DOI: 10.26387/bpa.2023.00004

Exploratory Structural Equation Modeling (ESEM): Methodological considerations and empirical results using the Orientation for Teaching Survey (OTS)

Palmira Faraci, Rossella Bottaro

Faculty of Human and Social Sciences - University of Enna "Kore", Italy

rossella.bottaro@unikorestudent.it; rossella.bottaro1@gmail.com

ABSTRACT. Il presente studio si è posto l'obiettivo di fornire un quadro di riflessione metodologica sull'utilizzo della tecnica Exploratory Structural Equation Modeling (ESEM), presentando un esempio applicativo per mezzo dell'Orientation for Teaching Survey (OTS). 338 insegnanti italiani hanno partecipato ad una survey online per la valutazione della motivazione all'insegnamento e del benessere psicologico. Modelli confermativi ed ESEM sono stati comparati secondo un approccio olistico, che ha mostrato il modello bifattoriale ESEM quale scelta appropriata (χ^2 = 178.02, *df* = 102, CFI = .94, TLI = .92, RMSEA = .05, SRMR = .03; ω = .88) per la versione breve dell'OTS. I risultati della network analysis hanno, altresì, messo in luce le differenze tra insegnanti precari e di ruolo. Gli ESEM sembrano offrire soluzioni analitiche promettenti per le misure multidimensionali complesse in generale e potrebbero fornire una prospettiva innovativa per la valutazione della motivazione all'insegnamento in particolare.

SUMMARY. Exploratory Structural Equation Modeling (ESEM) has emerged as an intriguing approach for investigating the dimensionality of psychometric tools. The present study aimed to reflect on the advantages and drawbacks of the ESEM technique using the Orientation for Teaching Survey (OTS) as an application example. 338 Italian teachers, mostly women (77.5%; M_{age} = 46.84, SD = 10.65) completed an online survey that evaluated the motivation for teaching and indicators of psychological well-being. Confirmatory and ESEM models were compared to test the OTS factor solution. A series of network analysis were performed to investigate the relationship between motivation for teaching and depression, anxiety, stress, optimism, intolerance of uncertainty, and self-esteem in the total sample as well as the precarious and in-role groups. Our study revealed the superiority of the bi-factor ESEM model for the OTS short version (χ^2 = 178.021, df = 102, CFI = .949, TLI = .923, RMSEA = .047, SRMR = .034; ω = .88). The motivation for teaching was affected by psychological well-being indicators, particularly in the precarious group. The current study supported the use of the ESEM technique, especially for a complex and culturally oriented tool, as a simultaneously theory-driven and data-driven approach. Furthermore, the network analysis showed preliminary findings helpful to overcome a knowledge gap in the motivation of Italian teachers. Cross-cultural studies that compare different school systems using ESEM might provide an innovative perspective on assessing motivation for teaching.

Keywords: *Exploratory Structural Equation Model, Motivation for teaching, Psychometrics*

INTRODUCTION

Various methods were traditionally used to investigate the factor structure of the psychometric instruments. The factor analysis was developed to represent psychological constructs through latent factors that serve as the rationale for human behaviors (Morin, Myers & Lee, 2020). In other words, the observed and measured variables co-occur to identify a latent factor. Exploratory factor analysis (EFA) and Confirmatory factor analysis (CFA) were the most commonly used multivariate factor analysis techniques in psychological research within the family of structural equation modeling techniques. However, despite their widespread adoption, both EFA and CFA have some limitations.

In recent years, Exploratory Structural Equation Modeling (ESEM) has emerged as a challenge for psychometric evaluations and in the context of broader psychometric modeling (Alamer, 2022; Asparouhov & Muthén, 2009; Marsh, Liem, Martin, Morin & Nagengast, 2011; Perry, Nicholls, Clough & Crust, 2015). Previous research (Marsh, Morin, Parker & Kaur, 2014) suggested that ESEM is primarily a confirmatory technique, but it can be used exploratorily through a target rotation and cross-loading between items un-forced to zero. The ESEM approach, in particular, combines the advantages of traditional techniques. With a data-driven perspective, the EFA suggests the lowest number of dimensions that can adequately explain the covariation observed among a set of observed variables (Brown, 2015). However, it can make interpreting the factors extracted through labels difficult at times. Furthermore, researchers are frequently required to make multiple decisions, which, if not guided by strong theoretical knowledge, can lead to poor results (Morin et al., 2020). Based on these considerations, the ESEM advantages reflect the ability to freely estimate previously unknown parameters (i.e., cross-loadings). Indeed, the cross-loadings are not constrained to zero, allowing us to estimate the association between each item and all possible factors. The CFA, on the other hand, suggests the best factor solution from a theory-driven standpoint. In a parsimonious model, each item is a priori assigned to a specific latent factor based on previous theories. However, it is frequently more simplistic and restrictive for most psychological constructs because it assumes that an item loads to a single pure factor (i.e., cross-loadings are constrained to be zero), which represents an operationalized simplification and artificially idealistic representation of a portion of human complexity (Mai, Zhang & Wen, 2018; Marsh et al., 2009). The ESEM approach, like the CFA, allows the researcher to test an a priori theory-driven hypothesis and compare the goodness-of-fit indices provided by various models. Instead, ESEM may provide a more accurate representation of complex psychological constructs: freely esteemed cross-loadings may compensate for wording effects and cross-cultural shades in the interpretation of previously ignored variance. As expected, when CFA and ESEM models were compared, the latter fit the data better than the former because the estimated factor correlation is less biased than in traditional CFA (Marsh et al., 2014). Indeed, the ESEM could solve common multicollinearity problems between latent factors by incorporating not previously estimated variability parts (i.e., cross-loadings) into the model and reducing the correlation between factors. Consequently, the relationships with other variables (e.g., convergent and discriminant validity) will also be more accurate. Moreover, the exploratory approach could be seen in parameter estimation (Boffo, Mannarini & Munari, 2012): using maximum likelihood (ML) estimation or estimation methods robust to non-normality and EFA familiar loading matrix rotation methods that allow the identification of latent factors. Regarding the choice of rotation, the geomin rotation is preferable with not very complex models; the target rotation is used in a confirmatory way, that is when we make assumptions a priori compared to cross-loadings; the orthogonal rotation is used when one general factor (G) and specific factors (S) should be estimated as totally independent as well as in bifactor-ESEM models (Asparouhov & Muthén, 2009; Morin, Arens & Marsh, 2016; Xiao, Liu & Hau, 2019). Despite the fact that ESEM is mostly used to investigate the factorial structure of psychometric tools, its advantages can also be seen as part of more complex Structural Equation Models (SEM). Indeed, the presence of ESEM parts in articulated SEM models may improve their fit indices. Again, inserting new portions of variance into the model will result in a more accurate representation of reality.

However, several weakness and areas of application that have yet to be fully implemented should be discussed: i) at this time, it is not possible to estimate the bootstrap confidence intervals required to estimate the indirect effects within the mediation reports; ii) ESEM are not appropriate for mixed or multilevel models because the second-order latent factor should be based on estimates of first-order latency

correlations; iii) it is not possible to estimate partial invariance between factors and ESEM placed within larger models may present convergence problems; iv) ESEM models may be over-fitted; this evidence requires constant attention also at item analysis levels. To address some of these limitations, two types of ESEM have been proposed: set-ESEM and ESEM-within-CFA (Marsh, Guo, Dicke, Parker & Craven, 2020). The set-ESEM allows for more complex parameter estimation in accordance with both data-driven and theory-driven set determination: the parameters are freely estimated into the set (i.e., specific part of the model) and constrained between sets (e.g., in a complex SEM model, the set could be represented by items of specific psychometric tools. In a confirmatory way, we could constrain the parameters into known relationships between variables and freely estimate the factor structures between the administered instruments). The ESEM-within-CFA model is not an alternative to the full-ESEM model (i.e., they show the same results as full-ESEM). Rather, they outline simpler computational aspects that effectively address ESEM's convergence problems as part of more complex SEM models. In conclusion, these two types can broaden the technique's applicability within more complex analysis frameworks.

Finally, several studies have shown the advantages of using ESEM for the study of the dimensionality of psychometric instruments (e.g., Marsh, Nagengast, Morin, Parada, Craven & Hamilton, 2011; Perera, 2015; Tóth-Király, Morin, Bőthe, Orosz & Rigó, 2018) also in the Italian context (Boffo et al., 2012). Our goal was to discuss a recent useful technique for the validation of psychometric tools and show an empirical application.

The Orientation for Teaching Survey: A culturally oriented psychometric tool

The organization of work in Italian public schools is a widespread issue. In 2022, there were 914.839 teachers working in schools, with 703.169 on permanent contracts and 211.670 (23.1%) on fixed-term contracts (Anief, 2022). These data are worrying because they favour precarious work. Recent findings (Marzano, De Angelis & Vegliante, 2015) highlighted the effects of precarious work on teaching motivation in a group of Italian workers. The condition of instability affected most aspects of life, such as limited future planning due to economic uncertainty, difficulty recognizing oneself within a defined professional role, and slow rejection of vocational ideals (e.g., desire to work with young people, desire to teach and transfer their discipline's content, desire to contribute to society's improvement). Furthermore, teachers with a permanent employment contract face challenges in the Italian school (Marzano et al., 2015): some people enter this field by chance or in search of economic stability; however, the general lack of resources (i.e., financial and materials), unsatisfactory social prestige for the role of teacher, disruptive student behavior, and salaries that are frequently considered too low may reduce their motivation to teach (Kelly & Northrop, 2015; You & Conley, 2015).

The Orientation for Teaching Survey (OTS) was a psychometric instrument developed in America by Ferrell and Daniel (1993) to evaluate motivation for teaching. It was a 58-item tool with a 5-points Likert scale ranging from 1 (strongly agree) to 5 (strongly disagree), based on eight themes from Lortie's (1975) and Joseph and Green's (1986) theories. However, after preliminary research, the authors concluded that the 6-factor solution fits the data better than the 8-factor solution (i.e., Job security, Worthwhile service to society, Interpersonal relationships, Intellectual stimulation, Material benefits, and Continuation of work in a familiar setting). Unfortunately, various cross-cultural validation studies for OTS (e.g., Anghel, 2013; Sinclair, Dowson & Mcinerney, 2006) revealed inconsistent factor solutions (for a summary, see Simić, Purić & Stančić, 2018). Indeed, various motivation theories have been developed that seem to fit better in different cultural contexts. Additionally, in the study of the factorial structure of the OTS, the most common theories on teaching motivation based on two (i.e., intrinsic and extrinsic motivation; Ryan & Deci, 2000) or three factors (i.e., intrinsic, extrinsic, and altruistic motivation; Morgan, Kilpatrick, Abbott, Dallat & McClune, 2001) produced significant results. Despite the fact that the original paper (Ferrell & Daniel, 1993) did not include information about reliability properties, the Australian version (Sinclair et al., 2006) revealed Cronbach's alpha ranged from .58 to .78 for subscales, and the Rumen (Anghel, 2013) and Serbian (Jovanović, Bogdanović & Simić, 2013) version revealed Cronbach's alpha of .86 to .94 for the total score, respectively. Finally, Sinclair et al. (2006) highlighted high factor loadings and relatively low cross-loadings at the item analysis level. In conclusion, the OTS has been a useful tool for the purpose of this work due to its cultural specificities and psychometric features.

The present study

The current study sought to consider the strengths and drawbacks of the ESEM technique for investigating the dimensionality of psychometric instruments. In particular, we investigated and compared various CFA, full ESEM, and bi-factor ESEM models based on previously suggested factor solutions (i.e., 6, 3, and 2-factor models, as well as a short version) and exploratory structures of OTS, a culturally oriented tool. Furthermore, a series of network analyses were carried out in order to fill a knowledge gap regarding the unexplored relationship between motivation for teaching and indicators of psychological well-being (i.e., intolerance of uncertainty, optimism, anxiety, depression, and stress) in Italy, and the network was compared between precarious and in-role groups to test the model's invariance.

METHOD

Participants and procedure

Participants were 338 Italian teachers who take part in an online survey in May 2022. They were mostly women (women: n = 262, 77.5%; men: n = 72, 21.3%) with four (1.2%) preferring not to specify their gender. Their mean age was 46.84 (SD = 10.65) and their mean seniority was 15.30 (SD = 11.53). At the time of administration, 229 (67.8%) participants had a permanent employment contract in school (generally referred to as 'in-role' in Italy) and 109 (32.2%) had a fixed-term contract (generally referred to as 'precarious' in Italy). Participants spent an average of 15 minutes responding to the survey via a Google form with a mandatory response format to avoid missing data. According to our eligibility criteria, Italians aged 18 and up who worked in Italian schools voluntarily participated in the research. Following an explanation of the study's objectives, all participants provided their informed consent.

The research project proposal was carried out in accordance with the Declaration of Helsinki, and it was approved by the internal review board for psychological research of the University of Enna "Kore". The measures were administered in accordance with the privacy guarantee regulations outlined in legislative decree no. 196/2003 and the GDPR (EU Regulation no. 2016/679).

Measures

Our online survey consisted of ad hoc items – which were created to detect the sample's sociodemographic characteristics – and self-report psychometric instruments to assess our selected variables. They will be presented below.

- *Motivation for teaching.* The English version of OTS was independently translated into Italian by two Italian native speakers. The two translations were then compared, and no significant differences were found. The first final version was back-translated into English by one bilingual speaker who was familiar with the psychological topic. After comparing the back-translation to the original version, a minor revision was required (see Appendix for items). In addition to the OTS, ad hoc items were developed to detect the sample's sociodemographic characteristics and other constructs were evaluated to assess relationships with motivation for teaching.
- *Self-esteem.* We administered the *Rosenberg Self-Esteem Scale* (*RSES*; Rosemberg, 1989) to evaluate self-esteem levels. It is a 10-items self-report scale (e.g., "I think I have a number of qualities", "I guess I don't have much to be proud") with a 4-points Likert scale ranging from 1 (strongly agree) to 4 (strongly disagree). We used the Italian version (Prezza, Trombaccia & Armento, 1997), which showed good internal consistency (Cronbach's α =.84). Cronbach's α for the present sample was .92.
- *Anxiety, depression, and stress.* We used the *Depression Anxiety Stress Scales – 21* (*DASS-21*; Lovibond & Lovibond, 1995) in its Italian version (Bottesi et al., 2015) to assess stress, anxiety, and depression in a unique psychometric instrument. It is a 21-items self-report scale (e.g., "I felt a lot of tension and I had difficulty recovering a state of calm", "I just couldn't feel any positive emotions", "I felt stressed out") using a 4-point Likert scale ranging from 0 (never happened to me) to 3 (it happened to me almost always) with good internal consistency and temporal stability both in the original version (Lovibond & Lovibond, 1995) (anxiety Cronbach's α = .74; depression Cronbach's α = .82; stress Cronbach's α = .85; total Cronbach's α = .90) and in the present sample (anxiety Cronbach's α = .86; depression Cronbach's α = .90; stress Cronbach's α =.89; total Cronbach's α = .95).
- *Intolerance of uncertainly.* The short version of the *Intolerance of Uncertainty Scale* was used (*IUS12*; Carleton, Norton & Asmundson, 2007). It is a 12-item scale with a

5-point Likert response format ranging from 1 (not at all characteristic of me) to 5 (entirely characteristic of me), with higher scores indicating higher levels of intolerance of uncertainty. In addition to a total score, two dimensions of uncertainty intolerance can be evaluated: perspective intolerance of uncertainty (e.g. "When things suddenly happen, I get very nervous"), and inhibitory uncertainty intolerance (e.g. "Feeling uncertain blocks me in making the most of things"). In the present study, we used the Italian version of IUS-12 (Bottesi et al., 2015) which demonstrated good psychometric properties. Cronbach's α for the present sample was .92.

– *Optimism*. The *Life Orientation Test-Revised* (*LOT-R*; Scheier, Carver & Bridges, 1994) in its Italian version (Giannini, Schuldberg, Di Fabio & Gargaro, 2008) was used to explore the teachers' optimism. The LOT-R is a 10-items scale. It employs a 5-point scale ranging from 0 (strongly disagree) to 4 (strongly agree) for 10 items (e.g., "I'm always optimistic about my future", "I hardly ever expect things to go right"). The total score ranges from 6 to 30, with higher scores indicating higher optimism levels. Cronbach's α values ranged from .74 to .78. Cronbach's α for the present sample was .70.

Data analysis

Following preliminary analysis to ensure that the data was normal, we ran and compared a series of CFA and ESEM models to the previously suggested factorial solutions for the OTS. The Maximum Likelihood Robust (MLR) estimation method was used because it did not assume the data's normality distribution. We reported the goodness-of-fit indices and measurement quality indicators and selected only the models that met the following cut-off criterion: Root Mean Square Error of Approximation (RMSEA) .06-.08 marginally acceptable and .01-.05 excellent, non-significant (p>.01), 90% confidence interval range should not include zero; Comparative Fit Index (CFI) .90-.95 marginally acceptable and .96-.99 excellent; Tucker-Lewis Index (TLI) .90-.95 marginally acceptable and .96-.99 excellent; Standardized Root Mean Residual (SRMR) .06-.08 marginally acceptable and .01-.05 excellent (Marsh, Hau & Wen, 2004; Marsh, Hau & Grayson, 2005). We used Mplus Version 7 (Muthén & Muthén, 2012) for the current analysis and supplemented the selected model's information with indices estimated by Dueber bifactor indices calculator (Dueber, 2017). Finally, we used the R-packages psychonetrics (Epskamp, 2020) and qgraph (Epskamp, Cramer, Waldorp, Schmittmann & Borsboom, 2012) to conduct a series of network analyses in RStudio v.2022.12.0+353 (RStudioTeam, 2020) to investigate the relationships between motivation for teaching and other related variables and compared the evidence between groups (i.e., in-role and precarious teachers). The psychometrics network model for Gaussian graphical models (GGMs) in particular creates an undirected network of partial correlations and it is useful for cross-sectional data (Epskamp, 2020).

RESULTS

Preliminary data processing

First, the minimum sample size required for ESEM estimation was a priori calculated (Cohen, 2013; Soper, 2022; Westland, 2010). We estimated it for a medium effect size (i.e., .3), a desired statistical power level of 80%, a confidence interval of 95%, and the most expensive model among those provided (i.e., 58 observed variables and 3 latent factors). The minimum sample size required to detect the effect was 119. As a result, our sample meets the requirements to a large extent.

Following data collection, the dataset was screened for potential issues. The multivariate normality of data was checked by the computation of Mahalanobis' distance, which revealed that the data were not distributed normally (i.e., Mardia's multivariate Kurtosis coefficient = 3799.94; df = 59~60, chi-square critical value = 99.608 when p<.001). Furthermore, no missing data were discovered as a result of our Google form's mandatory response format.

Comparison between CFA and ESEM models

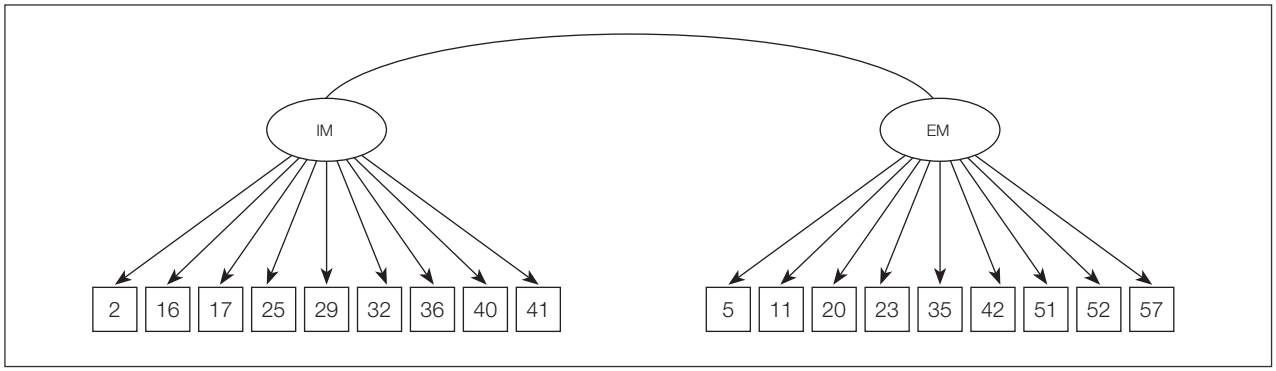
To identify the best fitting model, we performed a series of CFA, full ESEM, and bi-factor ESEM models based on both previously suggested and new models, according to the exploratory nature of the ESEM approach (i.e., 6, 3, 2, factors models and short version models; see Table 1 and Figure 1a, 1b, 1c). In line with previous suggestions (Morin et al., 2016),

Table 1 – Estimated models

Model	Type	χ^2	*p*	*df*	CFI	TLI	RMSEA [90% C.I.]	SRMR	AIC	BIC	aBIC	Meets criteria
6-factors												
Model 1	CFA	4937.419	.00	1580	.605	.587	.079 [.077-.082]	.109	54222.760	54945.316	54345.778	No
Model 2	ESEM	2647.520	.00	1320	.838	.797	.055 [.052-.058]	.041	51477.558	53187.414	51763.156	No
Model 3	ESEM bifactor	2608.684	.00	1268	.820	.765	.056 [.053-.059]	.037	51328.810	53236.689	51647.484	No
3-factors												
Model 4	CFA	4553.428	.00	1592	.652	.639	.074 [.072-.077]	.096	53814.769	54491.448	53929.977	No
Model 5	ESEM	3405.011	.00	1482	.741	.711	.062 [.060-.065]	.053	52031.810	53124.747	52214.364	No
Model 6	ESEM bifactor	3097.389	.00	1427	.775	.739	.059 [.056-.062]	.048	51781.682	53084.066	51999.220	No
2-factors												
Model 7	CFA	4640.517	.00	1594	.642	.629	.075 [.073-.078]		53897.857	54566.890	54011.764	No
Model 8	ESEM	3901.168	.00	1538	.711	.690	.068 [.065-.071]	.058	52295.206	53174.887	52442.140	No
Model 9	ESEM bifactor	3525.772	.00	1482	.750	.722	.064 [.062-.067]	.053	52031.810	53124.747	52214.364	No
Short version 2-factors												
Model 10	CFA	742.915	.00	134	.656	.607	.116 [.108-.124]	.113	17457.608	17667.876	17493.407	No
Model 11	ESEM	274.782	.00	118	.907	.880	.063 [.053-.073]	.042	16665.785	16936.164	16710.947	Yes
Model 12	ESEM bi-factor	178.021	.00	102	.949	.923	.047 [.036-.059]	.034	16613.545	16944.854	16668.884	Yes

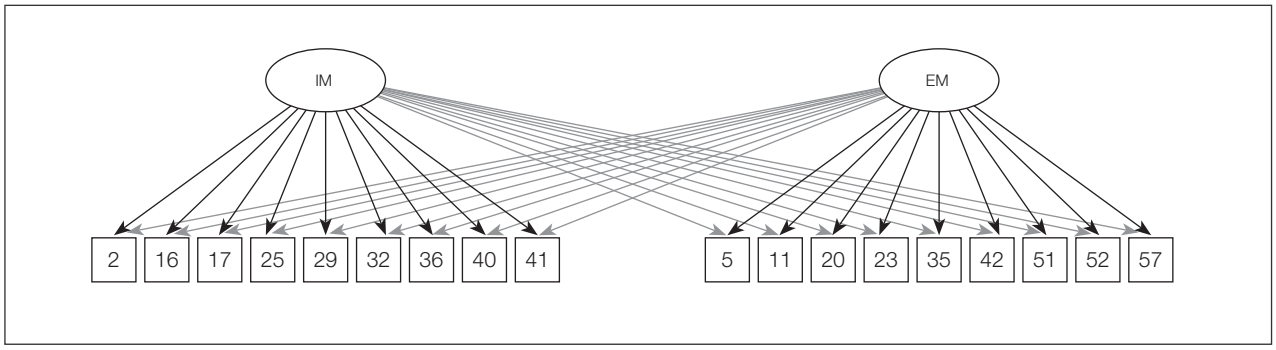
Legenda. CFI = Comparative Fit Index; TLI = Tucker-Lewis Index; RMSEA = Root Mean Square Error of Approximation; SRMR = Standardized Root Mean Square Residual; AIC = Akaike Information Criterion; BIC = Bayesian Information Criterion; aBIC = Akaike's Bayesian Information Criterion.

Figure 1a – CFA two factor model for OTS short version (Model 10)



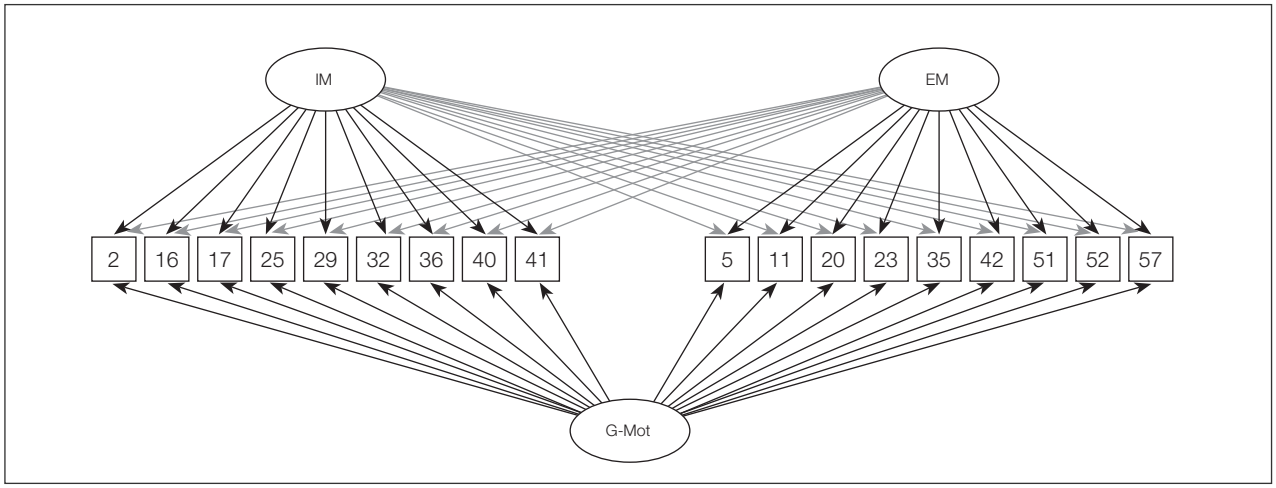
Legenda. IM = Implicit motivation for teaching; EM = Explicit motivation for teaching.

Figure 1b – Full-ESEM model for OTS short version (Model 11)



Legenda. IM = Implicit motivation for teaching; EM = Explicit motivation for teaching.

Figure 1c – ESEM Bi-factor model for OTS short version (Model 12)



Legenda. IM = Implicit motivation for teaching; EM = Explicit motivation for teaching; G-Mot = General factor-motivation for teaching.

Table 2 – Item level descriptive statistics, standardized loadings, reliability estimates and explained common variance of ESEM and ESEM Bi–factor model of OTS short version

Factors						Model 11 ESEM						Model 12 ESEM–bifactor								
	Item	Mean	*SD*	Skewness	Kurtosis	OTS–IM		OTS–EM				G–Mot		OTS–IM		OTS–EM				I–ECV
						λ	S.E.	λ	S.E.	δ	R^2	λ	S.E.	λ	S.E.	λ	S.E.	δ	R^2	
OTS–IM																				
	2	4.64	.65	−2.00	4.45	**.442**	.053	−.029	.054	.811	.189	**.168**	.051	**.407**	.066	−.004	.062	.806	.194	.146
	16	1.76	1.10	1.52	1.56	−.082	.057	**.646**	.041	.604	.396	**.549**	.063	**−.138**	.061	**.365**	.063	.547	.453	.664
	17	4.48	.82	−1.89	4.08	**.449**	.053	.017	.054	.794	.206	**.223**	.053	**.396**	.067	−.019	.064	.793	.207	.240
	25	2.68	1.34	.31	−.97	**.193**	.055	**.558**	.041	.595	.405	**.647**	.041	.030	.057	−.023	.067	.579	.421	.997
	29	4.14	1.12	−1.20	.68	**.779**	.036	−.062	.043	.420	.580	**.299**	.063	**.710**	.064	−.045	.057	.405	.595	.150
	32	3.62	1.39	−.59	−.90	**.584**	.046	.045	.049	.643	.357	**.302**	.058	**.535**	.068	.037	.076	.621	.379	.241
	36	2.86	1.27	.11	−.90	**.220**	.052	**.630**	.041	.482	.518	**.781**	.041	−.009	.070	**−.177**	.054	.359	.641	.951
	40	3.82	1.17	−.76	−.20	**.669**	.040	.018	.045	.546	.454	**.313**	.059	**.614**	.054	.025	.068	.524	.476	.206
	41	4.55	.73	−1.91	4.47	**.677**	.042	**−.093**	.046	.566	.434	**.249**	.065	**.581**	.059	**−.191**	.078	.564	.436	.142
OTS–EM																				
	5	2.38	1.19	.43	−.73	−.047	.048	**.647**	.041	.595	.405	**.612**	.044	**−.187**	.056	.042	.095	.589	.411	.911
	11	2.14	1.16	.76	−.24	.087	.047	**.623**	.041	.567	.433	**.628**	.053	−.030	.046	.142	.105	.584	.416	.949
	20	4.21	.94	−1.34	1.86	**.478**	.052	−.002	.060	.772	.228	**.241**	.067	**.390**	.070	−.153	.091	.766	.234	.249
	23	2.89	1.40	.18	−1.17	**.116**	.054	**.477**	.050	.730	.270	**.539**	.051	−.031	.061	−.072	.095	.703	.297	.979
	35	3.72	1.16	−.63	−.38	**.213**	.054	**.391**	.053	.758	.242	**.518**	.048	.052	.061	−.144	.099	.708	.292	.920
	42	2.92	1.49	.05	−1.34	**.326**	.053	**.310**	.055	.754	.255	**.472**	.052	.193	.057	−.093	.085	.731	.269	.829
	51	2.58	1.29	.33	−.93	**.162**	.049	**.554**	.045	.619	.381	**.606**	.048	.031	.046	.058	.108	.629	.371	.974
	52	2.01	1.23	1.15	.34	.001	.048	**.628**	.042	.605	.395	**.560**	.068	−.039	.046	**.456**	.097	.477	.523	.600
	57	1.59	.97	1.93	3.48	−.083	.049	**.628**	.043	.627	.373	**.521**	.073	−.114	.042	**.487**	.103	.478	.522	.520

	Omega	ECV	Omega	Omega_{hs}
G–Mot	—	.603	.880	—
OTS–IM	.753	.293	.880	.127
OTS–EM	.782	.104	.880	.003

Legenda. G–Mot = General factor–motivation for teaching; OTS–IM = Implicit motivation for teaching; OTS–EM = Explicit motivation for teaching; ECV = Explained Common Variance; I–ECV = Item–Explained Common Variance.

Bold items = significant target loadings (p<.05); underlined items indicate cross–loading items; S.E. = Standard Error; λ = standardized factor loadings; δ = item uniqueness.

we did not investigate hierarchical models because they simply involve replacing CFA factor correlations into a high-order factor, thus resulting in an empirically equivalent model in terms of degrees of freedom and fit indices. Furthermore, we did not consider any constraints because they were not supported by reference theory or previous validation studies.

Specifically, our findings showed that all CFA models failed to meet the criteria. Indeed, among the ESEM estimated models - with a target rotation - only the short versions (i.e., 2-factors and bi-factor with 2 first-order factors models) met the required criteria (Model 11: χ^2 = 274.782, *df* = 118, CFI = .907, TLI = .880, RMSEA = .063, SRMR = .042, AIC = 16665.785, BIC = 16936.164 and Model 12: χ^2 = 178.021, *df* = 102, CFI = .949, TLI = .923, RMSEA = .047, SRMR = .034, AIC = 16613.545, BIC = 16944.854, respectively). After model comparison, Model 12 (i.e., ESEM bi-factor model with two specific first-order factors) demonstrated the best data fitting (i.e., model with highest CFI, TLI, ΔRMSEA≤.015, ΔSRMR≤.015, and lowest χ^2, AIC, BIC, aBIC). Despite the Model 12 had a slightly high BIC than the Model 11, recent research (Cao & Liang, 2022) has revealed that this information criterion was biased in the ESEM technique, favouring the more parsimonious model, as well as in our results. According to previous research (Ryan & Deci, 2000), the general factor was labelled 'General motivation for teaching' and the two specific first-order factors were labelled 'Implicit and explicit motivation for teaching', respectively (see Figure 1c).

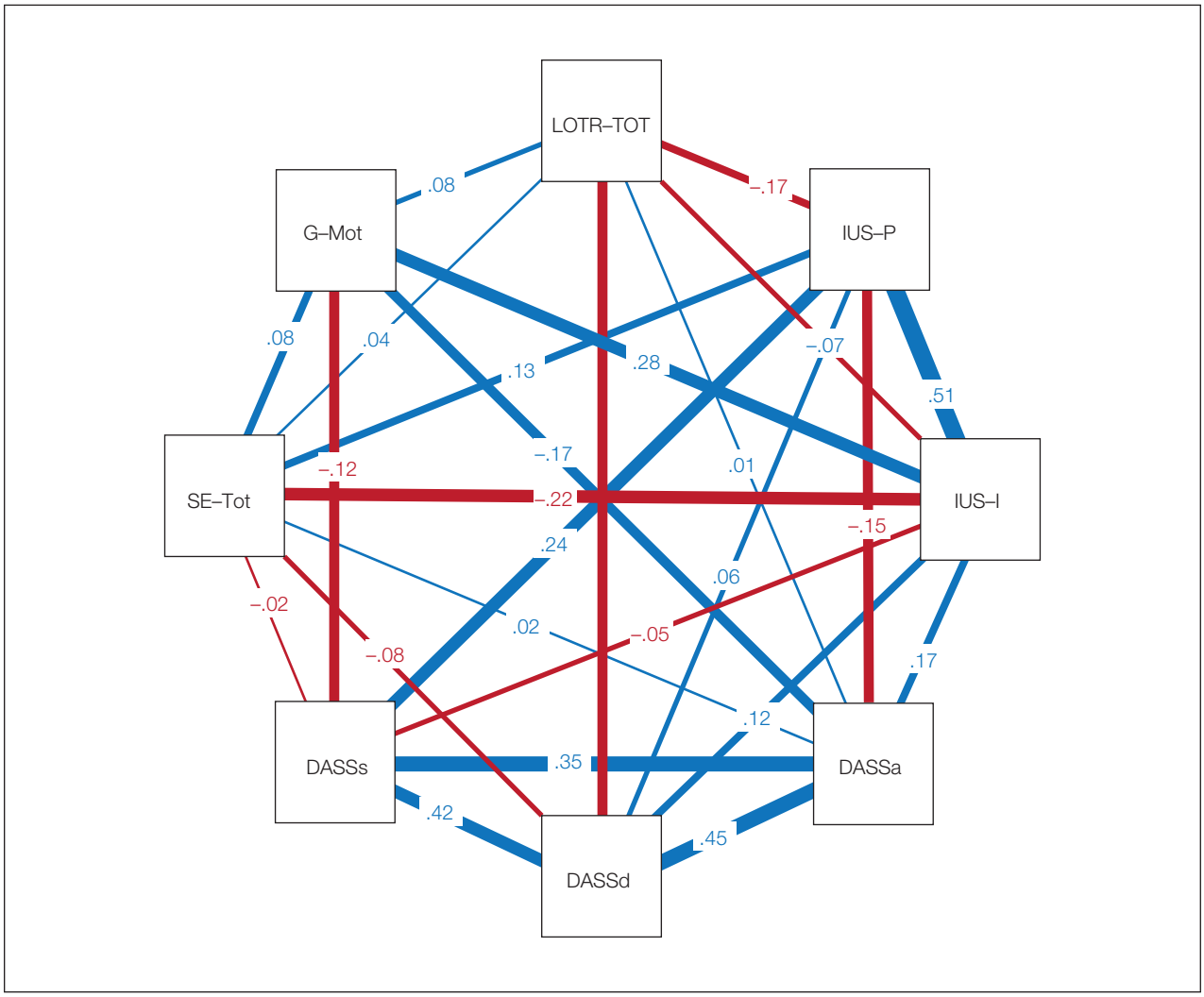
Beyond the fit indices, the comparison between Model 11 and 12 revealed that the latter had better defined factors (see Table 2). Notably, at the item level parameters, Model 11 displayed some issues in both the explicit and implicit dimensions: the items 16, 25, 36 did not exceeded the threshold (loadings λ>.30, *p*<.05) for the expected factor (i.e., implicit motivation), but did exceed it to the explicit motivation. Likewise, item 20 exceeded the threshold only for the unexpected factor (i.e., implicit motivation). Moreover, the items 20, 23, 35, 42, and 51 showed statistically significant loadings (*p*<.05) also for the implicit motivation. These findings suggested an unclear factor definition. On the other hand, the Model 12 generated a well-defined general factor with all items' *p*<.001 that explains most of the variance (loadings λ>.30, except for items 2, 17, 29, 41, and 20). The first-order specific factors were also well-defined for the same criteria, with the exception of items 16, 25, and 36, which refer to implicit motivation, and items 5, 11, 20, 23, 35, 42, and 51, which refer to explicit motivation. However, these results are consistent with the bi-factor model assumptions that the general factor explained the most part of the items' variance and the specific first-order factors - which showed the most minus cross-loadings - reflect the portion of the items' residual variance that the general factor does not explain (Morin et al., 2016). Additionally, although McDonalds's omega showed adequate reliability for Model 11 (Omega = .75 and .78, respectively), this value was increased in Model 12 (Omega = .88). Finally, as an additional support for the bifactorial structure, the proportion of common variance was mostly explained by General motivation for teaching (i.e., ECV for general factor = .603 and specific factors = .293, and .104, respectively). Indeed, the I-ECV (Stucky, Thissen & Edelen, 2013) - which refers to the proportion of common variance explained by the general factor at the item level (i.e., I-ECV>.80) - suggested that items 25, 36, 5, 11, 23, 35, 42, and 51 are essentially unidimensional. In summary, the Model 12 showed better psychometric properties than the Model 11 in terms of fit indices, item level parameters, and measurement quality criteria.

Network analysis for OTS

Based on the previous findings, we performed a series of network analyses for the OTS short version using the bi-factor ESEM solution. We investigated the relationship between teaching motivation and various indicators of psychological well-being (i.e., intolerance of uncertainty, optimism, anxiety, depression, stress, and self-esteem). On a graphical level, each variable is represented by a 'node', and the partial correlations are represented by 'edges' (Epskamp, 2020). First, using OTS's bi-factor structure, we investigated the relationship between general motivation for teaching and our indicators (*df* = 0, χ^2 = 0, *p* = 1, CFI = 1, RMSEA = 0; see Figure 2 and Table 3). The partial correlation matrix showed significant positive partial correlations between general motivation for teaching and inhibitory intolerance of uncertainty and anxiety (β = .028, *p*<.001; β = .17, *p*<.01, respectively) and significant negative correlations between general motivation for teaching and stress (β = −.012, *p*<.05), regardless of the presence of the other selected indicators in the network.

Secondly, we explored a network for in-depth knowledge that included first-order factors (i.e., extrinsic and intrinsic

Figure 2 – Network analysis between motivation for teaching and psychological well-being indicators



Legenda. Red lines: negative correlations; Blu lines: positive correlations; line thickness: association's intensity.
G-Mot = General factor-motivation for teaching; LOTR-tot = Revised Life Orientation Test; SE-tot = Rosenberg Self-esteem Scale; DASSs = Depression, Anxiety, and Stress Scale subscale Stress; DASSd = Depression, Anxiety, and Stress Scale subscale Depression; DASSa = Depression, Anxiety, and Stress Scale subscale Anxiety; IUS-I = Intolerance of Uncertainly Scale subscale Inhibitory; IUS-P = Intolerance of Uncertainly Scale subscale Perspective.

Table 3 – Partial correlation matrix for network analysis which include general motivation for teaching and psychological well–being indicators

Variable 1	Variable 2	β	Standard Error	*p*
IUS–P	LOTR–tot	–.17	.05	.002
IUS–I	LOTR–tot	–.07	.05	.20
DASSa	LOTR–tot	.01	.05	.80
DASSd	LOTR–tot	–.11	.05	.04
DASSs	LOTR–tot	–.00	.05	.96
SE–tot	LOTR–tot	.04	.05	.44
G–Mot	LOTR–tot	.075	.05	.17
IUS–I	IUS–P	.51	.04	.00
DASSa	IUS–P	–.15	.05	.00
DASSd	IUS–P	.06	.05	.25
DASSs	IUS–P	.24	.00	.25
SE–tot	IUS–P	.13	.05	.02
G–Mot	IUS–P	–.01	.05	.89
DASSa	IUS–I	.17	.05	.00
DASSd	IUS–I	.12	.05	.02
DASSs	IUS–I	–.05	.05	.33
SE–tot	IUS–I	–.22	.05	.00
G–Mot	IUS–I	.28	.05	.00
DASSd	DASSa	.45	.04	.00
DASSs	DASSa	.35	.05	.00
SE–tot	DASSa	.02	.05	.72
G–Mot	DASSa	.17	.05	.00
DASSs	DASSd	.42	.04	.00
SE–tot	DASSd	–.08	.05	.14
G–Mot	DASSd	–.01	.05	.89
SE–tot	DASSs	–.015	.05	.78
G–Mot	DASSs	–.12	.05	.03
G–Mot	SE–tot	.08	.05	.13

Legenda. G–Mot = General factor–motivation for teaching; LOTR–tot = Revised Life Orientation Test; SE–TOT = Rosenberg Self–esteem Scale; DASSs = Depression, Anxiety, and Stress Scale subscale Stress; DASSd = Depression, Anxiety, and Stress Scale subscale Depression; DASSa = Depression, Anxiety, and Stress Scale subscale Anxiety; IUS–I = Intolerance of Uncertainly Scale subscale Inhibitory; IUS–P = Intolerance of Uncertainly Scale subscale Perspective.

motivation for teaching) (df = 0, χ^2 = 0, p = 0, CFI = 1, RMSEA = 0; see Figure 3 and Table 4). The results revealed significant differences between the models. Specifically, the partial correlation matrix showed a significant positive association between i) extrinsic and intrinsic motivation (β = .028, p<.001), ii) anxiety, depression, and stress, and iii) inhibitory and perspective intolerance of uncertainty, which reflected the psychometric instruments' factor structure. Furthermore, focused on intrinsic motivation, the findings revealed positive partial correlations with self-esteem and anxiety (β = .015, p<.01; β = .014, p<.01, respectively), as well as negative partial correlation with stres (β = −.012, p<.05). On the other hand, focused on extrinsic motivation, we found a significant positive partial correlation with inhibitory intolerance of uncertainly (β = .018, p<.001).

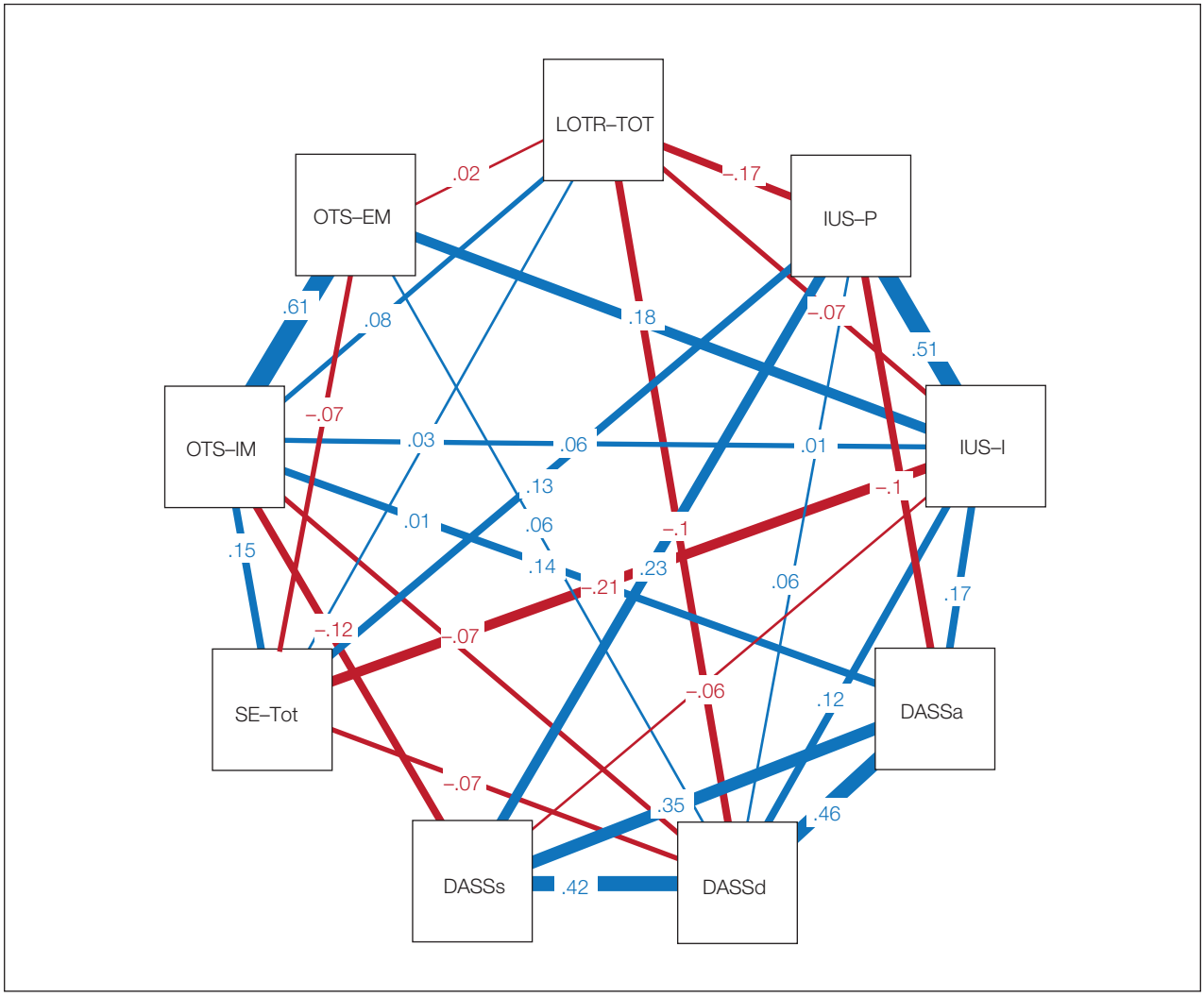
Finally, we tested the invariance between precarious and in-role groups using the general motivation for teaching in order to highlight the eventual differences. We compared two models: one model with free parameters (i.e., model-free) and the second model with parameters forced to be equal (i.e., model equal), using the 'compare' function of the psychometrics R-package, and found significant differences (model free: df = 0; RMSEA = not applicable; χ^2 = 0; model equal: df = 28; RMSEA = 0; χ^2 = −9.33). The findings revealed no significant differences in the direction of the associations between the two groups (see Figure 4 and 5; see Table 5). However, the most significant differences were found in the strength of these associations: high levels of motivation to teach in the precarious group are more positively associated with inhibitory intolerance of uncertainty (β = .37, p<.001), optimism (β = .026, p<.01) and negatively associated with stress (β = −.019, p<.05) compared to the in-role group (inhibitory intolerance of uncertainly: β = .24, p<.001; optimism: β = .01, p = .82; stress: β = −10, p = .13, respectively).

DISCUSSION

The present study aimed to reflect on the potential of the ESEM technique for the psychometric tools' factor structure. The OTS, a culturally oriented instrument, was studied as an application example. Indeed, the previous validation suggested various factor solutions that reflected cultural differences in various educational systems. First of all, the comparison between CFA, full-ESEM, and bi-factor ESEM models based on both previously suggested models and exploratory approach, according to the bivalent nature of the ESEM, highlighted the inadequacy of CFA models for the OTS in the Italian context. However, the ESEM models met the criteria for the short version in both full-ESEM (Model 11) and bi-factor ESEM (Model 12), with the latter performing better. This result may suggest that the ESEM technique explains the complexities of psychological construct better, especially when they are culturally determined. Indeed, cross-loadings un-forced to zero could introduce parts of unexplained variance into the model (Asparouhov & Muthén, 2009). This would allow us to estimate latent factors more adherent to reality and not pure. The Model 12 outperformed the Model 11 at various levels. In addition to improved fit indices, the factors are better defined at the item level. Although some factor loadings did not exceed the threshold criteria (λ>.30), these results could be considered acceptable due to their statistical significance. Furthermore, these results are consistent with the bi-factor model assumptions that the general factor explained the most part of items' variance (Morin et al., 2016). As an additional support, the bi-factor structure showed its potential: as suggested by omega - which showed higher values in Model 12 than in Model 11 - ECV, and I-ECV indices, the most common part of variance was explained by the general motivation for teaching. However, as a practical implication, maintaining a complex factorial structure rather than a one-dimensional structure reflects strong reference theories (Ryan & Deci, 2000) about motivation (i.e., intrinsic and extrinsic motivation) and allows for a more finely tuned assessment of motivation for teaching in a parsimonious short form.

Additionally, the network analysis also explored the relationship between motivation for teaching and psychological well-being indicators in the previously unexplored Italian context. Simultaneously, it may enable us to bridge the knowledge gap and suggest associations between variables. First, we explored the association between general motivation for teaching and the selected indicators. The results showed that high levels of general motivation for teaching are related to high levels of inhibitory intolerance of uncertainty and anxiety, as well as low levels of stress. Based on these findings and according with the traditional Yerkes-Dodson anxiety curve which considers anxiety also as a positive performance boost (Broadhurst, 1957), teachers who are highly motivated to teach may benefit from good levels of anxiety, which improves their performance

Figure 3 – Network analysis between extrinsic and intrinsic motivation and psychological well-being indicators



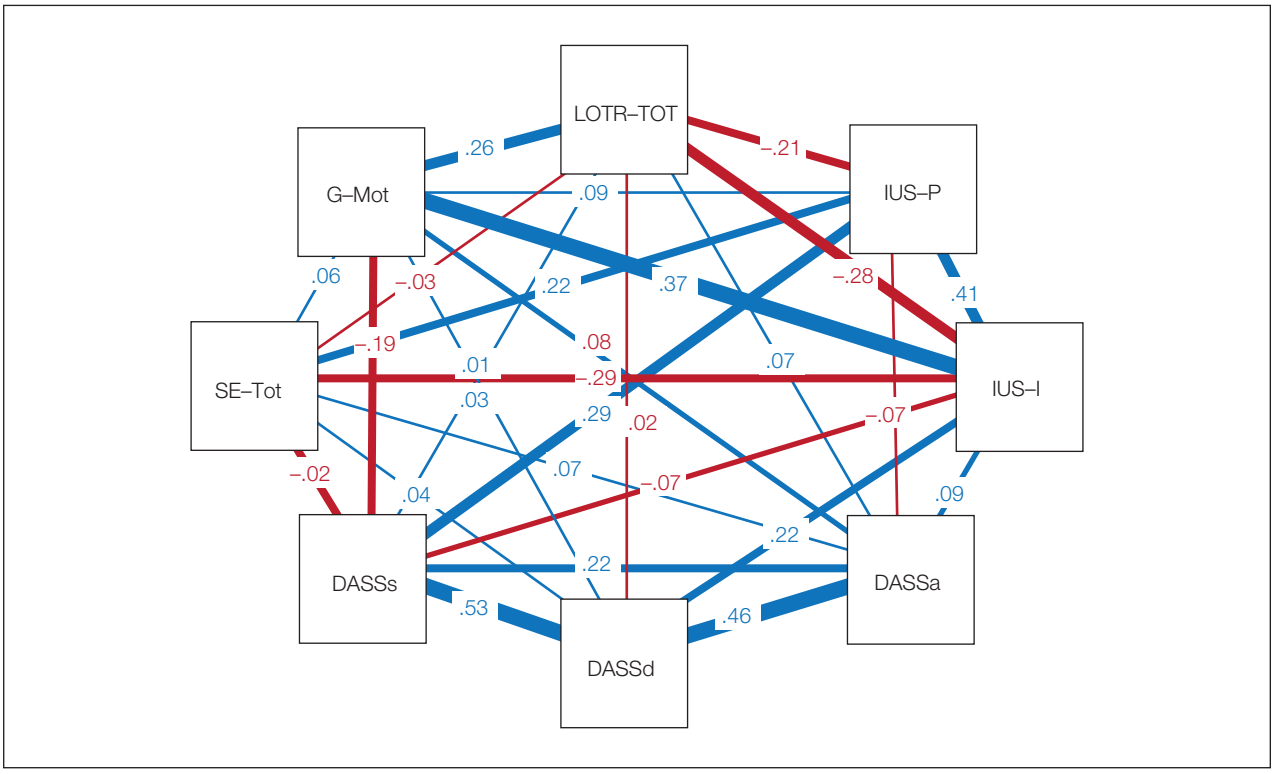
Legenda. Red lines: negative correlations; Blu lines: positive correlations; line thickness: association's intensity.
OTS-IM = Implicit motivation for teaching; OTS-EM = Explicit motivation for teaching; LOTR-tot = Revised Life Orientation Test; SE-tot = Rosenberg Self-esteem Scale; DASSs = Depression, Anxiety, and Stress Scale subscale Stress; DASSd = Depression, Anxiety, and Stress Scale subscale Depression; DASSa = Depression, Anxiety, and Stress Scale subscale Anxiety; IUS-I = Intolerance of Uncertainly Scale subscale Inhibitory; IUS-P = Intolerance of Uncertainly Scale subscale Perspective.

Table 4 – Partial correlation matrix for network analysis which include extrinsic and intrinsic motivation for teaching and psychological well–being indicators

Variable 1	Variable 2	β	Standard Error	*p*
IUS-P	LOTR-tot	−.17	.05	.002
IUS-I	LOTR-tot	−.07	.05	.22
DASSa	LOTR-tot	.01	.05	.87
DASSd	LOTR-tot	−.10	.05	.05
DASSs	LOTR-tot	.00	.05	.98
SE-tot	LOTR-tot	.035	.05	.53
OTS-IM	LOTR-tot	.08	.05	.12
OTS-EM	LOTR-tot	−.015	.05	.78
IUS-I	IUS-P	.51	.04	.00
DASSa	IUS-P	−.15	.05	.00
DASSd	IUS-P	.06	.05	.26
DASSs	IUS-P	.23	.05	.00
SE-tot	IUS-P	.13	.05	.02
OTS-IM	IUS-P	−.001	.05	.02
OTS-EM	IUS-P	−.00	.05	.99
DASSa	IUS-I	.17	.05	.00
DASSd	IUS-I	.12	.05	.03
DASSs	IUS-I	−.06	.05	.30
SE-tot	IUS-I	−.21	.05	.00
OTS-IM	IUS-I	.06	.05	.27
OTS-EM	IUS-I	.18	.05	.00
DASSd	DASSa	.46	.04	.00
DASSs	DASSa	.35	.05	.00
SE-tot	DASSa	.01	.05	.87
OTS-IM	DASSa	.14	.05	.01
OTS-EM	DASSa	.01	.05	.88
DASSs	DASSd	.42	.045	.00
SE-tot	DASSd	−.07	.05	.20
OTS-IM	DASSd	−.07	.05	.20
OTS-EM	DASSd	.06	.02	.27
SE-tot	DASSs	−.00	.05	.91
OTS-IM	DASSs	−.12	.05	.03
OTS-EM	DASSs	.01	.05	.91
OTS-IM	SE-tot	.15	.05	.01
OTS-EM	SE-tot	−.07	.05	.20
OTS-EM	SE-tot	.61	.03	.00

Legenda. OTS-IM = Implicit motivation for teaching; OTS-EM = Explicit motivation for teaching; LOTR-tot = Revised Life Orientation Test; SE-tot = Rosenberg Self-esteem Scale; DASSs = Depression, Anxiety, and Stress Scale subscale Stress; DASSd = Depression, Anxiety, and Stress Scale subscale Depression; DASSa = Depression, Anxiety, and Stress Scale subscale Anxiety; IUS-I = Intolerance of Uncertainly Scale subscale Inhibitory; IUS-P = Intolerance of Uncertainly Scale subscale Perspective.

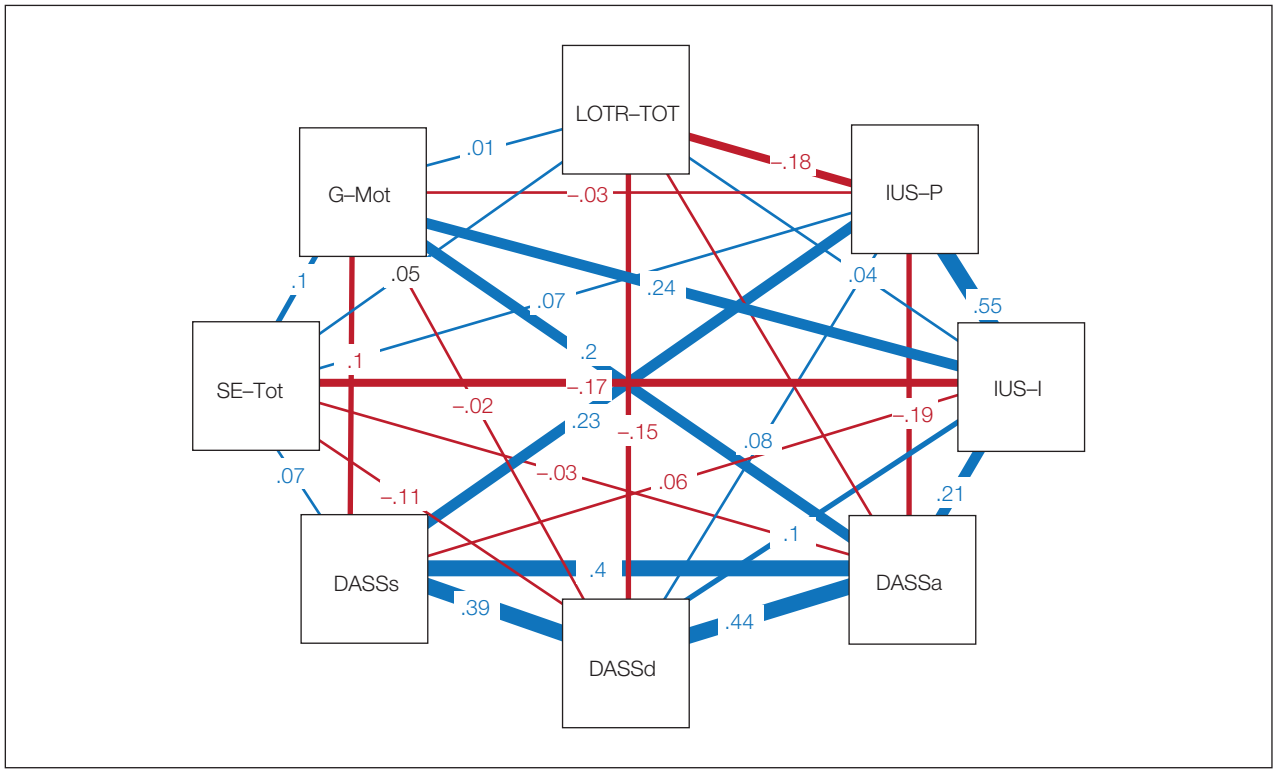
Figure 4 – Network analysis between motivation for teaching and psychological well-being indicators in precarious teachers group



Legenda. Red lines: negative correlations; Blu lines: positive correlations; line thickness: association's intensity.
G-Mot = General factor–motivation for teaching; LOTR-tot = Revised Life Orientation Test; SE-tot = Rosenberg Self-esteem Scale; DASSs = Depression, Anxiety, and Stress Scale subscale Stress; DASSd = Depression, Anxiety, and Stress Scale subscale Depression; DASSa = Depression, Anxiety, and Stress Scale subscale Anxiety; IUS-I = Intolerance of Uncertainly Scale subscale Inhibitory; IUS-P = Intolerance of Uncertainly Scale subscale Perspective.

and allows them to try a push to action. Working in a stressful environment, such as that found in some Italian schools (e.g., bad relationships with colleagues, old school structures, low pay), on the other hand, may have an impact on their motivation (Marzano et al., 2015). As a practical implication, it is crucial to pay close attention to the whole working environment and invest considerable resources in the teacher's well-being to promote quality education. Secondly, we estimated a network that includes the first-order factors (i.e., implicit and explicit motivation). High levels of intrinsic motivation are linked to high levels of self-esteem and anxiety and low levels of stress. As one possible interpretation, believing in oneself boosts self-confidence in one's abilities and good anxiety levels, allowing one to be more productive. On the other hand, high levels of extrinsic motivation are associated with high levels of inhibitory intolerance of uncertainty. As a viable explanation, being in a state of paralyzing uncertainty about the future can push one to pursue a teaching career for the financial stability and work-life balance that this work provides. Finally, we examined the network's invariance in the precarious and in-role groups. The results showed that there are no substantial

Figure 5 – Network analysis between motivation for teaching and psychological well-being indicators in in-role teachers group



Legenda. Red lines: negative correlations; Blu lines: positive correlations; line thickness: association's intensity.
G-Mot = General factor motivation for teaching; LOTR-tot = Revised Life Orientation Test; SE-tot = Rosenberg Self-esteem Scale; DASSs = Depression, Anxiety, and Stress Scale subscale Stress; DASSd = Depression, Anxiety, and Stress Scale subscale Depression; DASSa = Depression, Anxiety, and Stress Scale subscale Anxiety; IUS-I = Intolerance of Uncertainly Scale subscale Inhibitory; IUS-P = Intolerance of Uncertainly Scale subscale Perspective.

changes in the direction of association between variables between the two groups. Previous research (Marzano et al., 2015) discovered significant differences in the intensity of these associations: when compared to in-role teachers, high levels of motivation to teach in the precarious group are more associated with inhibitory and prospective intolerance of uncertainty and optimism (positive associations) and stress (negative association). Based on these findings, the motivation for teaching precarious teachers may be more oriented by uncertainty about the future and the search for stable employment than it is for in-role teachers who do not experience these dynamics. Also, optimism and stress were essential for the precarious: as a plausible explanation, spending every year in various schools, having to reinvent and re-environment their job in different situations, and frequently changing pupils and colleagues (situations not experienced by in-role teachers) were all very stressful experiences. The optimism for a better future remains the spring that allows precarious teachers to continue to work with motivation.

Table 5 – Partial correlation matrix for network analysis which general motivation for teaching and psychological well–being indicators between precarious and in rule groups

		Model Free						Model Equal					
		Precarious			In Rule			Precarious			In Rule		
Variable 1	Variable 2	β	Standard Error	*p*	β	Standard Error	p	β	Standard Error	*p*	β	Standard Error	*p*
IUS–P	LOTR–tot	–.21	.09	.02	–.18	.06	.01	–.48	<.0001	<.0001	–.48	<.0001	<.0001
IUS–I	LOTR–tot	–.28	.09	.00	.04	.07	.55	–.37	<.0001	<.0001	–.37	<.0001	<.0001
DASSa	LOTR–tot	.06	.10	.49	–.03	.07	.69	–.43	<.0001	<.0001	–.43	<.0001	<.0001
DASSd	LOTR–tot	–.02	.10	.84	–.15	.06	.02	–.58	<.0001	<.0001	–.58	<.0001	<.0001
DASSs	LOTR–tot	.01	.10	.90	.00	.07	.98	–.53	<.0001	<.0001	–.53	<.0001	<.0001
SE–tot	LOTR–tot	–.03	.10	.73	.05	.07	.47	.17	<.0001	<.0001	.17	<.0001	<.0001
G–Mot	LOTR–tot	.26	.09	.73	.01	.07	.82	–.09	<.0001	<.0001	–.09	<.0001	<.0001
IUS–I	IUS–P	.41	.08	.00	.55	.05	.00	1	<.0001	<.0001	1	<.0001	<.0001
DASSa	IUS–P	–.07	.10	.48	–.19	.06	.00	1	<.0001	<.0001	1	<.0001	<.0001
DASSd	IUS–P	–.01	.10	.89	.08	.07	.23	1	<.0001	<.0001	1	<.0001	<.0001
DASSs	IUS–P	.29	.09	.00	.23	.06	.00	1	<.0001	<.0001	1	<.0001	<.0001
SE–tot	IUS–P	.22	.09	.02	.07	.07	.30	–.27	<.0001	<.0001	–.27	<.0001	<.0001
G–Mot	IUS–P	.09	.09	.35	–.02	.07	.71	.60	<.0001	<.0001	.60	<.0001	<.0001
DASSa	IUS–I	.09	.09	.32	.21	.06	.00	1	<.0001	<.0001	1	<.0001	<.0001
DASSd	IUS–I	.22	.09	.02	.01	.07	.13	1	<.0001	<.0001	1	<.0001	<.0001
DASSs	IUS–I	–.07	.10	.44	–.06	.07	.37	1	<.0001	<.0001	1	<.0001	<.0001
SE–tot	IUS–I	–.29	.09	.00	–.17	.06	.00	–.48	<.0001	<.0001	–.48	<.0001	<.0001
G–Mot	IUS–I	.37	.08	.00	.24	.06	.00	.82	<.0001	<.0001	.82	<.0001	<.0001
DASSd	DASSa	.46	.07	.00	.44	.05	.00	1	<.0001	<.0001	1	<.0001	<.0001
DASSs	DASSa	.22	.09	.01	.40	.06	.00	1	<.0001	<.0001	1	<.0001	<.0001
SE–tot	DASSa	.07	.09	.46	–.03	.07	.63	–.52	<.0001	<.0001	–.52	<.0001	<.0001
G–Mot	DASSa	.08	.10	.39	.20	.06	.63	.88	<.0001	<.0001	.88	<.0001	<.0001
DASSs	DASSd	.53	.07	.00	.39	.06	.00	1	<.0001	<.0001	1	<.0001	<.0001
SE–tot	DASSd	.04	.10	.65	–.11	.07	.09	–.66	<.0001	<.0001	–.66	<.0001	<.0001
G–Mot	DASSd	.03	.10	.76	–.02	.07	.71	.79	<.0001	<.0001	.79	<.0001	<.0001
SE–tot	DASSs	–.20	.09	.03	.07	.07	.31	–.58	<.0001	<.0001	–.58	<.0001	<.0001
G–Mot	DASSs	–.19	.10	.04	–.10	.07	.13	.57	<.0001	<.0001	.57	<.0001	<.0001
G–Mot	SE–tot	.06	.10	.56	.10	.07	.12	–.11	<.0001	<.0001	–.11	<.0001	<.0001

Legenda. G–Mot = General factor–motivation for teaching; LOTR–tot = Revised Life Orientation Test; SE–TOT = Rosenberg Self–esteem Scale; DASSs = Depression, Anxiety, and Stress Scale subscale Stress; DASSd = Depression, Anxiety, and Stress Scale subscale Depression; DASSa = Depression, Anxiety, and Stress Scale subscale Anxiety; IUS–I = Intolerance of Uncertainly Scale subscale Inhibitory; IUS–P = Intolerance of Uncertainly Scale subscale Perspective.

Limitations and implications for further research

The results of the present study should be interpreted in light of some limitations. First, a convenient online sample and cross-sectional design were used. Further research in an Italian-speaking sample will be required to improve the generalizability of the findings. Secondly, we were unable to test the OTS's validity because there were no previous studies relevant to the Italian context that could be used to formulate hypotheses. Based on these considerations, the present paper provides preliminary exploratory knowledge that can be used in future research. In addition, based on the collected socio-demographic information we divided our sample into two groups (i.e., precarious and in-role teachers); however, further research could be divided into other groups (e.g., degree of school, years of experience, teaching subject) to gain more specific knowledge. Finally, cross-cultural studies that compare different school systems using the ESEM approach could provide an innovative perspective on assessing motivation for teaching.

CONCLUSION

The ESEM may provide an intriguing technique for testing the dimensionality of the psychometric tools, especially for complex and culturally oriented psychological constructs. The ESEM's combination of confirmatory and exploratory nature allows to combine theory-driven and data-driven advantages. Specifically, the OTS application of the ESEM technique for the Italian teachers offered the opportunity to reflect on the issues of cross-cultural validation while maintaining a complex structure and a strong reference to the theory of motivation in a parsimonious short version. Furthermore, preliminary findings from the network analysis might help Italian teachers overcoming a motivational gap. Indicators of psychological well-being had an impact on it. More specifically, intrinsic motivation seems to be influenced by intra-subject indicators (e.g., anxiety), whereas extrinsic motivation appears to be influenced by extra-subject indicators (e.g., uncertainty). Finally, focusing on teachers' contextual and personal well-being, especially in precarious situations, may improve their motivation. This can lead to better teaching quality with far-reaching implications for students and society as a whole.

In conclusion, we will not claim that this psychometric technique is necessarily useful for all instruments commonly used in psychological assessment. More broadly, we argue that this framework has the potential to become a standard tool in the study of multifaceted psychometric tools, especially those that present problems in cross-cultural validation. Ultimately, we encouraged the adoption of the ESEM technique, emphasizing that the common guidelines (Asparouhov & Muthén, 2009; Marsh, Liem et al., 2011a; Marsh et al., 2014; Morin et al., 2016) supported the comparison between CFA and ESEM models in order to select the more parsimonious model, while systematically demonstrating the advantages of the latter both theoretically (i.e., accurate representation of latent factors in reference to theory without "pure" factors) and technically (i.e., well-defined latent factors and better estimation of relationships with other variables) (Marsh et al., 2014). Indeed, an ESEM-based approach is more likely to produce better factorial solutions than the overly restrictive and widely used CFA strategy.

Author note: we have no conflicts of interest to disclose.

References

ALAMER, A. (2022). Exploratory structural equation modeling (ESEM) and bifactor ESEM for construct validation purposes: Guidelines and applied example. *Research Methods in Applied Linguistics*, *1* (1), 100005. doi.org/https://doi.org/10.1016/j.rmal.2022.100005

ANGHEL, I. (2013). Motivating aspects to become teachers in T-VET system. *Scientific Bulletin – Education Sciences Series*, *1*, 112-123.

ANIEF (2022). *Dossier Anief: "Nella scuola italiana, aumenta l'esercito di precari, il 22,4% del personale in servizio"*. Retrieved 20/12/2022 from https://anief.org/stampa/news/39736-dossier-anief-%E2%80%9Cnella-scuola-italiana,-aumenta-l%E2%80%99esercito-di-precari,-il-22,4-del-personale-in-servizio%E2%80%9D

ASPAROUHOV, T. & MUTHÉN, B. (2009). Exploratory structural equation modeling. *Structural Equation Modeling: A Multidisciplinary Journal*, *16* (3), 397-438. doi.org/10.1080/10705510903008204

BOFFO, M., MANNARINI, S. & MUNARI, C. (2012). Exploratory structure equation modeling of the UCLA loneliness scale: A contribution to the Italian adaptation. *TPM: Testing, Psychometrics, Methodology in Applied Psychology*, *19* (4), 345-363.

BOTTESI, G., GHISI, M., ALTOÈ, G., CONFORTI, E., MELLI, G. & SICA, C. (2015). The Italian version of the Depression Anxiety Stress Scales – 21: Factor structure and psychometric properties on community and clinical samples. *Comprensive Psychiatry*, *60*, 170-181. doi.org/10.1016/j.comppsych.2015.04.005

BOTTESI, G., GHISI, M., NOVARA, C., BERTOCCHI, J., BOIDO, M., DE DOMINICIS, I. & FREESTON, M.H. (2015). Intolerance of Uncertainty Scale (IUS-27 e IUS-12): Due studi preliminari. [Intolerance of Uncertainty Scale (IUS-27 and IUS-12): Two preliminary studies.]. *Psicoterapia Cognitiva e Comportamentale*, *21*, 345-365. Retrieved (17/03/2023) from https://www.researchgate.net/publication/281899656_Intolerance_of_Uncertainty_Scale_IUS-27_and_IUS-12_Two_preliminary_studies

BROADHURST, P.L. (1957). Emotionality and the Yerkes-Dodson Law. *Journal of Experimental Psychology*, *54*, 345-352. doi.org/10.1037/h0049114

BROWN, T.A. (2015). *Confirmatory factor analysis for applied research*. Guilford publications.

CAO, C. & LIANG, X. (2022). Sensitivity of fit measures to lack of measurement invariance in exploratory structural equation modeling. *Structural Equation Modeling: A Multidisciplinary Journal*, *29* (2), 248-258. doi.org/10.1080/10705511.2021.1975287

CARLETON, R.N., NORTON, M.A.P.J. & ASMUNDSON, G.J.G. (2007). Fearing the unknown: A short version of the intolerance of uncertainty scale. *Journal of Anxiety Disorders*, *21* (1), 105-117. doi.org/https://doi.org/10.1016/j.janxdis.2006.03.014

CHRISTOPHER WESTLAND, J. (2010). Lower bounds on sample size in structural equation modeling. *Electronic Commerce Research and Applications*, *9* (6), 476-487. doi.org/https://doi.org/10.1016/j.elerap.2010.07.003

COHEN, J. (2013). *Statistical power analysis for the behavioral sciences*. Routledge.

DUEBER, D.M. (2017). *Bifactor indices calculator: A Microsoft Excel-based tool to calculate various indices relevant to bifactor CFA models*. doi.org/https://doi.org/10.13023/edp.tool.01

EPSKAMP, S. (2020). Psychometric network models from time-series and panel data. *Psychometrika*, *85* (1), 206-231. doi.org/10.1007/s11336-020-09697-3

EPSKAMP, S., CRAMER, A.O.J., WALDORP, L.J., SCHMITTMANN, V.D. & BORSBOOM, D. (2012). qgraph: Network visualizations of relationships in psychometric data. *Journal of Statistical Software*, *48* (4), 1-18. doi.org/10.18637/jss.v048.i04

FERRELL, C.M. & DANIEL, L.G. (1993). *Construct validation of an instrument measuring teacher career motivations*. Annual Meeting of the Mid-South Educational Research Association, New Orleans, LA.

GIANNINI, M., SCHULDBERG, D., DI FABIO, A. & GARGARO, D. (2008). Misurare l'ottimismo: Proprietà psicometriche della versione italiana del Life Orientation Test – Revised (LOT-R). [Measuring optimism: Psychometric properties of the Italian version of the Life Orientation Test – Revised (LOT-R)]. *Counseling: Giornale Italiano di Ricerca e Applicazioni*, *1*, 73-84.

JOSEPH, P.B. & GREEN, N.S. (1986). Perspectives on reasons for becoming teachers. *Journal of Education*, *37* (6), 28-33.

JOVANOVIĆ, O., BOGDANOVIĆ, S. & SIMIĆ, N. (2013). Povezanost bazičnih crta ličnosti i motivacije studenata „nastavničkih" fakulteta za posao nastavnika [Relationship between the basic personality traits and motivation of the students from the teacher faculties for the future profession]. In *Zbornik radova sa XIX naučnog skupa Empirijska istraživanja u psihologiji*. Filozofski fakultet.

KELLY, S. & NORTHROP, L. (2015). Early career outcomes for the "best and the brightest": Selectivity, satisfaction, and attrition in the beginning teacher longitudinal survey. *American Educational Research Journal*, *52 (4)*, 624-656. doi.

org/10.3102/0002831215587352

LOVIBOND, S. & LOVIBOND, P. (1995). *Manual for the depression anxiety stress scales*. Psychology Foundation of Australia.

MAI, Y., ZHANG, Z. & WEN, Z. (2018). Comparing exploratory structural equation modeling and existing approaches for multiple regression with latent variables. *Structural Equation Modeling: A Multidisciplinary Journal*, *25* (5), 737-749. doi.org/10.1080/10705511.2018.1444993

MARSH, H.W., GUO, J., DICKE, T., PARKER, P.D. & CRAVEN, R.G. (2020). Confirmatory factor analysis (CFA), exploratory structural equation modeling (ESEM), and set-ESEM: Optimal balance between goodness of fit and parsimony. *Multivariate Behavioral Research*, *55* (1), 102-119.

MARSH, H.W., HAU, K.T. & GRAYSON, D. (2005). Goodness of fit evaluation in structural equation modeling. In A. Maydeu-Olivares & J. McArdle (Eds.), *Contemporary psychometrics. A festschrift to Roderick P. McDonald*. Hillsdale, NJ: Erlbaum.

MARSH, H.W., HAU, K.T. & WEN, X. (2004). In search of golden rules: Comment on hypothesis testing approaches to setting cutoff values for fit indices and dangers in overgeneralizing Hu and Bentler's (1999) findings. *Structural Equation Modeling*, *11*, 320-341. doi:10.1207/s15328007sem1103_2

MARSH, H.W., LIEM, G.A.D., MARTIN, A.J., MORIN, A.J.S. & NAGENGAST, B. (2011). Methodological measurement fruitfulness of exploratory structural equation modeling (ESEM): New approaches to key substantive issues in motivation and engagement. *Journal of Psychoeducational Assessment*, *29* (4), 322-346. doi.org/10.1177/0734282911406657

MARSH, H.W., MORIN, A.J.S., PARKER, P.D. & KAUR, G. (2014). Exploratory structural equation modeling: An integration of the best features of exploratory and confirmatory factor analysis. *Annual Review of Clinical Psychology*, *10* (1), 85-110. doi.org/10.1146/annurev-clinpsy-032813-153700

MARSH, H.W., MUTHÉN, B., ASPAROUHOV, T., LÜDTKE, O., ROBITZSCH, A., MORIN, A.J. & TRAUTWEIN, U. (2009). Exploratory structural equation modeling, integrating CFA and EFA: Application to students' evaluations of university teaching. *Structural Equation Modeling: A Multidisciplinary Journal*, *16* (3), 439-476. doi.org/10.1080/10705510903008220

MARSH, H.W., NAGENGAST, B., MORIN, A.J., PARADA, R.H., CRAVEN, R.G. & HAMILTON, L.R. (2011). Construct validity of the multidimensional structure of bullying and victimization: An application of exploratory structural equation modeling. *Journal of Educational Psychology*, *103* (3), 701. doi.org/10.1037/a0024122

MARZANO, A., DE ANGELIS, M. & VEGLIANTE, R. (2015). The precarious teacher in Italy: An exploratory research. *Proceedings of EDULEARN15 Conference*.

MORAN, A., KILPATRICK, R., ABBOTT, L., DALLAT, J. & McCLUNE, B. (2001). Training to teach: Motivating factors and implications for recruitment. *Evaluation and Research in Education*, *5* (1), 17-32. doi.org/https://doi.org/10.2298/PSI170327012S

MORIN, A.J.S., ARENS, A.K. & MARSH, H.W. (2016). A bifactor exploratory structural equation modeling framework for the identification of distinct sources of construct-relevant psychometric multidimensionality. *Structural Equation Modeling: A Multidisciplinary Journal*, *23* (1), 116-139. doi.org/10.1080/10705511.2014.961800

MORIN, A.J.S., MYERS, N.D. & LEE, S. (2020). Modern factor analytic techniques. In *Handbook of Sport Psychology*. doi.org/10.1002/9781119568124.ch51

MUTHÉN, L.K. & MUTHÉN, B.O. (2012). *Mplus User's Guide (7th ed.)*. CA: Muthén & Muthén.

PERERA, H.N. (2015). The internal structure of responses to the Trait Emotional Intelligence Questionnaire – Short form: An exploratory structural equation modeling approach. *Journal of Personality Assessment*, *97* (4), 411-423. doi.org/10.1080/00223891.2015.1014042

PERRY, J.L., NICHOLLS, A.R., CLOUGH, P.J. & CRUST, L. (2015). Assessing model fit: Caveats and recommendations for confirmatory factor analysis and exploratory structural equation modeling. *Measurement in Physical Education and Exercise Science*, *19* (1), 12-21. doi.org/10.1080/1091367x.2014.952370

PREZZA, M., TROMBACCIA, F.R. & ARMENTO, L. (1997). La scala dell'autostima di Rosenberg: Traduzione e validazione italiana. [The Rosenberg Self-Esteem Scale: Italian translation and validation]. *BPA Bollettino di Psicologia Applicata*, *223*, 35-44.

ROSENBERG, M. (1989). *Society and the adolescent self-image – Revised version*. Wesleyan University Press.

RSTUDIO TEAM (2020). *RStudio: Integrated development environment for R*. RStudio, PBC. www.rstudio.com/

RYAN, R.M. & DECI, E.L. (2000). Intrinsic and extrinsic motivations: Classic definitions and new directions. *Contemporary Educational Psychology*, *25* (1), 54-67. doi.org/https://doi.org/10.1006/ceps.1999.1020

SCHEIER, M.F., CARVER, C.S. & BRIDGES, M.W. (1994). Distinguishing optimism from neuroticism (and trait anxiety, self-mastery, and self-esteem): A reevaluation of the Life Orientation Test. *Journal of Personality and Social Psychology*, *67* (6), 1063-1078. doi.org/10.1037//0022-3514.67.6.1063

SCRIVEN, E.G. & PARRIOTT, K. (1975). Schoolteacher: A

sociological study. *Journal of Teacher Education*, *26* (4), 363-364. doi.org/10.1177/002248717502600425

SIMIĆ, N., PURIĆ, D. & STANČIĆ, M. (2018). Motivation for the teaching profession: Assessing psychometric properties and factorial validity of the orientation for teaching survey on in-service teachers. *Psihologija*, *51* (3), 309-331. doi.org/10.2298/PSI170327012S

SINCLAIR, C., DOWSON, M. & MCINERNEY, D.M. (2006). Motivations to teach: Psychometric perspectives across the first semester of teacher education. *Teachers College Record, 108* (6), 1132-1154. doi.org/10.1111/j.1467-9620.2006.00688.x

SOPER, D. (2022). *A-priori sample size calculator for structural equation models*. Retrieved (17/03/2023) from https://www.danielsoper.com/statcalc

STUCKY, B.D., THISSEN, D. & EDELEN, M.O. (2013). Using logistic approximations of marginal trace lines to develop short assessments. *Applied Psychological Measurement*, 37, 41-57. doi.org/10.1177/0146621612462759

TÓTH-KIRÁLY, I., MORIN, A.J., BŐTHE, B., OROSZ, G. & RIGÓ, A. (2018). Investigating the multidimensionality of need fulfillment: A bifactor exploratory structural equation modeling representation. *Structural Equation Modeling: A Multidisciplinary Journal*, *25* (2), 267-286. doi.org/10.1080/10705511.2017.1374867

XIAO, Y., LIU, H. & HAU, K.-T. (2019). A comparison of CFA, ESEM, and BSEM in test structure analysis. *Structural Equation Modeling: A Multidisciplinary Journal*, *26* (5), 665-677. doi.org/10.1080/10705511.2018.1562928

YOU, S. & CONLEY, S. (2015). Workplace predictors of secondary school teachers' intention to leave: An exploration of career stages. *Educational Management Administration & Leadership*, *43* (4), 561-581. doi.org/10.1177/1741143214535741

APPENDIX

Orientation for Teaching Survey (OTS) Italian version

Ho deciso di insegnare perché…
1. vorrei lavorare con i ragazzi
2. l'insegnamento mi permette di prestare un prezioso servizio di valore morale
3. mi piace stare nell'ambiente scolastico
4. ho/avrò la possibilità di percepire un buon stipendio
5. gli insegnanti godono di buoni benefit associati al loro lavoro
6. mi piacciono gli orari di lavoro e le vacanze scolastiche
7. l'insegnamento mi dà/darà la possibilità di aiutare i meno fortunati
8. l'insegnamento mi dà/darà l'opportunità di aiutare gli studenti ad acquisire un senso di realizzazione e autostima
9. l'insegnamento mi dà/darà la possibilità di "ripagare" i buoni insegnanti che ho avuto
10. i miei genitori ritenevano che l'insegnamento sarebbe stato una buona carriera per me
11. l'insegnamento mi dà/darà l'opportunità di avere autorità
12. l'insegnamento mi permette/permetterà di vivere l'amore e il rispetto dei ragazzi
13. l'insegnamento è un'occupazione relativamente non competitiva
14. ho una passione per una particolare materia
15. non ero soddisfatto/a del lavoro che avevo svolto in altri campi
16. è meno costoso prepararsi per insegnare di quanto non lo sia prepararsi per molti altri campi
17. è un'occupazione intellettualmente stimolante
18. l'insegnamento è un'occupazione appagante e stimolante
19. mi sento più a mio agio con i ragazzi che con gli adulti
20. mi piacerebbe risolvere alcuni dei problemi del sistema educativo
21. mi piace l'idea di essere al centro dell'attenzione in una stanza piena di persone
22. c'è così tanto bisogno di bravi insegnanti
23. l'insegnamento era il lavoro migliore tra quelli più prontamente disponibili per me
24. l'insegnamento è un'occupazione prestigiosa
25. l'insegnamento mi dà/darà la possibilità di essere il capo di me stesso/a
26. amo i ragazzi
27. mi è piaciuto lavorare con i ragazzi in altri contesti e ho pensato che l'insegnamento sarebbe altrettanto piacevole
28. l'insegnamento era il miglior lavoro tra quelli per cui sono più tagliato/a
29. sento una "vocazione" personale all'insegnamento
30. ho il desiderio di impartire conoscenze ad altre persone
31. l'insegnamento mi dà/darà la possibilità di avere un impatto sulla società
32. ho sempre voluto insegnare
33. l'insegnamento è una professione creativa

continued on next page

continued

34. da insegnante, posso avere l'opportunità di svolgere attività extracurriculari che mi piacciono
35. l'orario di lavoro è compatibile con la mia situazione domestica
36. l'insegnamento mi dà/darà la possibilità di migliorare la mia posizione sociale
37. l'insegnamento mi dà/darà la possibilità di fungere da modello positivo per i ragazzi
38. l'insegnamento si adatta bene alla mia personalità
39. insegnare è una tradizione di famiglia
40. le persone spesso mi considerano un insegnante nato
41. l'insegnamento mi dà/darà l'opportunità di promuovere il rispetto per la conoscenza e l'apprendimento
42. alcuni dei miei amici si sono laureati in ambito pedagogico
43. mi sono formato/a in un altro campo ma non sono riuscito/a a trovare un lavoro
44. mi sono formato/a in un altro campo ma non mi sentivo a mio agio in quell'ambito
45. qualcuno che stimo molto mi ha detto che sarei stato/a un buon insegnante
46. mi hanno parlato di una borsa di studio o di un programma di rimborsi delle tasse universitarie disponibile per coloro che intraprendono i percorsi formativi per diventare insegnanti
47. l'insegnamento mi offre/offrirà una buona opportunità per l'avanzamento di carriera
48. l'insegnamento può facilmente portarmi ad altre carriere
49. insegnare può aiutarmi a sviluppare il carattere
50. gli insegnanti vivono un ambiente di lavoro piacevole
51. l'insegnamento mi dà/darà opportunità di leadership
52. è facile formarsi per lavorare come insegnante
53. insegnare mi dà/darà l'opportunità di imparare per tutta la vita
54. l'insegnamento mi dà/darà l'opportunità di interagire con colleghi interessanti
55. l'insegnamento mi dà/darà l'opportunità di incontrare molte persone
56. l'insegnamento mi offre/offrirà un lavoro sicuro
57. l'insegnamento è un lavoro molto facile
58. ho sentito un discorso motivazionale sull'insegnamento oppure sono stato influenzato da materiale mediatico focalizzato sui benefici dell'insegnamento

Note. The items for the short version are: a) implicit motivation: 2, 16, 17, 25, 29, 32, 36, 40, 41; b) explicit motivation: 5, 11, 20, 23, 35, 42, 51, 52, 57.