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ORIGINAL RESEARCH

Distance Education Attitudes (DEAS) During Covid-19 Crisis: Factor Structure, Reliability and Construct Validity of the Brief DEA Scale in Greek-Speaking SEND Teachers

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Abstract
The aim of this study was to evaluate the psychometric properties (factor structure, reliability and construct validity) of the Brief Distance Education Attitudes (DEA) scale. Four hundred twenty-two SEND teachers filled out socio-demographic data forms and the DEAS. Factors were extracted by EFA (Principal Components Analysis) and confirmed by Analysis of Moment Structures. No floor-ceiling effects were observed. No significant differences of skewness and kurtosis were observed between the two Domains. All goodness of fit indices generated by CFA were found satisfactory ($TLI = 0.962 > 0.95$, $RMSEA = .035 < 0.08$, $CFI = 0.943 \geq 0.90$, $\chi^2(34) = 57.93$, $p = .000$ *and* $SRMR = 0.034 < 0.08$). Cronbach's alpha value formed at $\alpha = .764$. SEND teachers' attitudes towards Efficacy in Distance Education and Difficulties Related to Distance Education are considered as significant factors for the implementation of distance education during COVID-19 crisis. Consequently, universities, education technology corporations and policy makers should take consideration of these factors so as to train SEND teachers' and support emergency remote-teaching scenarios.

Keywords COVID-19 · Distance education attitudes scale · Reliability · Construct validity · Factor structure · SEND teachers · Pandemic

1 Introduction

In the last 50 years, a rapid growth in the provision of education at all levels has been observed worldwide. COVID-19 is the greatest challenge that educational systems have ever coped with (Daniel 2020). Many governments required from educational institutions to switch, almost overnight, to online teaching and distance education. Recent figures (UNESCO 2020b) suggest that country-wide school closings have been incited in more than 191 countries worldwide, as a result of the COVID-19 crisis. These decisions affected 91.3% of student population, enrolling almost 1.5 billion of students worldwide (Drane

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et al. 2020). As many countries have switched to online education, UNESCO (2020b) developed 10 key recommendations to ensure that learning remains undisturbed during the COVID-19 crisis. There is global evidence that some countries are commencing to implement a minimum number of these recommendations, during the period of mass educational closures, which include the investigation of the readiness of the school for closure, the intention that distance learning programs will achieve inclusivity, the prioritizing of solutions to deal with psychosocial challenges before teaching, providing support to special educational needs and disabilities (SEND) teachers and parents regarding the use of digital tools, blending appropriate approaches and limiting the quantity of applications and platforms used, developing distance learning rules and actively monitoring students' learning process and creating communities that enhance connection.

Currently, it is common to reproduce online the content of traditional classroom lessons. However, due to the restriction of face-to-face education, SEND teachers must try more to arrange innovative online courses, which will actively engage students, through interactive lessons, tests, presentations, and open discussions. The COVID-19 crisis had a severe impact on traditional educational progress and universities may profit from this unanticipated opportunity to discover deficiencies and accelerate the reform of online education through efficient management. This urgent situation is possible to promote international collaboration and sharing of experiences, knowledge and resources to develop a global online education network (Sun et al. 2020).

2 Distance Education

In the first decade of the twenty-first century, there was a significant shift of educational systems to online education (Saba 2011). Over the past 30 years, distance education is gaining and maintaining ground in the field of education. As a sort of formal learning, distance learning is a major aspect in various educational settings through the employment of various technological applications, that connect students with their instructors (Moore et al. 2011; Simonson et al. 2011). Computer technologies, nowadays, enables the implementation of meaningful learning processes at any distance, under the structure of the student–teacher system (Bachmaier 2011). The institutional espousal of e-learning is expressed by strategic commitment among institutional leaders (Allen and Seaman 2017).

Distance learning has many positive assets. Firstly, students are provided with the flexibility to learn at their own place (Thoms and Eryilmaz 2014). Morever, there is a variety of educational tasks, which enable learners to adapt their learning schedule according to their own learning style, without following a tactical structured schedule of learning. In this way, distance learning programs provide the flexibleness for students to decide on their course of learning. In this way, distance learning programs provide the flexibleness for students to decide on their course of learning and there is no time wasted, as students can participate in the learning process from their homes (Davis et al. 2019).Additionally, for those who want to improve their professional and academic qualifications without leaving their jobs, distance education is often beneficial, as distance learning can serve both learning and working (de Oliveira et al. 2018).

Distance education is one of the most significant educational methods of the last decade. It has been developed rapidly around the world and has eventually become a vital aspect of school education. Countries around the world are investigating how to effectively educate students using modern technologies, in order to have meaningful educational experiences

(Zhou et al. 2020). According to recent findings (Allen and Seaman 2016), during 2014, 5.8 million students were registered in distance education and one half of which were learning in a fully online environment.

Distance learning, as an already familiar basic method of open education systems and also the point of differentiation from traditional learning methods, was the sole educational solution during the emergent events that led to the closing of educational settings in Greece, which could provide education in different types of educational settings (Foti 2020).

3 Special Education in Greece

According to the European Agency for Development in Special Needs Education (2010), there are 29,954 school-aged pupils in Greece who have SEN. From these pupils, 7483 attend special schools, while 22,471 attend special classes in mainstream schools. The Greek educational system provides the chance for undergraduate and postgraduate studies for SEND teachers (Brown 2016).

In line with the European Agency for Development in Special Needs Education, the scholar population in 2012 was 1,131,901 in Greece, including 801,101 students in primary education and 330,800 students in secondary education. Additionally, 73.17% of the students with specific learning difficulties and disabilities were enrolled in mainstream schools and 21.83% were enrolled in special school units. The remaining 5% of pupils were educated in typical classrooms, where parallel instruction was offered (European Agency for Development in Special Needs Education 2012). Despite the legislative arrangements, many faculties do not seem to be equipped with specially qualified teaching staff, and that adds extra barriers in the provision of special education (Koutrouba et al. 2008). SEND teachers also have problems in their collaboration with the official institutions, as they believe that they do not receive the adequate support from them regarding their students with learning disabilities and that they do not always have the appropriate skills to teach these students (Kagkara 2020).

SEND teachers who employed in remote school settings and participated in distance professional development programs, improved their knowledge and increased their personal ability to apply evidence-based practices (Erickson et al. (2012). Consequently, professional training is significant for the improvement of their self-efficacy (Tzivinikou and Kagkara 2019). Special Education is a demanding field of training where teachers' strong beliefs of their teaching efficacy are of principal importance (Antoniou et al. 2017). Moreover, recent research findings (Antoniou et al. 2017; Billingsley and Cross 1992; Caprara et al. 2003; Durksen et al. 2017; Klassen and Chiu 2010; Koustelios and Tsigilis 2005; Perera et al. 2019; van Rooij et al. 2019) support that SEND teachers' perceptions about instructional strategies, classroom management and students' engagement in relation to their teaching self-efficacy show that SEND teachers can cope with educational difficulties in a meaningful way determined by their level of training and their experience in special education or inclusive classrooms.

Despite the importance of professional training for SEND teachers, difficulties sometimes arise in accessing training programs that may be related to time and geographical distances. Distance professional training can offer opportunities to overcome these difficulties (Elliott 2017). In a research that was conducted by Dunst and Raab (2010) it was found that distance training can be just as effective as traditional face-to-face training.

Geographical barriers cannot be considered as a limiting factor for distance professional training, as they rely mainly on the use of the Internet and new technologies and can be particularly useful for professional SEND teacher support in remote schools (Erickson et al. 2012). In a research that was conducted by Little and Housand (2011), positive results were found regarding teacher support with the use of distance professional training. As distance professional training can overcome geographic constraints and time-related constraints, the needs of most individuals can be met compared to traditional training (Adams xxxx).

In modern educational environments, success of distance learning depends, in a great level, on the perceptions of teachers. Many of them are doubting the effectiveness of distance education, using as argument restrictions regarding time factors and technical problems (Anderson and Dron 2011; Hung 2016). However, it is necessary to help teachers provide regular assessment of the online education quality (Meyer and Barefield 2010). Teachers' beliefs about the transition to distance learning will remain inadequate without satisfying these needs (Leontyeva 2018).

4 SEND Teacher's Attitudes and Quality of Distance Education Programs

SEND teachers' attitudes should be taken into consideration for the facilitation of technology integration (Galvis 2012), since, they can be considered as a starting point to overcome difficulties related to technology integration (Kim et al. 2013). Such difficulties seem to be statistically correlated with the frequency of using technology and the availability of technical assistance (Li and Ni 2010). Consequently, there is an immense need not only for the development of online learning environments, but also for the quality assurance of distance education programs.

Regarding post-secondary education, quality assurance is related to the development of reliable and valid measures. In literature (Catalano 2018), there are several measures that have been developed and validated using evidence-based practices for the evaluation of the quality of distance education programs. Distance education learning environments survey (DELES) is a measure which assesses psychosocial learning environment in distance higher education (Walker and Fraser 2005).

Another measure developed and validated by Bolliger and Wasilik (2009), to identify possible factors affecting the satisfaction of online faculty, and to create and validate an instrument which will be used to measure perceived faculty satisfaction within the context of the web learning environment. Moreover, during the first 2 months of the COVID-19 crisis in Greece, an attempt was made for the development of a scale including open and closed-ended questions in order to assess students' assumptions and emotions on the fast shift to online teaching, regarding 2 tutorial courses (Karalis and Raikou 2020). However, none of them, was developed to assess issues in distance education such as student engagement, faculty experiences and perceptions, student readiness to learn online, technology use and learning environment evaluation during turbulent times such as the COVID-19 crisis. Moreover, it is important that Efficacy in Distance Education (EDE) and Difficulties Related to Distance Education (DRDE) are considered as significant factors not only for the implementation of distance education during COVID-19, but also for the development of a measure assessing Distance Education Attitudes. As investors, education technology corporations and policymakers are trying to support this emergency

remote-teaching scenario, the appraisal of investments in academic technology seems to be of major importance (Hodges et al. 2020). Therefore, a further investigation in delivering online learning could be a necessary facet as it may affect the implementation and the increase of online education.

4.1 Hypotheses of the Study

The purpose of this study is to examine the factor structure of Distance Education Attitudes (DEAS) during the Covid-19 crisis, using EFA and CFA in a Greek-speaking sample of SEND teachers. Consequently, we formulated the following hypotheses:

1. Distance Education Attitudes (DEAS) during the Covid-19 crisis is described better with a two-factor model rather than a one-factor or a three-factor model;
2. The scale factors Efficacy of Distance Education (EDE) and Difficulties Related to Distance Education (DRDE) represent independent latent factors of Distance Education Attitudes (DEAS) during the Covid-19 crisis;
3. No measurement invariance is reported across SEND Teachers Holding Computer Certificate (Core);
4. CFA builds adequate evidence of construct validity of DEAS, and finally,
5. Cronbach's alpha coefficient (α) evaluation builds adequate evidence for internal consistency reliability.

5 Methods

5.1 Participants

The study sample consisted of a total of 422 SEND teachers who were enrolled in a distance education training program in the field of special education. Minimum sample size was estimated in the basis of the ratio 15:1 (participants per variable). Consequently, the sample size met the basic prerequisite of including at least 150 participants. Moreover, Kaiser–Meyer–Olkin measure of sampling adequacy and Bartlett's test of sphericity confirmed that the sample size is sufficient large for factor analysis (results from statistical analysis are presented in detail below).

5.2 Data Collection Tools

All participants assessed their attitudes towards distance education during the COVID-19 crisis, through the Brief DEAS, a self-reporting 10-items questionnaire. Furthermore, they were administered a socio/demographic data form.

5.3 DEA Scale

The Brief DEA scale consists of 10 items assessing two distinct domains of distance education attitudes. The first domain consists of six items related to the Efficacy of Distance Education (EDE), while the second domain consists of four items related to the Difficulties Related to Distance Education (DRDE). Each item apart from Item_4 and Item_5 can

be answered through a 4-Likert scale (1 = Strongly Disagree to 4 = Strongly Agree). For Item_4 and Item_5 scoring is reformed to scale (4 = Strongly Disagree to 1 = Strongly Agree). The average duration of time needed to complete the DEA scale is estimated at 9–12 min.

5.4 Socio-Demographic

Moreover, SEND teachers enabled us with a dataset of socio-demographic variables such as gender, age, educational level and computer certificate (Core or Advanced).

6 Procedure

6.1 Distribution Characteristics of the Greek DEAS and Reliability Analyses

Factor Analysis and Measurement Invariance approaches were employed for the analysis of the psychometric properties of the Brief DEA scale. Subject data were evaluated using IBM SPSS Statistics 25.0 software, SPSS Syntax and SPSS AMOS. The distribution characteristics were assessed through skewness and kurtosis and their cut-off values were formed at 1.0 and 2.0 respectively. The measurement capacity was evaluated through floor and ceiling effects and their cut-off values were formed at 15%. Moreover, we assessed the univariate normality of the scale items through the Kolmogorov–Smirnov, Shapiro–Wilk, Shapiro-Francia, and Anderson- Darling tests. Mardia's multivariate kurtosis test, Mardia's multivariate skewness test, Henze–Zirkler's consistent test, Doornik–Hansen omnibus test, E-statistic and Roston test were employed for the evaluation of multivariate normality. Reliability analysis of the scale included the internal consistency approach, which was assessed through Cronbach's alpha coefficient.

6.2 Validity Analyses

Construct Validity was assessed through Exploratory (EFA) and Confirmatory factor analysis (CFA). For Exploratory Factor Analysis we employed Principal Components Analysis method of extraction with Varimax Rotation. Kaiser–Meyer–Olkin measure of sampling adequacy value should be greater to 0.500 and Bartlett's test of sphericity should be significant. Analysis of Moment Structures (AMOS) was employed for the confirmatory factor analysis. Cut-off values for the statistical criteria for the goodness of fit of the proposed model were formed as described below for Confirmatory Fix Index (CFI) > 0.95, for Root Mean Square Error of Approximation (RMSEA) < 0.05, and for Standardized Root Mean Squared Residual (SRMR) < 0.08 and the Tucker-Lewis Index (TLI) > 0.9 and ChiSq/df < 2.0 (Hu and Bentler 1999; McDonald and Marsh 1990). Measurement invariance was evaluated across the SEND teachers who hold a Computer Certificate (Core) and those who did not. A comparison between the two groups of SEND teachers' measurements examined whether there was a difference between the two groups of participants. Measurement invariance (configural, weak, strong and strict full) was evaluated across the SEND teacher who hold a Computer Certificate (Core). In order to compare the nested models, we applied cutoff values for $\Delta CFI \leq 0.01$ and $\Delta RMSEA \leq 0.015$ (Wang and Wang 2012).

7 Results

7.1 Preliminary Analysis–Sample Characteristics Distribution

Characteristics of the sample (socio-demographic) of the *422* SEND teachers including data such as gender, age, educational level, computer certificate (Core or Advanced) are presented in Table 1. SEND teachers mean age was formed at 28.50 ± 11.78 years, while females comprised *89,8% (n = 379)* of the entire sample. As for their educational level, *75,6%* of the respondents were BA Graduates, *23,7%* MA Graduates and *0,7%* PhD Graduates. Two hundred seventy-one SEND teachers had a Core Computer Certificate, while one hundred thirty-five had an Advanced Computer Certificate. There was no statistically significant correlation ($p = 0.005$) of SEND teachers Distance Education Attitudes with their sociodemographic characteristics (gender, age, educational level, computer certificate core or advanced). The mean SEND teachers' DEAS questionnaire score was formed at 2.75 ± 0.674. The mean scores for the two discrete Domains were 2.90 ± 0.744 (EDE), 2.60 ± 0.604 (DRED), respectively (Table 2). No floor-ceiling effects were observed. The floor-ceiling effects in both domains of DEAS were below 15%. No significant differences of skewness and kurtosis were observed between the two Domains. Correlation analysis (2-tailed) of DEAS items showed statistically significant ($p < 0.01$) correlation among all items. Absolute values of Pearson correlation ranged from *0.242* to *0.695*, indicating that no outliers reported from statistical analysis (Table 3).

Table 1 Characteristics of the sample ($n = 422$)

Send teachers	Descriptive statistics ($n = 422$)	Distance education attitudes ($n = 422$)
	n(%)	Statistical Criterion
Gender		
Female	379 (89.8%)	U = 86.246.5, $p = 0.644 > 0.05$
Male	43 (10.2%)	
Age		
18–30	310 (73.5%)	Rho = 0.076, $p = 0.567 > 0.05$
31–45	93 (22%)	
46–65	19 (4.5%)	
Educational level		
PhD	3 (0.7%)	F(1.264) = 2.248, $p = 0.284 > 0.05$
Master	100 (23.7%)	
Bachelor—Degree	319 (75.6%)	
Computer certificate (Core):		
Yes	271 (64.2%)	U = 97,458.6, $p = 0.644 > 0.05$
No	151 (35.8%)	
Computer certificate (Advanced)		
Yes	135 (32%)	U = 87,453.4, $p = 0.644 > 0.05$
No	287 (68%)	

Table 2 Descriptive statistics and univariate normality for DEAS

	Descriptive Statistics				Tests of Normality			
	Mean	Std. Deviation	Skewness	Kurtosis	Kolmogorov–Smirnov	Shapiro–Wilk	Shapiro–Francia	Anderson–Darling
DEAS.1	3.09	.693	−.386	−.019	.277	.809	.809	74.94
DEAS.2	2.19	.798	.411	−.145	.292	.847	.847	63.82
DEAS.3	2.54	.750	.006	−.326	.250	.848	.848	75.73
DEAS.4	3.60	.490	−.418	−1.834	.394	.621	.621	64.45
DEAS.5	1.41	.493	.358	−1.881	.386	.625	.625	23.12
DEAS.6	2.91	.781	−.420	−.123	.283	.842	.842	63.45
DEAS.7	2.76	.721	−.179	−.172	.294	.834	.834	83.23
DEAS.8	3.23	.635	−.354	−.129	.303	.776	.776	71.83
DEAS.9	2.96	.788	−.364	−.353	.261	.845	.845	43.81
DEAS.10	3.15	.729	−.497	−.160	.251	.814	.814	42.67
Domain_1	2.90	.744	−.307	−.192	.375	.754	.754	44.92
Domain_2	2.60	.604	.365	−.997	.368	.826	.826	43.67
DEAS_Total	2.75	.674	.365	−.997				

Table 3 Correlation analysis of DEAS items

	DEAS.1	DEAS.2	DEAS.3	DEAS.4	DEAS.5	DEAS.6	DEAS.7	DEAS.8	DEAS.9	DEAS.10
DEAS.1	1									
DEAS.2	−.496**	1								
DEAS.3	.569**	−.490**	1							
DEAS.4	.363**	−.428**	.280**	1						
DEAS.5	−.296**	.323**	−.242**	−.391**	1					
DEAS.6	.340**	−.271**	.322**	.259**	−.254**	1				
DEAS.7	.573**	−.475**	.695**	.328**	−.303**	.415**	1			
DEAS.8	.387**	−.293**	.263**	.339**	−.302**	.232**	.310**	1		
DEAS.9	.538**	−.395**	.541**	.264**	−.285**	.353**	.584**	.371**	1	
DEAS.10	.574**	−.440**	.518**	.300**	−.317**	.294**	.565**	.355**	.640**	1

**Correlation is significant at the 0.01 level (2-tailed)

8 Factor Analysis

8.1 Data Screening

Data screening identified no univariate outliers. Exploratory Factor Analysis requires a minimum amount of $n=150$ data, estimating 15 questionnaires per questionnaire item. Consequently, our sample size, including $n=422$ questionnaires can be considered as satisfactory. Kaiser–Meyer–Olkin measure of sampling adequacy and Bartlett's test of sphericity showed that variables in subscales can share a common factor. More specifically, $KMO=0.900>0.500$ and Barlett's test of sphericity $\chi^2(45)=1682{,}192,\ p=0.000<0.005$ was significant.

8.2 Construct Validity of the DEAS

Results from Exploratory Factor Analysis suggested reasonable factorability, since, each of the 10 items of DEA scale was correlated with at least one other variable with at least 0.39 (Table 4). The initial eigenvalue of Factor_1 was formed at 4748, representing a combined contribution of 47.483% to the observed variance, whereas for Factor_2 the initial eigenvalue was formed at 1067 and the combined contribution to the observed variance at 10.675%. Consequently, it appears that the supported a 2-factor model, explained 58,158% of total variance (Table 5). Scree plot supports the 2-factor model (Fig. 1). As we can see in Rotated Component Matrix (Table 4), there are two distinct factors. Factor_1 is comprised of 6 items (DEAS.1, DEAS.3, DEAS.6, DEAS.7, DEAS.9 and DEAS.10). Factor_2 is comprised of 4 items (DEAS.2, DEAS.4, DEAS.5 and DEAS.8).

8.3 Correlations Between DEAS Items

The inter-correlations between DEAS factors suggested that the subscales of the DEAS represent inter-related but distinct sub-constructs of Distance Education Attitudes.

Table 4 Rotated component matrix (EFA factor loadings) and communalities for the DEAS

Measured variables ($N=422$)	Factor_1	Factor_2	Communalities
DEAS.3	,813		.430
DEAS.7	,798		.572
DEAS.9	,797		.673
DEAS.10	,744		.469
DEAS.1	,692		.567
DEAS.6	,391		.568
DEAS.4		−.800	.756
DEAS.5		−.792	.489
DEAS.2		−.562	.567
DEAS.8		.547	.589

Extraction method: Principal component analysis. Rotation method: Varimax with Kaiser normalization, Loadings < .30 were excluded

Table 5 Total variance explained of DEAS per component

Total variance explained									
Component	Initial eigenvalues			Extraction sums of squared loadings			Rotation Sums of squared loadings		
	Total	% of Variance	Cumulative %	Total	% of Variance	Cumulative %	Total	% of Variance	Cumulative %
1	4.748	47.483	47.483	4.748	47.483	47.483	3.444	34.444	34.444
2	1.067	10.675	58.158	1.067	10.675	58.158	2.371	23.714	58.158
3	.811	8.107	66.265						
4	.781	7.809	74.074						
5	.579	5.790	79.864						
6	.502	5.021	84.885						
7	.457	4.570	89.455						
8	.435	4.351	93.806						
9	.335	3.349	97.154						
10	.285	2.846	100.000						

Extraction Method: Principal component analysis

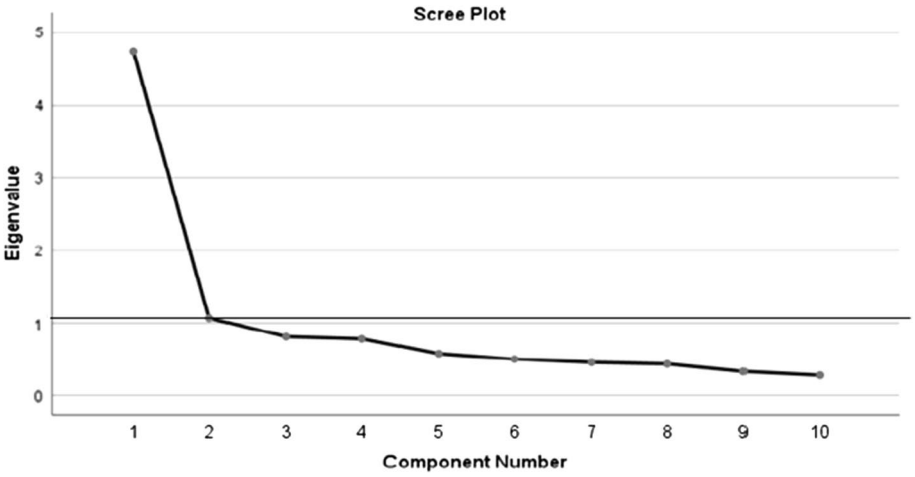

Fig. 1 Scree plot for EFA (*N* = *422*)

8.4 Univariate and Multivariate Normality

All available data (*n* = *422*) were examined for univariate and multivariate normality (no missing data existed in the sample). Statistical analysis indicated significant results for all tests and all variables (DEAS.1–DEAS.10), since percentage of cases that deviate from the normal curve (*p*-value) is less than 10%. Moreover, in univariate normality the statistical results from multivariate normality tests were also significant (p-value < 0.05) for the entire sample (*n* = *422*), i.e. *Mardia's skew* = *4.465,33; Mardia's kurtosis* = *47,76; Henze-Zirkler's* = *1,14; Doornik-Hansen* = *1,243.72; E-statistic* = *8,345; Royston test* = *2463,13*.

8.5 Confirmatory Factor Analysis–Goodness of Fit

Both one and two-factor model were evaluated for their goodness of fit. Fit indices for the models for the DEAS propose that the two-factor model has the best fit, providing the best representation of the structure of the DEAS. In Table 6, we can see the comparative fit indices for the two proposed models, such as $TLI = 0.962 > 0.95$, $RMSEA = 0.035 < 0.08$, $CFI = 0.943 \geq 0.90$, $\chi^2(34) = 57.93$, $p = 0.000$ and $SRMR = 0.034 < 0.08$, indicating that the

Table 6 Fit indices for the models for the DEAS specified in the CFA

Model	χ^2	*df*	*p.*	CFI	TLI	AIC_c	BIC	RMSEA	SRMR
One-factor	73.615	35	.000	.921	.923	1026.46	1373.57	.054	.023
Two-factor	57.93	34	.000	.943	.962	1048.76	1321.32	.035	.034

N = *422. CFI Comparative Fit Index; TLI Tucker-Lewis Index; AICc Corrected Akaike Information Criterion;*

BIC Bayesian Information Criterion; RMSEA root mean square error of approximation;

SRMR standardized root mean square residual

proposed two-factor solution. The summary of the proposed two-factor model fit is graphically represented with SPSS AMOS (Fig. 2).

8.6 Measurement Invariance

Results of statistical analysis showed an adequate fit for the SEND teachers holding a Computer Certificate–Core ($n=271$) and for those who did not ($n=151$). As we can see in Table 7, all nested invariance models indicate a good fit of the data. The model comparisons, including the weak to configural model comparison and the strong to weak model comparison, yielded ΔCFIs and ΔRMSEAs below the cutoffs of non-invariance. In the last model comparison (the strict to strong model comparison) as expected, invariance was not supported by ΔCFI cutoff (Table 7).

8.7 Internal Consistency

Reliability statistics analysis indicated a satisfactory level for Cronbach Alpha for the 10-item DEAS. More specifically, the internal consistency of the 422 SEND teachers' completed DEAS score was acceptable with a Cronbach's alpha value formed at $\alpha=0.764$ *(95% confidence interval: 0.74–0.78).* Moreover, coefficient alpha for all items ranged from *0.746* to *0.854* and average inter-item correlation ranged from *0.21* to *0.73.*

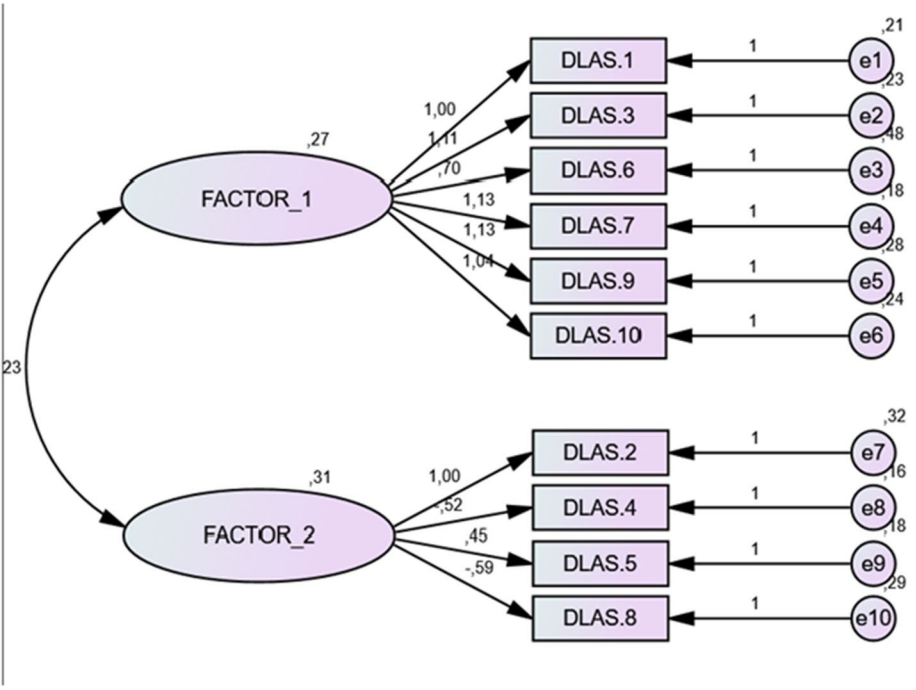

Fig. 2 Summary of the proposed 2-factor model fit

Table 7 Goodness-of-fit measures for testing measurement invariance across SEND Teachers Holding Computer Certificate (Core) for the 2-factor DEAS model

Models $N=422$	χ^2	*df*	χ^2/df	CFI	TLI	RMSEA	RMSEA lower CI	RMSEA Higher CI	SRMR
Model 1									
SEND Teachers Holding Computer Certificate (Core) ($N=271$)	67.93	38	3.468	0.942	0.924	0.021	0.011	0.031	0.01
Model 2									
SEND Teachers not Holding Computer Certificate (Core) ($N=151$)	64.74	38	3.669	0.936	0.943	0.039	0.019	0.059	0.03

Goodness-of-fit measures for the nested DEAS models

Models $N=422$	χ^2	*df*	CFI	RMSEA	Model comparison	ΔCFI	ΔRMSEA
(1) Configural invariance	68.14	68	0.912	0.016	–	–	–
(2) Weak factorial invariance	73.43	76	0.914	0.013	Model 2 vs 1	0.002	-0.003
(3) Strong factorial invariance	78.17	83	0.917	0.012	Model 3 vs 2	0.003	-0.001
(4) Strict factorial invariance	96.16	89	0.904	0.017	Model 4 vs 3	-0.012	0.005

9 Discussion

It is critical to mention that the present study managed to develop and evaluate the reliability and construct validity of a Distance Education Attitudes scale (DEAS) in Greek-speaking SEND teachers, during the Covid-19 crisis, providing a new scale that could be easily used in order to measure the effectiveness and the quality of various distance education programs. As the crisis of Covid-19 has led to the rapid development of distance educations programs, validated instruments such as DEA can be beneficial to develop distance education programs and monitor their progress. Effective programs are bases in the arrangement of innovative online courses aiming in active engagement of students through interactive lessons, quizzes, presentations, and open discussions (Sun et al. 2020). Crisis of COVID-19 has had a severe impact on traditional educational progress and universities may profit from this unanticipated opportunity to discover deficiencies and accelerate the reform of online education through efficient management. This urgent situation is possible to promote international collaboration and share experiences, knowledge and resources to develop a global online education network.

Distance Education Attitudes (DEAS) during the Covid-19 crisis is described better with a two-factor model rather than a one or three-factor model. The distinct factors of the proposed model describe domains related to the Efficacy of Distance Education (EDE) and the Difficulties Related to Distance Education (DRDE). Existing research findings support one-factor models, basically assessing instructor's experience, distance learning environment, or type of distance learning program (Muilenburg and Berge 2001). Consequently, it is important to mention the shift of interest to Distance Education Attitudes in terms of the Efficacy of Distance Education (EDE) and the Difficulties Related to Distance Education (DRDE).

The efficacy of distance education and difficulties of distance education are particularly important for the investigation and the development of quality distance education programs. It is crucial that the present study validated the brief DEA scale in Greek-speaking SEND teachers, as the attitudes of the teachers play an important role in the provision of distance education programs and should be taken in consideration for the improvement of distance education programs. Previous research suggest that teacher's attitudes should be taken in consideration for the facilitation of technology integration (Galvis 2012). In the study of Kim et al. (2013), it was found that teacher attitudes should be further studied since those attitudes can be a starting point to overcome the barriers to technology integration. Moreover, in the study of Li and Ni (2010), the data showed that there is a strong correlation between teachers' attitudes towards technology, their frequency of using technology, and technological supports from each school unit.

According to Hodges et al. (2020), despite the fact that distance learning can offer many opportunities for learners, evaluation and monitoring of these new learning environments should be carried out for many reasons: to identify their impact on students' learning experience, to give us the information of how and what the students are learning; to provide us with data on how online practices can be improved and, finally, to provide an evidence base that can be used by other countries regarding the future implementation of distance education. There is no doubt that this current context has as a result the reassessment of investments in educational technology, as investors, education technology companies, governments, officials, and policymakers are attempting to support this emergency remote-teaching situation. In compliance with our findings, a similar two factor scale was also described in the research of Artino and Mccoach (2008), as from the exploratory factor

analysis that was conducted, results also suggested two interpretable factor analysis. The resulting 11-item, two-factor scale appears to be psychometrically sound, with reasonable factor structure and good internal reliability.

No measurement invariance is reported across SEND Teachers Holding Computer Certificate (Core). Data screening identified no outliers. Results indicate a good fit of the data to the general trend of the data set collected with DEAS. Moreover, no ceiling or floor effects in addition to scores of skewness suggest the sensitivity of the scale.

10 Conclusions

The present study managed to develop and assess the reliability and construct validity of a Distance Education Attitudes scale (DEAS) in Greek-speaking SEND teachers during the Covid-19 crisis, providing a new scale that could be easily used in order to measure the effectiveness and the quality of various distance education programs. As the Covid-19 crisis has led to the rapid development of distance educations programs, validated instruments such as the DEA can be beneficial for the improvement of the management and the development of successful distance education programs. More research needs to be conducted regarding relevant scales that could measure the effectiveness and the quality of various distance education programs in Greek typical and special educational settings, especially now that distance education seems to play a major role in all educational levels.

11 Study Limitations

The essential limitation of the present investigation is related to the lack of earlier research findings on the specific topic. Therefore, there was a need to build up a completely new research typology. Notwithstanding any limitation, this study gave us a significant opportunity to identify existing gaps in the literature and to present the requirement for further improvement in this field.

Data Availability we declare that data will be available upon request.

Compliance with Ethical Standards

Conflict of interest Authors declare that they have no conflict of interes.

Ethical Considerations We complied with the principles of British Educational Research Association [BERA] (2018) Ethical Guidelines for Educational Research in implementing the study. The study was approved by the relevant Ethics Committee and consent forms were obtained from all SEND teachers that participated in the study.

Appendix: Distance Education Attitudes Scale (DEAS) During Covid-19 Crisis

This survey is designed to help us understand the nature of distance education attitudes during Covid-19 crisis. Please circle the number that best represents your opinion about each of the statements. Please attempt to answer all questions.

1	2	3	4			
Strongly disagree	Disagree	Agree	Strongly agree			
			SD	D	A	SA
1	My participation in distance education programs during COVID-19 crisis is satisfactory		1	2	3	4
2	I cope with difficulties in Distance education rather than traditional education		1	2	3	4
3	I consider Distance education equally effective to traditional education		1	2	3	4
4	I cope with difficulties in using the digital material		4	3	2	1
5	I cope with difficulties during the teleconference process		4	3	2	1
6	I am able to interact with the instructor during the teleconference		1	2	3	4
7	I consider that effective learning outcomes can be achieved equally to distance education and traditional education		1	2	3	4
8	I have the appropriate skills to participate in distance education		1	2	3	4
9	I have the same level of motivation to participate in distance education compared to traditional education		1	2	3	4
10	I want to participate in distance learning programs in the future		1	2	3	4

Scoring for *Items 4 and Items 5* are reformed.

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