Psychometric Evaluation of Non Cognitive Skills for Undergraduate Students of Professional Courses

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Abstract

Student success depends on number of cognitive factors but the researches have proved that academics play a little role in student success. In addition to these non cognitive factors are playing the major contribution in making of a successful person in all aspects. In order to assess the individuals on various non cognitive factors plenty of researches have been conducted where one or other skills or combination of some skills have been assessed but a comprehensive measure of assessing non cognitive skills was not developed. So, this research was conducted with an objective to construct and standardize a comprehensive measure for assessing non cognitive skills of UG students of different disciplines and battery of different tests based on the UNESCO's concept.

Key Words: Non Cognitive, Skills, Validation, Standardisation, UNESCO

Introduction

Economists of the times represent different set of attributes that measure the non cognitive skills. Heckman et. al. (2006) predicted the number of skills like perseverance, conscientiousness, self-control, trust, empathy etc. that impact the employment outcomes of young ones apart from their academic skills. National Research Council (2011) recommended that interpersonal and intrapersonal skills along with cognitive skills are essential for success at workplace today and in future. ATC21S, an organization for evaluating and teaching 21st century skills recommended taxonomy of skills for a successful life which includes a set of skills under ways of working and thinking; tools for working and living in the world. Further, WHO (1997) recommended a set of non cognitive skills like thinking skills; social skills; emotional skill that was adopted by NCF (2005) India in CBSE school curriculum under CCE as life skills. UNESCO gave key characteristics for youth development in the form of Interpersonal skills, critical and innovative thinking, global citizenship, and Intrapersonal skills.

On the basis of the construct of non cognitive skills it is clear that non cognitive skill is an canopy term covering a extensive range of skills essential for academic and non academic success in life and to assess these skills different researchers from time to time selected a few of these skills according to the need of their research and developed certain measures to assess these skills. Looking into the literature, investigator explored that Non Cognitive Skills mentioned by UNESCO (2016) covers a broad range of skills set required to meet the challenges of today's' competitive world and so far no any research instrument has been designed to include the assessment of overall skill set as prescribed by UNESCO specifically for youth development. So, as per the need of present work to assess non cognitive skills of undergraduate professional students the researcher finalized the construct of non cognitive skills as recommended by UNESCO (2013). The construct includes four main skills vis-à-vis Critical and Innovative thinking; Intrapersonal skills; Interpersonal skills; Global citizenship with a set of sub skills under each skill. So, investigator constructed a non cognitive skills test containing four likert scales to assess four major skills, and standardized it on a sample of undergraduate students studying in various professional courses.

Scaling of items

Non cognitive skills scale is a combination of four scales based on major skills given by UNESCO. So, each scale in the Scale was developed separately on a five point Likert scale and norms have been developed for each scale separately as well as for the complete scale.

Description of Critical and Innovative Thinking Skills Scale

Critical and innovative thinking is first major skill recommended by UNESCO (2013) covering a set of sub skills namely entrepreneurship, resourcefulness, creativity, reflective thinking, application skills, and reasoned decision making. Investigator constructed a scale including all the dimensions of critical and innovative thinking given by UNESCO. The construction and validation of scale was completed using the following steps:

Item generation and Content Validation

A preliminary pool of 31 items was created including all the sub skills of critical and innovative thinking by taking help from existing literature, by discussing and taking opinion from the research experts. All items were framed in English and were sorted in appropriate item format for its content validation from subject and language experts. After getting reviews from five subject experts and two language experts the scale was subjected to evaluation of content validity of 31 items using Lawshe (1975, p. 567) criteria for calculating Content Validity Ratio (CVR). After estimation of CVR quantitatively, 15 items were retained as such and 4 items were retained with modification 12 item were deleted.

Item Refining

The preliminary draft of the scale was administered using a 5 point Likert scale on a sample of 287 UG students studying in 3^{rd} , 5^{th} , & 7^{th} semester of Engineering, Pharmacy and Business disciplines. Jang & Roussos (2007) suggested that items with mean less than 2 and greater than 4 should be rejected and Jackson(1970) recommended than items with SD<1 should be eliminated. Further to test the normality, skewness should be less than 3 (Distefano, 2006 a, b) and Kurtosis should be less than 8 (Barry and Finney, 2008). Moreover, item-total correlation should be >0.25 (Likert, 1932). Estimating all the descriptive, out of 19 items selected after content validation only 2 items were deleted which were not meeting the criteria up to satisfactory level. So, another draft of 17 items was exposed to item evaluation by means of independent sample t-test.

Item Evaluation

After refining the items, the procedure of item analysis was followed where scores of upper and lower 27% respondents of total sample of 287 was taken. 77 respondents in each group were taken and significance of difference between means of each item was calculated using independent samples of t-test as suggested by Edward and Kilpatrick (1948). After observing t-value, the items with t-value greater than 1.96 at 0.05 level of significance with df 285 were retained (Garret & Woodworth, 2007) indicating average responses of upper and lower criterion groups for each item varies significantly. Thus, out of 17 items finalized 1 item was rejected after item refining and remaining 16 were subjected to EFA.

Exploratory Factor Analysis

To reduce data to smaller set of summary variable and to explore the underlying theoretical structure of the phenomenon by studying the relationship between respondents and variable, EFA was applied on a set of 16 items using SPSS 23.0. Before performing Exploratory Factor Analysis for validation of critical and innovative thinking scale, KMO and Barlett test of sphericity were calculated. The KMO was found to be 0.66 depicting that the sample is adequate for further analysis as the obtained value is greater than the critical value i.e. 0.6 (Tatachnick & Fidell, 1996) and Barlett's test of sphericity was χ^2 =535.39 (p=0.00) indicating that sample is suitable for structure detection. CIT is multidimensional construct as per its operationalization according to UNESCO with six factors as suggested by UNESCO and these factors are correlated to each other therefore, oblique rotation with direct Oblimin method was employed to generate factors with maximum dispersion of loading within factor, Field (2009). Rotation converged in 16 iterations and pattern matrix revealed that 15 items out of 16 converged into 4 factors with factor loading greater than or equal to 0.40 ignoring signs (Hair et al. 2009) except for one item for which loading was <0.40 and hence the item was dropped. So, finally 14 item converged in rotation with 55% of total variance (>50%; Russel, 2000) and factors were renamed on the basis of their original names as given by UNESCO.

The items of entrepreneurship and resourcefulness were merged into same factor and factor was renamed as Entrepreneurial skills and items of application skill and reasoned decision making were overlapped as per their loadings in the matrix, so, the factor was named as Reasoned decision making as application ability is base of decision making ability of an individual. The results of EFA are summarized in the table given below:

Sr. No.	Factor	Variance (%)	Statement	Loading
1	Creativity	36.50	I am able to analyze the problem from multiple perspectives	0.403
			2	0.691
			3	0.434
			4	0.633
2	Entreprene	42.74	I analyze risk perpetuating in any project	0.849
	urial Skills		2	0.404
			3	0.417
3	Reasoned Decision	48.89	I design a clearly stated problem before starting to work on it	0.623
	Making		2	0.421
			3	0.723
4	Reflective Thinking	54.43	Once the problem is solved, I review back to avoid reoccurrence of the same problem	0.744
			2	0.579
			3	0.736
			4	0.556

Table 1: Exploratory Factor Analysis of CIT Scale

Confirmatory Factor Analysis

EFA provided clear information that a total 14 indicator variables are there which are related to 4 latent variables of CIT. Further to confirm these measured variables to their specific latent variables; CFA was applied using AMOS 23.0 to evaluate the measurement model validity of proposed model of CIT after EFA.

Following Brown's recommendations, the following cut-off values were used to indicate model fit:

Table 2: Model Fit Indices for CITS Scale

Measure	CMIN/df	GFI	AGFI	TLI	CFI	RMSEA
Calculated	1.051 (p=0.368)	0.968	0.951	0.984	0.988	0.013
Standardized	<3 (p>0.05)	>0.80	>0.90	>0.90	>0.90	< 0.05

Further, to assess the construct validity its main components i.e. discriminant validity and convergent validity were evaluated. "Convergent validity was indicated by an item factor loading \geq 0.5 and p<0.05 (Hair, Black, Babin& Anderson, 2009), Average Variance Extracted (AVE \geq 0.5) and Composite Reliability (CR \geq 0.7) (Fornell&Larcker, 1981)".

Factor	Label	Statement	Loading	AVE	CR
Creativity	C1	I am able to analyze the problem from multiple perspectives	0.760*	0.50	0.80
	C2	2	0.791*		
	C3	3	0.582*	-	
	C4	4	0.693*	-	
Entrepreneurial	ER1	I analyze risk perpetuating in any project	0.693*	0.57	0.71
Skills	ER2	2	0.687*	-	
	ER3	3	0.698*	-	
Reasoned Decision Making	DM1	I design a clearly stated problem before starting to work on it	0.645*	0.53	0.70
	DM2	2	0.762*	-	
	DM3	3	0.241		
Reflective Thinking	RT1	Once the problem is solved, I review back to avoid reoccurrence of the same problem	0.775*	0.52	0.76
	RT2	2	0.655*		
	RT3	3	0.114	-	
	RT4	4	0.721*	1	

Table 3:	Convergent	Validity	indicating	Factor	Loadings.	AVE.	CR for	CITS	Scale
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Note: * indicates that regression weights of items are significant with p<0.05.

Boldfaced items are dropped

Therefore, based on the results from above table two items labelled as DM3 and RT3 were deleted as these items were having poor factor loadings i.e. 0.241 & 0.114 respectively. So, final scale consists of 12 items distributed in 4 factors with 10 positive and 2 negative items with AVE for all factors > 0.5 and CR for all factors is >0.7. Discriminant validity should be greater than correlation of any pair of latent constructs (Chin, 1998) and \geq 0.50 (Fornell & Larcker, 1981).

Table 4: Discriminant Validity of CITS Scale

Construct	Creativity	Entrepreneurial Skills	Reasoned Decision Making	Reflective Thinking
Creativity	0.70			
Entrepreneurial Skills	0.629	0.75		
Reasoned Decision Making	0.391	0.422	0.73	
Reflective Thinking	0.550	0.187	0.671	0.72

The highlighted values in the table above indicates the square root of AVE and it can be clearly seen that these values are greater than the correlation between different constructs and all values are >0.5 thereby discriminating each construct from the other construct.

Looking into the convergent and discriminant validity tables above it can be interpreted that all the constructs of the scale are able to meet the all-critical values so, the Critical and Innovative Thinking Skills Scale possesses good construct validity on the selected standardization sample.

Reliability Analysis

For the present scale reliability coefficients are given in the table below:

Table 5: Reliability of CITS Scale

Method of Reliability	Coefficient of Reliability	Strength of Internal Consistency
Cronbach α	0.72	High
Split half Reliability (Spearman Brown Prophecy formula)	0.74	High
Greatest Lower Bound to Reliability (GLB)	(0.74, 1)	High

Since the factor loadings of 12 items of the scale vary from 0.40 to 0.74, the present measurement model is congenric and tan-equivalence assumption is violated. So, Cronbach α (0.72) & split half reliability (0.74) together underestimate the true reliability of the scale (Raykov, 1997). These reliability indicators can't be considered as valid as the items are heterogeneous and construct is multidimensional. Therefore, finally Greatest Lower bound (GLB) reliability is reported (Table 3.12) as it is a stable and true measure of reliability (Lila et.al. 2014) which is estimated in confidence interval instead of points like other measures of reliability. The reliability coefficient for greatest lower bound to reliability in case of thinking skills scale came out to be (0.74, 1).

Description of Interpersonal Skills Scale

Interpersonal Skill is another important skill recommended by UNESCO (2013) covering a set of sub skills namely presentation and communication skills, leadership, organizational skills, teamwork, collaboration, initiative, sociability, collegiality. Investigator constructed a scale including all the dimensions of Interpersonal skills given by UNESCO. The construction and validation of scale was completed using the following steps:

Item generation and Content Validation

An initial pool of 31 items was prepared including all the sub skills of interpersonal skills by taking help from existing literature, by discussing and taking opinion from the research experts. All items were framed in English and were sorted in appropriate item format for its content validation from subject and language experts. Again, following the reviews from subject experts and language experts the scale was subjected to evaluation of content validity using criteria like used in CITS scale.

Based on estimation of CVR quantitatively and qualitative suggestions, 8 items were retained as such, 7 items were retained with modification, 16 item were deleted based on ratings done by the expert on each item followed by estimation of CVR. Also, 6 new items were added as per the recommendations of the experts making a total of 22 items after content validation.

Item Refining

Like CITS scale, the same procedure was followed for item refining of Interpersonal Skills. Estimating all the descriptive, out of 22 items selected after content validation all items fulfilled the criteria and hence, no

item was deleted in the process of item refining. So, these 22 items were subjected to item evaluation using independent sample t-test.

Item Evaluation

After refining, the items were analysed in terms of their ability to differentiate upper and lower groups in the skills they possess. Following the same process of item evaluation as in above scale only 1 item was having t-value <1.96 and was rejected. So, 21 items out of 22 were retained and were subjected to EFA.

Exploratory Factor Analysis

To reduce data to smaller set of summary variable and to explore the underlying theoretical structure of the phenomenon by studying the relationship between respondents and variable, EFA was applied on a set of 21 items using SPSS 23.0. The KMO was found to be 0.739 depicting that the sample is adequate for further analysis and Bartlett's test of sphericity was χ^2 =806.04 (p=0.00) indicating that sample is suitable for structure detection. Interpersonal skills is multidimensional construct as per its operationalization according to UNESCO with eight factors as suggested by UNESCO and these factors are correlated to each other therefore, oblique rotation with direct oblimin method was employed to generate factors with maximum dispersion of loading within factor, Field (2009). Rotation converged in 26 iterations and pattern matrix revealed that 20 items out of 21 converged into 6 factors using Monte Carlo Principal Component Analysis with factor loading greater than or equal to 0.40 ignoring signs (Hair et al. 2010) except for one item which was not loaded and hence dropped. So, finally 20 items converged in rotation with approximately 60% of total variance (>50%; Russel, 2000) and factors were renamed on the basis of their original names as given by UNESCO.

The items of presentation & communication skill and leadership were merged into one factor as communication is major component of Leadership skills and renamed as communication and Leadership Skills. The factor named organizational skills was merged into teamwork as per its factor loading. The final results of EFA are summarized in the table given below:

Sr.	Factor	Variance	Statement	Loading
No.		(%)		
1.	Communication & Leadership	29.535	During face to face interaction, I maintain eye contact with other person	0.502
			2	0.646
			3	0.766
			4	0.788
2.	Collegiality	37.769	I tend to provide strong social support to my friends	0.620
			2	0.652
			3	0.516
3.	Teamwork	43.629	I can manage material resources more efficiently than human resources	0.452
			2	0.781
			3	0.751
4.	Initiative	49.359	I can work more efficiently individually than in	0.693

Table 6: Exploratory Factor Analysis of IPS Scale

			groups*	
			2	0.598
			3	0.416
			4	0.445
5.	Sociability	54.791	I can infuse liveliness in a group	0.580
			2	0.707
			3	0.610
6.	Collaboration	59.536	I recognise the contribution of every group member in the group	0.766
			2	0.684
			3	0.739

Confirmatory Factor Analysis

EFA provided clear information that a total of 20 indicator variables are there which are related to 6 latent variables of IPS. Further to confirm these measured variables to their specific latent variables; CFA was applied using AMOS 23.0 to evaluate the measurement model validity of proposed model of IPS after EFA.

Following Brown's recommendations, the results of fit indices are given below in the table:

 Table 7: Model Fit Indices for IPS Scale

Measure	CMIN/df	GFI	AGFI	TLI	CFI	RMSEA
Calculated	1.542 (p=0.000)	0.934	0.905	0.890	0.852	0.044
Standardized	<3	>0.80	>0.90	>0.90	>0.90	< 0.05

Further, the construct validity of the scale was calculated through its main components i.e. convergent validity and discriminant validity.

Table 8:	Convergent	Validity	indicating	Factor	Loadings,	AVE,	CR f	or IPS	Scale
		•							

Factor	Label	Statement	Loading	AVE	CR
Communication & Leadership	CL1	During face to face interaction, I maintain eye contact with other person	0.745*	0.49	0.79
	CL2	2	0.699*		
	CL3	3	0.716*		
	CL4	4	0.644*		
Collegiality	CY1	I tend to provide strong social support to my friends	0.660*	0.50	0. 75
	CY2	2	0.675*		

	CY3	3	0.789*		
Teamwork	TW1	I can manage material resources more efficiently than human resources	0.748*	0.50	0.74
	TW2	2	0.684*		
	TW3	3	0.669*	_	
Initiative	I1	I can work more efficiently individually than in groups*	0.208	0.51	0.76
	I2	2	0.751*	_	
	I3	3	0.757*	_	
	I4	4	0.625*	_	
Sociability	S1	I can infuse liveliness in a group	0.740*	0.50	0.75
	S2	2	0.671*		
	\$3	3	0.714*	_	
Collaboration	C1	I recognise the contribution of every group member in the group	0.747*	0.61	0.76
	C2	2	0. 811*		
	C3	3	0.189		

Note: * indicates that regression weights of items are significant with p<0.05. Boldfaced items are dropped

Therefore, based on the results from above table two items; one from each initiative and collaboration dimension of IPS scale labelled as 11 and C3 were deleted as these items were having poor factor loadings i.e. 0.208 & 0.189 respectively. So, final scale consists of 18 items distributed in 6 factors with 15 positive and 3 negative items with AVE for all factors > 0.5 except for one i.e. communication & Leadership for which it is 0.49 i.e approx. 0.5 and CR for all factors is >0.7.

 Table 9: Discriminant Validity of IPS Scale

Construct	Communication & Leadership	Collegiality	Teamwork	Initiative	Sociability	Collaboration
Communication & Leadership	0.7					
Collegiality	0.661	0.68				
Teamwork	0.046	0.206	0.70			
Initiative	0.265	0.133	0.181	0.71		
Sociability	0.391	0.303	0.128	0.549	0.70	

Collaboration	0.612	0.525	0.296	0.012	0.213	0.71

The highlighted values in the table above indicates the square root of AVE and it can be clearly seen that these values are greater than the correlation between different constructs and also all values of square root of AVE are >0.5 thereby discriminating each construct from the other construct.

Looking into the convergent and discriminant validity tables above it can be interpreted that all the constructs of the scale are able to meet the all critical values so, the Interpresonal Skills Scale possesses good construct validity on the selected standardization sample.

Reliability Analysis

As calculated in case of CITS scale same methods of reliability were used for calculating reliability coefficient of interpersonal skills scale and the reliability coefficients are given in the table below:

Table 10: Reliability of IPS Scale

Method of Reliability	Coefficient of Reliability	Strength of Internal Consistency
Cronbach α	0.778	High
Split half Reliability (Spearman Brown Prophecy formula)	0.783	High
Greatest Lower Bound to Reliability (GLB)	(0.81, 1)	Very High

Reliability Analysis indicates that scale possess good internal consistency. But as the factor loadings of 18 items of the scale vary from 0.625 to 0.811, the present measurement model is congenric and tan-equivalence assumption is violated. So, Cronbach α & split half reliability (Raykov, 1997) together underestimate the true reliability of the scale. These reliability indicators cannot be considered as valid as the items are heterogeneous and construct is multidimensional. Therefore, finally Greatest Lower bound (GLB) reliability is reported (Table 3.24) as it is a stable and true measure of reliability (Lila et.al. 2014) which is estimated in confidence interval instead of points like other measures of reliability. The reliability coefficient for greatest lower bound to reliability in case of interpersonal skills scale came out to be (0.81, 1).

Description of Intrapersonal Skills Scale

The next major skill recommended by UNESCO (2013) is Intrapersonal Skill covering a set of sub skills namely self discipline, enthusiasm, perseverance, Self motivation, compassion, integrity, Commitment. Investigator constructed a scale including all the dimensions of Interpersonal skills given by UNESCO. The construction and validation of scale was completed using the following steps:

Item generation and Content Validation

An initial pool of 24 items was prepared including all the sub skills of intrapersonal skills by taking help from existing literature, by discussing and taking opinion from the research experts. All items were framed in English and are sorted in appropriate item format for its content validation from subject and language experts based on conceptual and grammatical accuracy of items on the same fixed criteria as mentioned in CITS scale.

After getting reviews experts the scale was subjected to evaluation of content validity using Lawshe (1975, p. 567) criteria for calculating Content Validity Ratio (CVR). Based on the qualitative suggestions received and estimation of CVR quantitatively, 6 items were retained as such, 7 items were retained with modification, 11 item were deleted on the basis of ratings done by the expert on each item followed by estimation of CVR. The criterion of retaining items was followed as suggested by Wilson et. al.(2012) where items with CVR < CVR_{critical} (recommended as 1) when no. of experts are 5. Further, 6 new items were added as

per the recommendations of the experts making a total of 19 items after content validation. The CVR for newly added items was not estimated as these were suggested by experts themselves.

Item Refining

Estimating all the descriptive as in CITS scale out of 19 items selected after content validation only one item did not meet the criteria and hence deleted from the second draft and finally 18 items were subjected to item evaluation using independent sample t-test.

Item Evaluation

After refining the items, they were analysed in terms of their ability to differentiate upper and lower groups in the skills they possess. After following the same process of item evaluation as in CITS scale only 1 item was having t-value <1.96 (t=1.409) is rejected. So, 17 items out of 18 were retained and were subjected to EFA.

Exploratory Factor Analysis

To reduce data to smaller set of summary variable and to explore the underlying theoretical structure of the phenomenon by studying the relationship between respondents and variable, EFA was applied on a set of 16 items using SPSS 23.0. The KMO was found to be 0.736 depicting that the sample is adequate for further analysis and Bartlett's test of sphericity was χ^2 =722.09 (p=0.00) indicating that sample is suitable for structure detection. Interpersonal skills is multidimensional construct as per its operationalization according to UNESCO with eight factors as suggested by UNESCO and these factors are correlated to each other therefore, oblique rotation with direct oblimin method was employed to generate factors with maximum dispersion of loading within factor, Field (2009). Rotation converged in 16 iterations and pattern matrix revealed that 15 items out of 17 converged into 3 factors using Monte Carlo Principal Component Analysis with factor loading greater than or equal to 0.40 ignoring signs (Hair et al. 2010). So, finally 15 items converged in rotation with approximately 53% of total variance (>50%; Russel, 2000) and factors were renamed based on their original names as given by UNESCO.

The items of self motivation, compassion, commitment, and perseverance mentioned by were merged into one factor based on their loadings and named as skill of persistence because persistence includes all these skills and their items were overlapping with other otherwise. Items of integrity and compassion were combined as per their loadings and factor was named as compassion as per the nature of items. The results of EFA are summarized in the table given below:

Sr.	Factor	Variance	Statement	Loading
No.		(%)		
1.	Self Discipline	41.113	I set my own standards in order to live a peaceful	0.464
			life	
			2	0.486
			3	0.566
			4	0.542
2.	Persistence	47.177	I tend to lose patience in adverse situations	0.523
			2	0.418
			3	0.618
			4	0.720
			5	0.580
			6	0.447
3.	Compassion	52.567	I am able to listen the inner voice of my heart	0.530
			2	0.618
			3	0.575

Table 11: Exploratory Factor Analysis of IAPS Scale

	4	0.502	
		5	0.405

Confirmatory Factor Analysis

EFA provided clear information that a total of 15 indicator variables are there which are related to 3 latent variables of IAPS. Further to confirm these measured variables to their specific latent variables; CFA was applied using AMOS 23.0 to evaluate the measurement model validity of proposed model of IPS after EFA.

Following Brown's recommendations, results of fit indices is given below in the table:

 Table 12: Model Fit Indices for IAPS Scale

Measure	CMIN/df	GFI	AGFI	TLI	CFI	RMSEA
Calculated	2.736	0.902	0.891	0.915	0.940	0.05
Standardized	<3	>0.80	>0.90	>0.90	>0.90	< 0.05

Further, the construct validity of the scale was assessed through its main components i.e. convergent validity and discriminant validity.

Factor	Label	Statement	Loading	AVE	CR
Self Discipline	Sd1	I set my own standards in order to live a	0.668*	0.80	0.50
		peaceful life			
	Sd2	2	0.686*		
	Sd3	3	0.745*		
	Sd4	4	0.734*		
Persistence	P1	I tend to lose patience in adverse situations	0.723*	0.82	0.50
	P2	2	0.618*		
	P3	3	0.618*		
	P4	4	0.687*		
	P5	5	0.784*		
	P6	6	0.773*		
Compassion	Cp1	I am able to listen the inner voice of my heart	0.614*	0.84	0.51
	Cp2	2	0.720*		
	Cp3	3	0.263		
	Cp4	4	0.805*		
	Cp5	5	0.642*		

Table 13: Convergent Validity indicating Factor Loadings, AVE, CR for IAPS Scale

Note: * indicates that regression weights of items are significant with p < 0.05.

Boldfaced items are dropped

Therefore, looking into the table above one item labelled as Cp3 from compassion sub skill was deleted. Although this item was having significant loading but value was less than 0.4. So, final scale consists of 14 items distributed in 3 factors with 9 positive and 5 negative items with AVE for all factors > 0.5 except for one i.e. communication & Leadership for which it is 0.49 i.e approx. 0.5 and CR for all factors is >0.7.

Discriminant validity of IAPS scale is:

Table 14: Discriminant Validity of IAPS Scale

Construct	Self Discipline	Persistence	Compassion
Self Discipline	0.70		
Persistence	0.511	0.70	
Compassion	0.242	0.642	0.71

The highlighted values in the table above indicates the square root of AVE and it can be clearly seen that these values are greater than the correlation between different constructs and all values of square root of AVE are >0.5 thereby discriminating each construct from the other construct.

Looking into the convergent and discriminant validity tables above it can be interpreted that all the constructs of the scale are able to meet the all-critical values. So, the Intrapersonal Skills Scale possesses good construct validity on the selected standardization sample.

Reliability Analysis

For the present scale reliability coefficients are given in the table below:

Table 15: Reliability of IAPS Scale

Method of Reliability	Coefficient of Reliability	Strength of Internal Consistency
Cronbach α	0.718	High
Split half Reliability (Spearman Brown Prophecy formula)	0.734	High
Greatest Lower Bound to Reliability	(0.70, 1)	High

Reliability Analysis indicates that scale possess good internal consistency. But as the factor loadings of 18 items of the scale vary from 0.614 to 0.805, the present measurement model is congenric and tan-equivalence assumption is violated. So, Cronbach α & split half reliability (Raykov, 1997) together underestimate the true reliability of the scale. These reliability indicators can't be considered as valid as the items are heterogeneous and construct is multidimensional. Therefore, finally Greatest Lower bound (GLB) reliability is reported as it is a stable and true measure of reliability (Lila et.al. 2014) which is estimated in confidence interval instead of points like other measures of reliability. The reliability coefficient for greatest lower bound to reliability in case of intrapersonal skills scale came out to be (0.70, 1)

Description of Skill of Global Citizenship Scale

Another important skill recommended by UNESCO (2013) is skill of global citizenship covering a set of sub skills namely awareness, tolerance, openness, respect for diversity, intercultural understanding, ability to resolve conflicts, civic/political participation, conflict resolution, respect for the environment. Investigator constructed a scale including all the dimensions of Interpersonal skills given by UNESCO. The construction and validation of scale was completed using the following steps:

Item generation and Content Validation

An initial pool of 31 items was prepared including all the sub skills of global citizenship by taking help from existing literature, by discussing and taking opinion from the research experts. All items were framed in

English and are sorted in appropriate item format for its content validation from subject and language expert based on conceptual and grammatical accuracy of items.

After getting reviews from five subject experts and three language experts the scale was subjected to evaluation of content validity using Lawshe (1975, p. 567) criteria for calculating Content Validity Ratio (CVR). Based on the qualitative suggestions received and estimation of CVR quantitatively, 13 items were retained as such, 8 items were retained with modification, 10 items were deleted on the basis of ratings done by the expert on each item followed by estimation of CVR. The CVR for newly added items was not estimated as these were suggested by experts themselves.

Item Refining

Estimating all the descriptive as in CITS scale, out of 26 items selected after content validation all items fulfilled the criteria and hence, no item was deleted in the process of item refining. So, these 26 items were subjected to item evaluation using independent sample t-test.

Item Evaluation

After refining the items, they were analysed in terms of their ability to differentiate upper and lower groups in the skills they possess. After following the same process as in previous scales, only 1 item was found to be having t-value <1.96 (t=0.485) is rejected. So, 25 items out of 26 were retained and were subjected to EFA.

Exploratory Factor Analysis

To reduce data to smaller set of summary variable and to explore the underlying theoretical structure of the phenomenon by studying the relationship between respondents and variable, EFA was applied on a set of 26 items using SPSS 23.0. The KMO was found to be 0.764 and Bartlett's test of sphericity χ^2 =1175.971 (p=0.00) indicating that sample is suitable for structure detection. Interpersonal skills are multidimensional construct as per its operationalization according to UNESCO with eight factors as suggested by UNESCO and these factors are correlated to each other therefore, oblique rotation with direct oblimin method was employed to generate factors with maximum dispersion of loading within factor, Field (2009). Rotation converged in 30 iterations and pattern matrix revealed that all of the 25 converged into 9 factors with overlapping of items in 3 factors, one factor was loaded with only one item and one was loaded with two items, so 5 factors were dropped with 9 items loaded in these factors. Finally, using Monte Carlo Principal Component Analysis 14 items were distributed in 4 factors with factor loading greater than or equal to 0.40 ignoring signs (Hair et al. 2010). So, finally 14 items converged in rotation with approximately 65% of total variance (>50%; Russel, 2000) and factors were renamed based on their original names as given by UNESCO.

Awareness, tolerance, openness, respect for diversity, intercultural understanding, ability to resolve conflicts, civic/political participation, conflict resolution, respect for the environment. The items of awareness and tolerance were overlapped with skill of openness, hence merged and skill was named as openness as per UNESCO nomenclature. Further, conflict resolution and ability to resolve conflicts are same as per their dictionary meanings and are part of intercultural understanding as per review of literature. Also, respect for diversity shares same components as intercultural cultural understanding hence as per factor loadings all these items were merged into one factor and named as intercultural understanding. The results of EFA are summarized in the table given below:

Sr.	Factor	Variance	Statement	Loading
No.		(%)		
1.	Openness	52.39	I cannot change my communication style according	0.799
			to others' cultural background*	
			2	0.606
			3	0.728

Table 16: Exploratory Factor Analysis of GCS Scale

2.	Intercultural	56.68	I am curious enough to attend and celebrate	0.568
	Understanding		festivals of different cultures	
			2	0.458
			3	0.441
			4	0.436
			5	0.609
3.	Respect for	60.59	I tend to explore opportunities for engagement with	0.609
	Environment		community	
			2	0.731
			3	0.493
4.	Civic Political	60.48	I avoid to participate in any event meant for global	0.725
	Participation		cause	
			2	0.702
			3	0.667

Confirmatory Factor Analysis

EFA provided clear information that a total of 14 indicator variables are there which are related to 4 latent variables of GCS. Further to confirm these measured variables to their specific latent variables; CFA was applied using AMOS 23.0 to evaluate the measurement model validity of proposed model of GCS after EFA.

Following Brown's recommendations, the results of fit indices are given below in the table:

Table 17: Model Fit Indices for GCS Scale

Measure	CMIN/df	GFI	AGFI	TLI	CFI	RMSEA
Calculated	1.688	0.921	0.904	0.903	0.937	0.049
Standardized	<3	>0.80	>0.90	>0.90	>0.90	< 0.05

Further, the construct validity of the scale was assessed through its main components i.e. convergent validity and discriminant validity.

Factor	Label	Statement	Loading	AVE	CR
Openness	01	I cannot change my communication style	0.763*	0.65	0.84
		according to others' cultural background*			
	O2	2	0.738*		
	03	3	0.665*		
Intercultural	IU1	I am curious enough to attend and celebrate	0.414*	0.49	0.82
Understanding		festivals of different cultures			
IU2		2	0.647*		
IU3		3	0.669*		
	IU4	4	0.597*		
	IU5	5	0.401*		
Respect for RE1 I tend to explore opportunities for		0.560*	0.56	0.79	
Environment		engagement with community			
RE2		2	0.698*		
	RE3	3	0.711*		
Civic Political	CP1	I avoid to participate in any event meant for	0.491*	0.55	0.78
Participation		global cause			
	CP2	2	0.724*		

Table 18: Convergent Validity indicating Factor Loadings, AVE & CR for GCS Scale

		CP3	3	0.731*			
Mo	Note: * indicates that represent weights of items are significant with $r < 0.05$						

Note: * indicates that regression weights of items are significant with p<0.05. Boldfaced items are dropped

Boldfaced items are dropped

Therefore, based on the results from above table it is clear that all the 14 items finalized after EFA are retained after subjected to CFA. So, final scale consists of 14 items distributed in 4 factors with 9 positive and 5 negatives. All items are having AVE for all factors > 0.5 except for one i.e. intercultural understanding for which it is 0.49 i.e approx. 0.5 and CR for all factors is > 0.7.

Table 19: Discriminant Validity of GCS

Construct	Openness	Intercultural Understanding	Respect for Environment	Civic Political Participation
Openness	0.8			
Intercultural Understanding	0.212	0.7		
Respect for Environment	0.436	0.027	0.75	
Civic Political Participation	0.247	0.543	0.154	0.74

The highlighted values in the table above indicates the square root of AVE and it can be clearly seen that these values are greater than the correlation between different constructs and all values of square root of AVE are >0.5 thereby discriminating each construct from the other construct so, the Global Citizenship Skills Scale possesses good construct validity on the selected standardization sample.

Reliability Analysis

For the present scale reliability coefficients are given in the table below:

Table 20: Reliability of GCS

Method of Reliability	Coefficient of Reliability	Strength of Internal Consistency	
Cronbach α	0.833	Very High	
Split half Reliability	0.742	High	
(Spearman Brown Prophecy formula)			
Greatest Lower Bound to Reliability	(0.81, 1)	Very High	

Reliability analysis indicates that scale possess good internal consistency. But as the factor loadings of 18 items of the scale vary from 0.625 to 0.811, the present measurement model is congenric and tan-equivalence assumption is violated. So, Cronbach α & split half reliability (Raykov, 1997) together underestimate the true reliability of the scale. These reliability indicators can't be considered as valid as the items are heterogeneous

and construct is multidimensional. Therefore, finally Greatest Lower bound (GLB) reliability is reported (Table 3.48) as it is a stable and true measure of reliability (Lila et.al. 2014) which is estimated in confidence interval instead of points like other measures of reliability. The reliability coefficient for greatest lower bound to reliability in case of global citizenship skills scale came out to be (0. 81, 1).

Description of Non Cognitive Skills Scale

Samar (2015) created a psychometrically valid measure of non cognitive academic success factor for undergraduates constituting items related to grit, conscientiousness, openness, self-concept, intrinsic motivation, self efficacy, and resiliency and scores on the scale predicted greater variance in GPA. The study also reported that the individual constructs (mentioned above) combined to form non cognitive academic success factor were also associated to the academic success of students individually. On the similar lines, investigator created a composite measure of Non Cognitive Skills comprising of four different scales measuring four types of non cognitive skills i.e. thinking, interpersonal, intrapersonal and global citizenship skills with total of 58 items in the scale and the analysis of the data has been done by considering each skill individually and composite construct of non cognitive skills as well. The literature also supports that each of the individual constructs taken here are also individually associated with the academic achievement of students. Therefore, the four major skill tests developed can be administered separately as all have been standardized separately with separate norms for each skill test and also the composite scale can be administered as a whole to assess the complete skill set possessed by an individual. This non cognitive skills test can be administered in both individual and group settings. The reliability of the complete test is estimated as below:

Reliability Analysis

For the present scale reliability coefficients are given in the table below:

Method of Reliability	Coefficient of Reliability	Strength of Internal Consistency
Cronbach α	0.776	Good
Split half Reliability (Spearman Brown Prophecy formula)	0.813	Very Good

Table 21: Reliability of NCS Scale

So scale possess good internal consistency.

The Cronbach alpha (α) for Non Cognitive Skills Scale was also established on the total sample of 976 UG students and it came out be high with reliability coefficient.

Conclusion

Non cognitive skills scale is a battery of tests comprising of four different scales measuring different skills among UG students of various disciplines. The scale can be used to measure the skills of students seeking admission in Engineering, Management and pharmaceutical sciences and also students studying in these programs to diagnose their skills. Each of the four tests can be used individually and the battery can be used as a whole. Future researches are recommended on validating the scale on other samples like students of other disciplines and school students as well.

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