VILNIUS TECH
Vilnius Gediminas Technical University

Creativity studies
ISSN 2345-0479 / eISSN 2345-0487
2023 Volume 16 Issue 1: 274–296
https://doi.org/10.3846/cs.2023.16085

MEASUREMENT INVARIANCE, VALIDITY, RELIABILITY, AND FACTOR STRUCTURE EXAMINATION OF THE CREATIVITY NURTURING BEHAVIOUR SCALE FOR TEACHERS: COMPARISONS ACROSS GENDER IN THIRTEEN COUNTRIES

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Received 6 December 2021; accepted 12 September 2022

Abstract. Creativity is fundamental to the overall progress of humanity and hence identified as a key competence required for being successful in the 21st century. Teaching that nurtures creativity helps not only to unfold children's creative potential but also to enhance the effectiveness of teaching. The essential step in helping teachers to learn the principles of creativity nurturing pedagogy is to measure creativity nurturing behaviour for teachers and develop it through training. Assessment of teachers' ability to nurture creativity is much needed. In this research we measured the creativity nurturing behaviour of 2006 teachers from various countries across global with creativity nurturing behaviour scale for teachers and analyzed the four-factor model's reliability, validity and measurement invariance across gender and countries. The following values were obtained: Cronbach's alpha (0.75, 0.70, 0.72, 0.79), composite reliability (0.76, 0.72, 0.701, 0.784), configural invariance (comparative fit index: 0.913, root mean square error of approximation: 0.063 and standardized root mean square residual: 0.662), metric invariance (obtained value in comparative fit index: 0.912,

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root mean square error of approximation: 0.061 and standardized root mean square residual: 0.52) and scalar invariance (obtained value in comparative fit index: 0.909, root mean square error of approximation: 0.064 and standardized root mean square residual: 0.7). The results of the study show that creativity nurturing behaviour scale for teachers is a valid and reliable scale which is invariant across gender and countries. Hence, the scale can be administered to measure the creativity nurturing behaviour of teachers and its results can be employed to identify the developmental needs of teachers to foster creativity in the classroom. This first scale for teachers is translated into Hindi, Arabic, Spanish, English, Turkish, and Persian.

Keywords: creativity nurturing, creativity nurturing behaviour, critical creativity, critical thinking, measurement invariance, teachers.

Introduction

If creativity researchers published a collection of aphorisms encapsulating all their wisdom, one of the aphorisms would go as follows: to value creativity is not the same as to nurture it. Indeed, creativity is fundamental to the overall progress of humanity and hence identified as a key competence required for being successful in the 21st century (Bellanca & Brandt, 2010; Craft, 1999; Trilling & Fadel, 2009; Wagner, 2012). Teaching in a manner to nurture creativity helps not only to unfold children's creative potential but also to enhance the effectiveness of teaching (Beghetto & Kaufman, 2010; Cropley, 1997; Torrance, 1995). Previous research has revealed how teachers' behaviours and implicit theories of creativity can either foster or hinder students' creativity (*e.g.*, Bereczki & Kárpáti, 2018; Esquivel, 1995; Mullet et al., 2016; Soh, 2017). However, regardless of the scientific evidence, there is still a gap between scientific knowledge about creativity and widely used educational practices (Grigorenko, 2019; Sternberg, 2015).

The essential step in helping teachers to learn the principles of creativity nurturing pedagogy is to measure teachers' creativity nurturing behaviour (CNB) and develop it through training (Henriksen et al., 2016). At the same time, the incorporation of creative pedagogy in training programs for teachers is still a challenge rather than an achieved educational standard (Makel, 2009). A measure of CNB has to fulfill several conditions. First, it has to be in accordance with the current educational literature and include sample of behaviour established as conducive to enhancing creativity in a classroom (Beghetto, 2019; Cropley, 1997; de Souza Fleith, 2000; Esquivel, 1995; Pang 2015). Second, it has good psychometric properties of reliability and validity. Further, it has to be concise and does not require a lot of time to complete because teachers usually experience high workloads and do not have enough free time for extra-activities, including participation in research studies (Butt & Lance, 2005; Philipp & Kunter, 2013). Finally, it has to allow for direct cross-cultural comparisons as creativity is high on many countries' agendas for competing global markets (Hui & Lau, 2010; McWilliam & Haukka, 2008; Kaufman & Sternberg, 2010).

One of the measurement tools satisfying several conditions listed above is a recently designed creativity nurturing behaviour scale for teachers (CNBST) (Sharma & Sharma, 2018; for another example, see Cropley, 1997; Soh, 2000). CNBST is a brief self-report measure that assesses the teacher's involvement in nurturing creative potential and creative behaviour in school children. This scale satisfies the first three conditions (Sharma & Sharma, 2018)

discussed above but the fourth condition of assessing the psychometric properties across different countries is not met. There are very few scales on CNB of teachers that satisfy all the four conditions and none of the existing scales has assessed the measurement invariance (MI) across countries and gender. Therefore, our research questions are framed as follows: first, is the CNBST valid and reliable across different countries? Second, does this scale exhibit MI across countries and gender? So, the purpose of this research is to assess the psychometric properties including MI and latent mean of the CNBST across countries, to satisfy all conditions required for a CNB measure.

To achieve our goals, we surveyed a sample of school teachers from Western and Eastern cultures, resulting in thirteen countries in total, *i.e.* United Arab Emirates/Jordan, France, Ghana, Greece, India, Iran, Philippines, Portugal, Russia (Commonwealth of Independent States), South Korea (SK), Spain, Trinidad and Tobago, Turkey.

Our study contributes to the growing literature on teaching and enhancing creativity (Hernández-Torrano & Ibrayeva, 2020) and aims to fulfill the needs of educational researchers for sound psychometric tools for measuring teacher's CNB in a classroom. The present study is first, that cover such a wide geographical span worldwide with a modest idea of providing the research and teaching fraternity with a useful CNBST that has been validated over a period of five years.

1. Data and research methodology

1.1. Research design

The study was conducted to examine the validity, reliability, and MI of CNBST in different countries. So, the cross-sectional research design was employed to collect the data (Hall, 2008). The research is confirmatory study of the existing scale by administering it to the sample from various countries.

1.2. Research sample and method of data collection

Participants were randomly selected from thirteen countries, based on available representatives in those countries with expertise and keen collaborative interest in the field of CNB analysis, and their willingness to volunteer the required task to validate the scale in their educational institutions in their respective countries. This was deemed important because scale validation depends on an expert judgment (Fernández-Gómez et al., 2020).

Participants were recruited from thirteen countries via online platforms and social networks. To take part in the study, participants had to be working as school teachers for no less than one year. In all countries, data collection was organized online via *Google Forms*. At the start, teachers had to complete CNBST and then answer questions about their pedagogical style and implicit beliefs on creativity. The total sample consisted of 2006 school teachers (1359 females) aged from 20 to 60 with teaching experience varying from 1 to 40 years. The detailed sample description for each country is provided in Table 1. Participation in the study was voluntary and anonymous. Participants were not compensated for their time.

Table 1. Sample characteristics across countries (source: created by authors)

Countries	Number of respondents	Females, %	M_{age} (standard deviation)	Teaching (M_{years})	Number of settlements	Urban schools, %
United Arab Emirates/ Jordan	193	62.7	37.72 (7.08)	12.23	1	79.3
France	52	84.6	40.96 (9.51)	15.79	32	90.4
Ghana	208	32.2	41.74 (7.31)	17.42	6	77.4
Greece	85	65.9	31.62 (5.65)	0.01	3	68.2
India	116	72.4	40.04 (9.43)	14.05	1	98.3
Iran	421	40.6	38.41 (8.53)	13.55	1	99.3
Philippines	48	56.3	32.42 (9.76)	4.41	1	89.6
Portugal	24	79.2	47.96 (8.94)	21.71	17	66.7
Russia (Commonwealth of Independent States)	223	88.8	36.91 (10.57)	14.35	129	77.0
South Korea	39	71.8	34.38 (5.42)	8.59	9	66.7
Spain	29	62.1	48.38 (11.26)	21.86	14	82.8
Trinidad and Tobago	92	84.8	37.40 (9.11)	11.60	33	69.6
Turkey	476	94.1	31.30 (6.00)	7.87	45	75.4

2. The creativity nurturing behaviour scale for teachers and its review

Scale translation: The CNBST was translated by professional language editors (members of the university in respective countries, and language departments) who have been trained and certified in accredited academic training institutions. After the translation, technical issues were vetted and validated by creativity experts who worked with universities of respective countries (languages). The back translation was done to ensure the best possible version of the translation of the scale. Finally, the scale pilot study was conducted with ten participants in respective countries as another step in ensuring language validity.

3. Data collection: instrument, response, data and scoring

CNBST is a self-report measure consisting of fifteen items that assess teachers' involvement in nurturing creative potential and creative behaviour in school students (Sharma & Sharma, 2018). Participants have to respond to each item using a 6-point scale where 1 refers to totally disagree and 6 refers to totally agree. CNBST comprises of four subscales: (1) inquisitiveness, (2) abstraction, (3) critical thinking, and (4) motivation.

Inquisitiveness (or curiosity) is defined as an ability to stimulate students to ask questions to understand new ideas and concepts. Acquiring new knowledge is essential for creative thinking because knowledge can serve later as input for divergent thinking and conceptual combination resulting in creative ideas (Hardy et al., 2017; Mumford et al., 2012; Schutte & Malouff, 2020). Therefore, it is hardly surprising that psychologists and educators emphasized the necessity to fuel students' desire to ask questions, absorb new knowledge, and find out how new knowledge relates to something they already know (Hallman, 1967; Torrance, 1965).

By definition, *abstraction* is ability to encourage students to explore their ideas before evaluating them. Premature judgment may hinder generation of truly creative ideas at both the individual and group levels because it raises the chances that highly original ideas would be either not found or dismissed regardless of their potential benefits (Osborn, 2007; Starko, 2014; Torrance, 1995). Hence, a teacher has to convey to students a notion that any idea however deficient it may appear at first glance, deserves some reflection before being condemned by the voice of critical reason (Frederiksen, 1983). In contrast, *critical thinking* is an ability to stimulate objective analysis and evaluation of an issue to form a judgment. Any idea requires critical examination at later stages of the creative process to ensure that it solves the problem at hand (Cropley, 2006; Mumford et al., 1991; Wallas, 2014), otherwise, one is at risk of making false claims about novelty and usefulness of an idea. Thus, students have to develop their evaluative abilities to differentiate between more and less creative ideas and to consider ways of improving an idea that deserves a closer look (Dailey & Mumford, 2006; Runco & Chand, 1995; van Broekhoven et al., 2020). Finally, *motivation* is understood as an ability to boost students' morale and encourage learning from failures. Any creative endeavor requires courage since it involves risks (Eisenman, 1987; May, 1994; Zhang & Sternberg, 2011), and the latter comes not alone but with a sequence of failures that might lead to despair and distress. Teachers can provide an environment that supports students' efforts to express their creativity and helps them to learn a plain truth that errors can be not only misleading but also rewarding by opening gates towards discoveries (Manalo & Kapur, 2018; Sternberg, 2007).

Table 2. Items of creativity nurturing behaviour scale for teachers (source: created by authors)

No.	Subscale	Item
Q1	Abstraction	I regularly give group assignments as part of the pedagogy.
Q2	Abstraction	The students have opportunity to share their ideas and suggestions during the class.
Q3	Abstraction	The students are expected to work cooperatively in group.
Q4	Abstraction	Before sharing my viewpoint on the student's idea, I urge them to explore it further.
Q5	Abstraction	I do not react immediately to the suggestions of the students rather give them time.
Q6	Inquisitiveness	I keep track of the progress in the students' ideas.
Q7	Inquisitiveness	I give students the opportunity to share their ideas and thoughts.
Q8	Inquisitiveness	I give heed to every student's query.
Q9	Motivation	I am open to listening to the distressed students.
Q10	Motivation	I encourage students to learn the basics of the topic.
Q11	Motivation	I lay emphasis on the proficient learning of essential knowledge and skills.
Q12	Critical thinking	To develop critical thinking, I inquire students about their idea.
Q13	Critical thinking	The students are motivated to apply their learning in different situations.
Q14	Critical thinking	I provide opportunity to students to evaluate and judge themselves.
Q15	Critical thinking	I motivate students to apply the teachings in different contexts.

All CNBST's items are given in Table 2. Based on the native language of the country, prior to collecting data, the instrument was translated to Russian, French, Persian, Turkish, Spanish, Arabic, and Dutch. Subscales' scores were derived by aggregating item scores constituting a particular subscale. Information on the internal consistency reliability of the measure will be reported in further sections, along with the results of factor analysis.

4. Data analysis

Statistical analysis is based on the following:

1. Demography-age (average age, and range), gender, country;
2. Four-factor model (FFM) (exploratory factor analysis (EFA), confirmatory factor analysis (CFA)): average values along with the value of standard deviations (SDs) were computed for all statements and all subscales. In addition, to check the internal reliability of the scale Cronbach's alpha and composite reliability were computed.

First, we used *SPSS* version 24.0 for computing descriptive statistics.

Second, the unidimensionality of scale was estimated through CFA by using *IBM SPSS Amos* version 7.0. All the four factors of the CNBST were considered to be represented by one latent factor. The CFA was found to be an appropriate method because the validity and reliability of the scale was already proven. The current study intended to verify this across different countries.

Model fit was assessed using chi-squared test (χ^2), degree of freedom, comparative fix index (CFI), root mean square error of approximation (RMSEA), and standardized root mean square residual (SRMR).

Later, MI was assessed based on the recommendations of Vandenberg and Lance (2000). A baseline model across groups was assessed by conducting a configural invariance (CI) with free estimation of factor loadings, intercepts, and residuals. Then, metric invariance (MTI) mode was tested constraining the factor loadings to the same. Later scalar invariance (SI) was estimated where the intercepts and factor loadings were constrained to be the same for all groups.

After the establishment of SI, latent mean differences were compared between gender and constructs of creativity nurturing (*i.e.*, abstraction, inquisitiveness, motivation, and critical thinking). Specifically, a full SI model was used as the baseline.

4.1. Confirmatory factor analysis

First CFA and later multi-group confirmatory factor analysis (MGCFA) were done using *Amos* version 7.0. As multivariate normality was not observed in the sample, maximum likelihood method along with the Satorra–Bentler scaled chi-squared test ($SB\chi^2$) was used to check the fit supplemented by the RMSEA, SRMR and CFI (Brown, 2006; Kline, 2016). Good fit of the hypothesized model is said to be attained if RMSEA value is .06 or less and CFI value is above .95, whereas CFI equals to .90, and RMSEA between .06 and .08 are moderate values and so it is acceptable model fit (Hu & Bentler, 1999; Kline, 2016; Schumacker & Lomax, 2010).

4.2. Measurement invariance

MI of the scale was tested with the help of MGCFA. Before running MGCFA, for each country the model fit was tested individually considering the FFM of CNBST. MI can be checked through multi-group analysis in *Amos* version 7.0. Testing MI requires a step-wise method which begins with determination of the multi-group model fit. MI at following levels is generally identified or tested in cross-national research, which includes CI, MI, and SI (Horn & McArdle, 1992; Byrne & van de Vijver, 2010). If all the three invariances are supportive then it sets the ground for analyzing and contrasting the values of latent mean.

The "configural or baseline model" is a model without constraints and hence allows all parameters to be free. CFA models for each group are separately tested to develop the baseline model. Once the fit indices are determined, following invariances are calculated: CI, MTI, and SI for all groups and then each invariance is compared to the "configural model". CI is examined to test for the pattern of free and fixed parameter loadings on latent variables across groups. If the CI is established, it implies that the basic pattern of the parameters is supported by all the groups and then the MTI is measured by fixing constraints on factor loadings for equality of all groups (Putnick & Bornstein, 2016). Constrained model is then matched to the CI model and compared, if fit of the constrained model is better than or equal to the CI model, the MTI is supported reflecting that model-fit is not significantly affected by constraining the factor loadings across groups (Horn & McArdle, 1992). After MTI is established, the item intercepts are constrained to test for SI and if it is supported then the latent mean analysis is done to compare latent mean for different groups (Meredith, 1993).

The fit of MI models (CI, MTI, and SI) is generally assessed by the comparison of the "two nested models that are identical except for a target set of restrictions in one" (Putnick & Bornstein, 2015). The literature supports the comparison of chi-square or the goodness of fit statistic of the constrained and less-restricted model (Byrne & Stewart, 2006; Kline, 2016; Cheung & Rensvold, 2002) but most of the times both the fit-statistic are in disagreement (Rusticus et al., 2008). It is also observed that χ^2 is sample size-sensitive and generally χ^2 fit-statistic would not give accurate results with the large sample size (Meade et al., 2008; Chen, 2007; French & Finch, 2006; Cheung & Rensvold, 2002). Hence, it is suggested to consider alternative criteria for evaluating the nested model fit like CFI (–.01) (Cheung & Rensvold, 2002), RMSEA (.015), and SRMR (.03) (Chen, 2007; Meade et al., 2008).

5. Research ethics

The participants of the study were employed by sending out electronic mails to them. Those who gave consent to participate in the research survey were sent the google form. The research participation was completely voluntary and confidential. Pseudo-anonymity was adopted in treating the responses of the survey by the study participants for the study. The respondents' names were replaced by the dummy numbers. Complete, properly filled and valid questionnaire were only included at data analysis stage of this research and confidentiality was maintained. The privacy and confidentiality of the participants have been ensured. We certify that all authors abide by the rules and regulations that are set up by the citation

and publication style that authors have used in the research. Authors worked according to the code of ethics of conduct in the research methodology and discussions section to ensure that this writing follows the legal and ethical code of conduct.

6. Results

6.1. Descriptive statistics, validity and reliability

Table 3 provides information about the descriptive statistics for CNBST for different nation. The sample consisted of 647 males and 1359 females. The mean of the sub-scales for the total sample ranged between 4.99 and 4.72. Motivation has mean value which is highest of the four subscales (M = 4.99; SD = .827) and the mean value of inquisitiveness is lowest of all (M = 4.72; SD = .861). The results imply that teachers have a higher motivation to boost student moral and encourage learning from failure as creativity requires courage and ability to take risk. The lower value of inquisitiveness is related to teacher's behaviour – "allowing curiosity of students to ask questions in class" which implies teachers discourage students from asking questions.

Table 3. Descriptive statistics of sample (source: created by authors)

Subscale	Descriptive	
	Mean	Standard deviation
Critical thinking	4.8441	.81747
Motivation	4.9958	.82744
Inquisitive	4.7270	.86165
Abstraction	4.7954	.76930

Table 4 shows that Cronbach's alpha of the overall scale is .925 and that of latent variables is > 0.70 that shows the scales and subscales have internal consistency (Abraham & Barker, 2015; Nunnally & Bernstein, 1994; Lin et al., 2015; Bland & Altman, 1997; DeVellis, 2011). The composite reliability of all the latent factors is also more than 0.70 (Srinivasan et al., 2002).

Table 4. Reliability and validity of the subscales (source: created by authors)

Subscales	Reliability and validity measures		
	Cronbach's alpha	Composite reliability	Average variance extracted
Abstraction	.751	.769	.502
Inquisitiveness	.701	.720	.566
Motivation	.725	.701	.509
Critical thinking	.791	.784	.577

6.2. Confirmatory factor analysis

CNBST's FFM (Figure 1) exhibits good to mediocre model fit in different countries (Table 5). Item loads of all the statements of each country were more than 0.5 showing the acceptable standards (Truong & McColl, 2011; Hulland, 1999; Chen & Tsai, 2007) (Table 6). Hence, the original model (FFM) with four factors was used as the configural model for MI testing. The configural models need not necessarily be absolutely same for all groups (Bentler, 2006; Byrne, 2008). The FFM fit indices of CNBST model shows excellent model fit with CFI = 0.913, RSMEA = 0.063, and SRMR = 0.05.

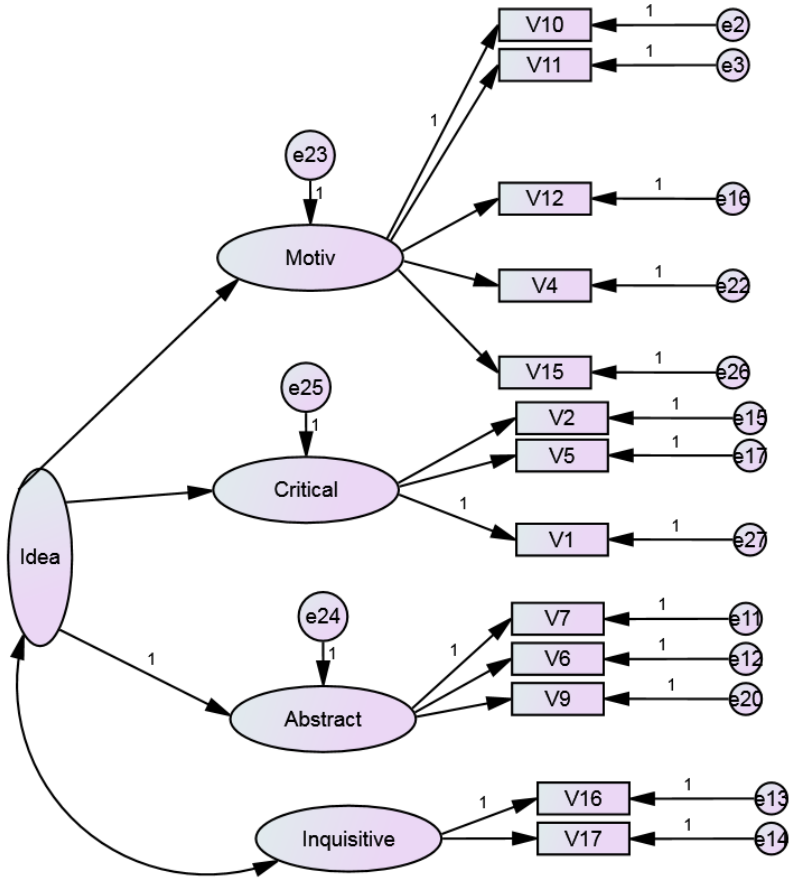

Figure 1. Four-factor model for creativity nurturing behaviour scale for teachers (source: created by authors)

Table 5. Model fit statistics using maximum likelihood estimation: country-wise (source: created by authors)

Country*	Maximum likelihood estimation						
	Satorra–Bentler scaled chi-squared test$_{(df)}$	Root mean square error of approximation (90% configural invariance)	Change in root mean square error of approximation	Comparative fit index	Change in comparative fit index	Standardized root mean square residual	Change in standardized root mean square residual
A	58.72 (70)	0.05		0.96		0.04	
B	199.3 (70)	.08		0.90		0.08	
C	117.6 (70)	.08		0.90		0.07	
D	328.9 (70)	.08		0.93		.03	
E	229.32 (70)	.09		0.90		.06	
F	251.24 (70)	.07		.91		.05	
G	234.22 (70)	.08		.90		.06	
H	173.53 (70)	.08		.90		.08	
I	115.7 (70)	.08		.90		.08	
J	141.8 (70)	.08		.90		.07	
K	162.9 (70)	.08		.90		.08	
L	155.8 (70)	.08		.90		.08	
M	127.4 (70)	.08		.90		.06	
Configural invariance	2316.5 (910)	.028		.921		.030	
Metric invariance	2784.004 (1042)	.029	.001	.915	.006	.058	.028
Scalar invariance	3396.09 (1162)	.031	.002	.909	.006	.061	.003
Measurement covariance	4275.07 (1320)	.029	.002	.902	.007	.062	.001
Residual	6375.41 (1510)	.029	.00	.902	.00	.065	.003

*Note**: The list of the countries can be found in Table 1.

Table 6. Item loadings (source: created by authors)

Items	Estimates			
	1 (n = 208), Ghana	2 (n = 116), India	3 (n = 92), Trinidad and Tobago	4 (n = 476), Turkey
Q1 (abstraction)	.340	.981	.930	.719
Q5 (abstraction)	.354	.486	.749	.770
Q6 (abstraction)	.189	.668	.620	.516
Q7 (abstraction)	.170	.649	.582	.665

Continue of Table 6

Items	Estimates			
	1 (n = 208), Ghana	2 (n = 116), India	3 (n = 92), Trinidad and Tobago	4 (n = 476), Turkey
Q16 (abstraction)	.364	.638	.678	.685
Q3 (inquisitiveness)	.346	.743	.753	.760
Q4 (inquisitiveness)	.301	.778	.762	.759
Q17 (inquisitiveness)	.213	.559	.290	.560
Q10 (motivation)	.522	.658	.819	.775
Q13 (motivation)	.264	.612	.728	.692
Q14 (motivation)	.248	.559	.698	.678
Q2 (critical thinking)	.418	.955	.916	.651
Q8 (critical thinking)	.247	.836	.650	.684
Q9 (critical thinking)	.348	.372	.794	.749
Q15 (critical thinking)	.356	.352	.911	.755
Items	Estimates			
	5 (n = 193), Jordan	6 (n = 421), Iran	7 (n = 223), Russia	8 (n = 85), Greece
Q1 (abstraction)	.633	.640	.322	.886
Q5 (abstraction)	.723	.633	.568	.700
Q6 (abstraction)	.501	.484	.558	.727
Q7 (abstraction)	.421	.495	.616	.809
Q16 (abstraction)	.437	.606	.709	.882
Q3 (inquisitiveness)	.846	.691	.578	.828
Q4 (inquisitiveness)	.752	.438	.594	.856
Q17 (inquisitiveness)	.337	.412	.550	.860
Q10 (motivation)	.698	.558	.364	.857
Q13 (motivation)	.728	.396	.466	.785
Q14 (motivation)	.616	.490	.431	.819
Q2 (critical thinking)	.732	.549	.597	.881
Q8 (critical thinking)	.598	.511	.723	.862
Q9 (critical thinking)	.698	.539	.552	.826
Q15 (critical thinking)	.657	.464	.542	.863

Items	Estimates				
	9 (n = 39), South Korea	10 (n = 24), Portugal	11 (n = 29), Spain	12 (n = 52), France	13 (n = 48), Philippines
Q1 (abstraction)	.893	.934	.885	.761	.914
Q5 (abstraction)	.797	.850	.966	.954	.958
Q6 (abstraction)	.767	.834	.835	.788	.762
Q7 (abstraction)	.853	.940	.941	.953	.943

End of Table 6

Items	Estimates				
	9 (n = 39), South Korea	10 (n = 24), Portugal	11 (n = 29), Spain	12 (n = 52), France	13 (n = 48), Philippines
Q16 (abstraction)	.810	.815	.875	.851	.724
Q3 (inquisitiveness)	.851	.980	.815	.653	.959
Q4 (inquisitiveness)	.889	.828	.898	.980	.304
Q17 (inquisitiveness)	.878	.575	.923	.834	.546
Q10 (motivation)	.834	.915	.777	.839	.952
Q13 (motivation)	.835	.806	.848	.806	.915
Q14 (motivation)	.734	.873	.889	.959	.935
Q2 (critical thinking)	.870	.921	.875	.876	.958
Q8 (critical thinking)	.820	.824	.736	.414	.881
Q9 (critical thinking)	.825	.908	.923	.935	.911
Q15 (critical thinking)	.850	.824	.945	.945	.888

6.3. Latent mean comparisons

6.3.1. Measurement invariance of creativity nurturing behaviour scale for teachers

CNBST exhibits both MTI and SI across thirteen countries implying that CNBST items are understood similarly by teachers irrespective of gender and country.

6.3.1.1. Measurement invariance of creativity nurturing behaviour scale for teachers across country

The thirteen countries separately were found to have CFI, RMSEA, and SRMR values within the acceptable range proving the good model fit. Hence, the MI models were tested for the countries. CI is established with CFI (.921), RMSEA (.03), and SRMR (.058). MTI is established with CFI (0.915), RMSEA (.031), and SRMR (.061). The cutoff value for CFI > 0.9, RMSEA > 0.6, SRMR > 0.6 (Table 7).

The SI is established with CFI (0.909), RMSEA (.031) and SRMR (.0613). CFI, RMSEA, and SRMR values for all the models are in acceptable limit as shown in Table 5. Hence, CNBST is invariant across countries. The obtained values of CFI and RMSEA indicates FFM fit, which fulfills our first objective of this research study that states – "CNBST with four factor structure is found to be statistically invariant across gender and countries" is proved by results of SI, CI, and MTI.

6.3.2. Measurement invariance of creativity nurturing behaviour scale for teachers across gender

The two groups-male and female separately were found to have CFI, RMSEA, and SRMR values within the acceptable range proving the good model fit. Hence, the MI models were tested for the gender. The CI is established with CFI (.913), RMSEA (.063), and SRMR (.0522). MTI is established with CFI (0.912), RMSEA (.061), and SRMR (.0662). The SI is established with CFI (0.909), RMSEA (.064), and SRMR (.0783).

Further, metric, scalar, measurement covariance and residual invariance is established based on the difference of CFI, RMSEA, and SRMR values in the relative models. CFI, RMSEA, and SRMR values for all the models are in acceptable limit as shown in Table 8. CNBST is invariant across genders.

Table 7. Difference statistics for measurement invariance models (source: created by authors)

Model	Satorra–Bentler scaled chi-squared test$_{(df)}$	Root mean square error of approximation (90% configural invariance)	Change in root mean square error of approximation	Comparative fit index	Change in comparative fit index	Standardized root mean square residual	Change in standardized root mean square residual
Gender							
Female	841.5 (70)	.09		.915		.05	
Male	421.2 (70)	.08		.908		.04	
Configural		.063		.913		.0486	
Metric		.061	0.002	.912	.001	.0523	.003
Scalar		.060	0.001	.911	.001	0.0668	.014

Table 8. Fit indices based on gender (source: created by authors)

	Standardized root mean square residual		Chi-statistics: degrees of freedom	Comparative fit index		Root mean square error of approximation	
Unconstrained	.0486						
model 1 (unconstrained/ configural invariance)	.0522		1263.436 (140)	.913		.063 (.060–.067)	
Model 2 (measurement weights/metric invariance)	.0662	.01	1285.901 (151)	.912	.001	.061 (.058–.064)	.002
Model 3 (measurement intercept/scalar invariance)	.0783	.01	1516.186 (166)	.905	.007	.064 (.061–.067)	.003
Model 4 (measurement covariance)	.0658	.01	1529.107 (176)	.905	.00	.062 (.059–.065)	.002
Model 5 (measurement residual/residual invariance)	.0658	.00	1705.350 (205)	.903	.002	.060 (.058–.063)	.002

6.4. Latent mean analysis across gender

Once the MI is established, latent mean comparison was done to calculate the differences of the CNB of teachers based on gender as well as country. For latent mean analysis on basis of gender, the latent mean of the male group was constrained to zero and for the country based latent mean analysis latent mean of "country 2" (India) is constrained to zero. The group whose latent mean is constrained to "zero" is considered reference group. Since male group's latent mean is constrained to zero, the latent mean of the female group shows the difference in the mean values of both the groups (Hong et al., 2003). Estimates of the mean values are provided in Table 11, which shows the significant difference in the latent mean estimates of all the four variables. The latent mean of females are higher than those of males by 0.49, 0.73, 0.46, and 0.51 for abstraction, inquisitiveness, motivation, and critical thinking respectively refer Table 9. Effect size is computed with Cohen's *d* indices (Hong et al., 2003; Jang et al., 2012; Kember & Leung, 2011). But, before computing Cohen's *d* (Table 10), proof of the invariance across the groups is required and after that the SDs of the two groups is used to calculate the Cohen's *d* indices (Hong et al., 2003). Cohen's *d* indices presented in Table 12 indicate that the value of effect size for all the four latent variables is d = 0.5 which indicates medium effect size (Cohen, 1988).

Table 9. Latent mean difference based on gender results of difference comparison (gender) (source: created by authors)

Constructs	Differences of latent mean	Standard error
Abstraction	.498	.044
Inquisitiveness	.739	.058
Motivation	.462	.045
Critical thinking	.517	.040

Table 10. Cohen's *d* for gender (source: created by authors)

Constructs	**Cohen's *d***
Abstraction	0.5
Inquisitiveness	.5
Motivation	.5
Critical thinking	.5

6.5. Difference of latent mean based on country

Latent mean analysis based on country was done by fixing the latent mean of the "country 2" (India) to zero. "Country 2" was regarded as the reference group because the original scale was validated in this country and hence the comparison of latent mean of other countries was done with the "country 2". Estimates of latent mean are provided in Table 11, which shows the significant difference with respect to all the four variables in the sample of country 4, 5, and 6. Cohen's *d* indices are presented in Table 12.

Table 11. Difference of latent mean based on country (source: created by authors)

	Differences of latent mean (standard error)					
Constructs	Country 1	Country 3	Country 4	Country 5	Country 6	Country 7
Abstraction	.172 (.317) Non-significant	1.641 (.712) Non-significant	.660 (.071) Significant	.898 (.191) Significant	.267 (.035) Significant	.685 (.149) Significant
Inquisitiveness	.031 (.050) Non-significant	–.166 (.357) Non-significant	.591 (.070) Significant	.940 (.236) Significant	.351 (.062) Significant	.164 (.042) Significant
Motivation	.064 (.029) Non-significant	.158 (.070) Non-significant	.430 (.046) Significant	.493 (.102) Significant	.241 (.047) Significant	.237 (.113) Non-significant
Critical thinking	.136 (.118) Non-significant	.364 (.140) Non-significant	.400 (.054) Significant	.484 (.102) Significant	.142 (.031) Significant	.451 (.154) Non-significant
	Differences of latent mean (standard error)					
Constructs	Country 8	Country 9	Country 10	Country 11	Country 12	Country 13
Abstraction	–.565 (.661) Non-significant	4.193 (2.455) Non-significant	.428 (.810) Non-significant	6.28 (2.93) Non-significant	–2.148 (1.90) Non-significant	1.935 (.527) Significant
Inquisitiveness	.299 (.165) Non-significant	.726 (.550) Non-significant	4.527 (9.65) Non-significant	2.34 (2.517) Non-significant	.368 (.287) Non-significant	1.643 (.734) Non-significant
Motivation	.233 (.118) Non-significant	.300 (.343) Non-significant	.463 (.291) Non-significant	.089 (.185) Non-significant	.565 (.243) Non-significant	.737 (.195) Significant
Critical thinking	.119 (.160) Non-significant	4.895 (1.148) Non-significant	.174 (.521) Non-significant	.903 (1.272) Non-significant	1.569 (1.876) Non-significant	1.106 (.305) Significant

Table 12. Cohen's *d* for country (source: created by authors)

Cohen's *d*												
Constructs	Country 1	3	4	5	6	7	8	9	10	11	12	13
Abstraction	0.5	.20	.55	.10	.78	.16	.39	.10	.55	.56	.13	.97
Inquisitiveness	.78	.87	.21	.40	1.04	.42	.14	.68	.03	.086	.34	.51
Motivation	.97	.13	.14	.01	1.27	.67	.02	.33	.05	.21	.07	.60
Critical thinking	.54	.35	.43	.08	1.0	.07	.265	.50	.10	.23	.37	.89

Discussion

The current study was set up to examine the psychometric properties along with the measurement invariance of the CNBST (Sharma & Sharma, 2018) across gender and countries in a sample of school teachers.

The following values were obtained: Cronbach's alpha (0.75, 0.70, 0.72, 0.79), composite reliability (0.76, 0.72, 0.701, 0.784) and CI (CFI: 0.913, RMSEA: 0.063, and SRMR: 0.662), MTI (obtained value CFI: 0.912, RMSEA: 0.061, and SRMR: 0.52) and SI (obtained value CFI: 0.909, RMSEA: 0.064 and SRMR: 0.7). This is a first scale for teachers, translated into Hindi, Arabic, Spanish, English, Turkish, and Persian.

The outcome of the study shows that CNBST is a measurement instrument with appropriate psychometric properties and can be administered efficiently; therefore, it is useful for the assessment of CNB of teachers. The levels of internal consistency for TCNB in the current study are approximately same as mentioned in the earlier studies (Sharma & Sharma, 2018; Miroshnik et al., 2019; Sharma et al., 2019). The FFM of the original scale comprising abstraction, inquisitiveness, motivation, and critical thinking exhibited a reasonably good fit to the data and so the factorial structure of CNB, measured by TCNB, could be considered comprising of four correlated factors; however, few studies have also found the one-factor solution as the most parsimonious (Miroshnik et al., 2019). The FFM was found to be invariant across gender and countries. Some other research studies have measured factorial invariance in the population of teachers using different self-report measures like creativity fostering teacher behaviour index (Soh, 2000) but have not examined measurement invariance across gender and country (Cheng, 2019; Soh, 2015; Dikici & Soh, 2015). Hence, this requires the attention of researchers for the future study.

The present study was a cross country CNBST validation study and as such required the selection of "country" as a key variable (Baistow, 2000). Also creativity debates in most scales on the relationship between "gender" and creativity favors men (Ellis, 2022; Hedges & Nowell, 1995; Johnson et al., 2008; He & Wong, 2021). So we carried out the latent mean analysis based on country and gender as the variable of this study. The other equally relevant variable such as culture, educational background of teachers, age, and other social variables may be taken in future studies.

The latent mean analysis (refer the results in Table 11, as above) based on gender reported statistically significant differences. The latent mean difference between four factors of creativity nurturing (*i.e.* motivation, inquisitiveness, abstraction, and critical thinking) indicates females obtained higher scores than males in all the four variables, which could be strengthened by the argument of the earlier researchers who posits that females are higher on teaching effectiveness than males (Sofat, 1977; Luschei, 2012; Marchbanks, 2000). As a function of country, teachers of Trinidad and Tobago (country 3) obtained higher score on inquisitiveness and those from country 8 scored higher on abstraction as compared to the Indian teachers. Teachers of India scored highest on motivation and critical thinking.

The findings support the earlier research which reflects that the CNB differs across nations (Soh, 2015; Maddux et al., 2010). However, the results show the difference in latent mean of the variables across countries, but the sample of few countries show the significant difference with moderate and large effect size and the others does not have significant

difference. One of the objectives of this was to study the measurement invariance and latent mean of CNBST across gender and country which were found to support the robustness of the scale. The variable analysis and the factors affecting the variables would be explored as part of future research.

Limitations

The study findings were analyzed considering some possible limitations.

First, the challenge that translators encounter is the lack of corresponding words in the target language. Every language has some words that are exceptionally difficult to translate. The reason for this is that they may not have equivalent words in other languages, they have multiple meanings, or they describe minute thoughts and sensations.

The CNBST was translated by professional language editors (members of the university in respective countries, and language departments) who have been trained and certified in accredited academic training institutions. After the translation, technical issues were vetted and validated by creativity experts who worked with universities of respective countries (languages). The back translation was done to ensure the best possible version of the translation of the scale. Finally, the scale pilot study was conducted with ten participants in respective countries as another step in ensuring language validity.

Second, the sample size from the different countries is not same, which might make comparison difficult. However, the comparative study to identify the differences across countries with culture as the variable is ongoing. The authors intend to collect more data from these countries.

Third, in this study, information was gathered based solely on self-reports and hence suffers with the drawbacks of the self-report surveys (Rosenman et al., 2011).

Fourth, it is not a longitudinal study and the creativity of the students is not considered to cross-examine and validate the self-report responses of the teachers. The prospective research must further the study of measurement invariance of CNBST across cultures and include the advancements in field of measurements by adapting the computer-based testing.

Conclusions

The present study represents a relevant contribution to the literature on CNB studies for teachers for the simple reason, no other research on CNBST has been carried in thirteen different countries across Eastern, Middle Eastern and Western parts of world (India, Philippines, SK, Iran, Arab, Jordan, Turkey, Greece, France, Russia, Spain, Portugal, Ghana, Trinidad and Tobago) and eight different culture/languages (English, Spanish, Greek, Arabic, Persian, Turkish, Russian, Dutch). Previous studies are done on sample from teachers from single country (in case of CNBST India)/culture. The favorable psychometric properties of scale across makes this scale ideal to measure CNB as it fulfils even the fourth condition laid down for the ideal scale in this area.

This research is the first to compute latent mean analysis to test the gender differences in of teachers between male CNB and female teachers along with the cross-country differences

along with CFA and EFA to address the contradiction in the literature regarding the role of gender in teaching effectiveness. The study concludes that CNBST is invariant for both gender and countries which could facilitate the educationalists to develop relevant curricula for the graduates in education and training programs to equip all the teachers irrespective of gender to be able to foster creativity. Similarly, analyzing the cross-country differences among thirteen different countries could also facilitate developing tools and techniques to imbibe the CNB amongst teachers across countries by identifying the gap that exists in their current behaviour to nurture creativity.

The main findings from the present study suggest that, despite some cross- country variations in teachers CNB among individuals from Western and Eastern societies, all European, Arab, African, Turkish, West Indian and Eastern individuals, the scale is valid and reliable. Hence, this scale can be used for teachers across the globe to measure their CNB and also to mentor, counsel and develop them to nurture creativity of the children.

Future research should expand work of translation of this scale in other parts of the world, not translated yet and MI of CNBST should be validated to establish it for further use as a reliable scale in different part of world not explored in this research, and this could be done across gender, country, age, culture, education, languages, socioeconomic, racial, and ethnic groups of teachers and researchers to generate the confirmatory evidence in this respect. Such a measure can further stimulate cross-cultural studies of teachers' creative behaviour (*e.g.*, Hartley & Plucker, 2014). The latter is of interest because national cultures inherit differences in creativity-related values (Niu, 2019) that can manifest through differences in CNB of teachers across countries (*e.g.*, Niu et al., 2017).

Further it could be used to explore the need of teachers training, and schools to have a model where optimum creativity nurturing environment is maintained by teachers.

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