teaching content, and their knowledge, beliefs, and thoughts about ERT.

The teaching staff participating in the research do not think that ERT increases student success and does not facilitate the acquisition of teaching gains. In ERT practices, they cannot take into account the individual differences of their students. Beyond that, they do not trust that something will be taught with ERT, and they do not find what is done with ERT effective. However, they are not so irritated with ERT that they become demoralized, nor do they consider abolishing ERT. As a matter of fact,

instructors are relatively satisfied with the spatial flexibility provided by ERT, the ability to use audio-visual resources in their classes easily, and the accessibility of their classes. At this point, Menchacaa and Bekeleb (2008) found that different visual and auditory content used in distance education positively affects students with varying learning styles.

Clark (2009) states that previous experiences in distance education, the media used for teaching, and the preferred teaching method affect the teaching staff's attitude. Kroenung and Eckhardt (2015) also report that the attitude-behavior relationship is mainly affected by "volunteering, the type of technology used, and compliance" in technology-based uses. For ERT, which has become compulsory at the higher education level in Turkey as of March 2020, different universities across Turkey have used online applications such as Adobe Connect, Google Meet, Google Hangout, Zoom, depending on the infrastructure they have (Telli-Yamamoto & Altun, 2020). In this context, the extent to which attitudes measured by ERTAS are affected by using different database systems should also be tested.

The sub-dimensions of ERTAS have measurement invariance according to the variables of gender, seniority, and gender seniority interaction. Measurement invariance was also tested for the participants' science area, but the measurement invariance of the sub-dimensions of ERTAS could not be proven. In this context, when it comes to using ERTAS for data to be collected from people working in different fields of science, it is recommended to check ERTAS's EFA, DFA, and measurement invariance tests.

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