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Research Article

Psychometric Properties of Abbott's Creative Self-efficacy Inventory for Iranian Adolescents

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Abstract

Aim: Taking into account the importance of creativity and the effective role of creative self-efficacy (CSE) in it, several attempts have been performed to develop appropriate measures. One of the multi-dimensional tools to assess CSE is Abbott's (2010) creative self-efficacy inventory. The current study is an attempt to investigate factor structure and psychometric properties of Abbott's CSE Inventory (2010) in Persian sample. The other objectives were to examine the differences in CSE regarding age and gender.

Methods: The participants of this study were students in the age range of 13-19 years and also were schooling in 7^{th}-12^{th} grades of West Azerbaijan high schools (N= 400). Abbott's CSE Inventory (2010) and intellect/imagination subscale of five factors personality Mini-IPIP scale were used. CFA was executed using AMOS and the data was analysed by SPSS software.

Results: Reliability coefficients of raters for creative thinking self-efficacy (CTSE) and creative performance self-efficacy (CPSE) were 0.96 and 0.97 respectively ($p<0.01$). In addition, internal consistency of the whole scale, CPSE, and CTSE based on Cronbach's alpha was 0.95, 0.88, and 0.93 respectively. The results showed that two factors were identified by the EFA, with eigenvalues greater than 1. These two factors were retained with 59.529 % of the total variance. The CFA supported construct validity of the CSE Inventory and its multi-factor structure. Also, there was no difference between the genders in terms of CSE, while CSE and age were directly related.

Conclusion: The current research revealed that the structure and psychometric properties of the CSE Inventory for the Iranian sample are adequate.

1. Background

Creative self-efficacy (CSE) is one of the constructs of self-creativity beliefs, (which form one's creative identity) and is affected by a wide range of environmental and social-cognitive factors such as physiological condition, physical environment specifications, prior performance, vicarious experiences, and social persuasion (Karwowski, Lebuda, and Beghetto, 2019). CSE or the individual's belief in their potential capabilities to cope with new situations and demonstrate a creative performance is a form of self-efficacy that has drawn much attention among researchers (Karwowski, 2011). Bandura (1997) has declared about the relationship between self-efficacy and innovation as follows:

"Innovativeness requires an unshakeable sense of efficacy to persist in creative endeavors when they demand prolonged investment of time and effort, progress is discouragingly slow, the outcome is highly uncertain, and creations are socially devalued when they are too incongruent with pre-existing ways" (p. 239).

Abbott's definition of terms also is "CSE refers to an individual's state-like belief in his or her own ability to perform the specific tasks required to produce novel, original, or appropriate solutions" (2010, p. 2). The point is, having CSE is a determinant factor in choosing an innovative approach and feeling confident about one's own knowledge and skills to generate and implement ideas.

Many researches have been conducted on gender differences in terms of creativity, and results have indicated similarities and differences (Baer and Kaufman, 2008; Reilly, Neumann, and Andrews, 2019). As to creative thinking, women outperform men (Baer and Kaufman, 2008) and as to creative performance, men outperform women (Reilly, Neumann, and Andrews, 2019). To explain these superiorities or differences, many have focused on self-efficacy as a key variable. According to gender-based clichés and cultural beliefs, many, including women themselves, have a more negative appraisal of females' creative and innovative performance. Therefore, women tend to believe less strongly in their creative roles. Studies have also shown a higher level of CSE in men (e.g. Hora, Lemoine, Xu, and Shalley, 2021). Such traditional beliefs make women unable to be norm-breaking, assertive, and independent sufficiently to carry out creative action. Furthermore, several studies have examined differences in creativity and its dimensions in terms of age. The findings show that age, experience, knowledge, and neurological development increase one's capability to have creative thinking and performance (Wei and Dzeng, 2013). Therefore, the increase in cognitive capabilities is coincident with an increase in creativity.

Several attempts have been performed to develop appropriate measures to assess. Two general approaches have been followed by researchers. One assumes CSE as a one-dimensional construct and has developed a measure which represents a general index of this concept. In the second approach, CSE is viewed as a multi-faceted and multi-factor construct.

One of the multi-dimensional tools to assess CSE is Abbott's (2010) creative self-efficacy inventory. He highlighted four research mainstreams in the CSE studies field and introduced a multi-dimensional measure by combining them.

According to multi-dimensional model of CSE, the concept contains at least two main dimensions of creative thinking self-efficacy (CTSE), and creative performance self-efficacy (CPSE). CTSE means one's belief in their capability to think creatively, and CPSE refers to one's belief in producing a creative performance (Abbott, 2010).

Abbott (2010) refined the CSE inventory, previously developed and validated by him.. He constructed CTSE using four latent factors depending on Torrance's (2004) work; fluency, Flexibility, elaboration, and originality and constructed the CPSE through three latent factors identified by Csikszentimalyi (1996); domain, field, and personality (Abbott, 2010). Each of these

factors is indicated by four statements. To examine the latent structure of his CSE scale, Abbott conducted a study on a sample of 297 undergraduate students at Midwestern Research University. The proposed scale to measure CSE had adequate psychometric properties, and CTSE and CPSE were related to specific personal traits and to Beghetto's CSE.

To develop an adequate measure for CSE, Abbott (2010) proposed a measurement model based on Bandura's social cognitive theory. It combined the components of Guilford's divergent thought and the components of Csikszentmihalyi's systems model of creativity. Table 1 represents the model.

Table 1. Abbot's suggested measuring model for CSE

CSE COMPONENT	Factor	Description	Items
Creative Thinking Self-Efficacy (CTSE)	Fluency	ability to generate many ideas	4
	Flexibility	ability to generate many types of ideas or ideas from many different perspectives	4
	Elaboration	ability to add information to improve ideas	4
	Originality	quality that generates unique or unusual products, unexpected ideas, or the first of a kind	4
Creative Performance Self-Efficacy (CPSE)	Domain	symbol system that an individual (or group) working in an area uses (includes the tools, rules, conventions, knowledge, norms, and systems of techniques, codes, or symbols that help a person create or discover new things in the domain (Henriksen, Mishra & Fisser (2016).	4
	Field	The social organization, the hierarchy of groups and individuals who deal with and can influence the knowledge system, the specific cultural domain, on a regular basis (McIntyre, 2008)	4
	Person/Individual	Individual people (or groups/teams) produce creative work, ideas, art, or new discovery (Henriksen, Mishra, & Fisser, 2016)	4

Abbott (2010) collected quantitative data from university students using CTSE and CPSE self-reported measures. Then, in the qualitative phase, he interviewed individuals with different CSE levels to more accurately examine the latent structure of the instrument's measurement model. The results of his study showed that the psychometric properties and fit indices of CSE inventory were appropriate and the tool had a positive correlation with similar instruments and the openness to experience. Other studies have confirmed the relationship of openness to experience (and flexibility) with CSE (Abbott 2010). Therefore, this variable can be used to examine convergent validity of CSE.

CSE inventory has been examined psychometrically in a few researches. Alotaibi (2016) investigated psychometric properties of the inventory among outstanding college students in Saudi Arabia. The results revealed a two-factor structure of CSE and acceptable psychometric indices for the inventory. Vally et al. (2019) used CSE Inventory in their pilot study to measure CSE as a dependent variable. They examined internal consistency coefficient using Cronbach's alpha, which was 0.76, a satisfying value.

2. Objectives

An adequate instrument is required for the researchers to assess CSE reliably and statistically valid and to utilize measured data in their different studies. In addition, examining psychometric properties of valid tools in different cultures and languages has a key role in expansion of knowledge and optimization of the tools. The current study, therefore, is an attempt to investigate factor structure and psychometric properties of Abbott's CSE Inventory (2010) in Persian sample.

Regarding those studies that have not used multi-dimensional tools to study gender differences in self-efficacy, one of the present study's objectives was to examine the difference above using Abbott's test to assess CSE.

To the best of our knowledge, there has been no study on differences in CSE and its dimensions in terms of age. Thus, another objective of the study was to examine differences in CSE in different age groups.

3. Methods

3.1. Sample and procedure

The research society of this study was all of the students in the age range of 13-19 years and also were schooling in 7^{th}-12^{th} grades in West Azerbaijan province (including Urmia, Makoo, Oshnavieh, Miandoab and Sardasht) high schools in academic year of 2022-2023, which from them the research sample was selected by multi-stage cluster sampling method (N= 400; girls =52.8%; boys= 47.3%; $mean_{age}$ = 15.02; SD=2.01). Data gathering was done in small 10-member groups by trained psychologists during the students' leisure time. All participants participate in the research voluntarily and consentaneously**.**

3.2. Research Tools

The tools of this research are:

3.2.1. Abbott's CSE Inventory (2010)

The 28-item CSE Inventory was introduced by Abbott (2010) to measure CSE through a 16-item CTSE factor and 12-item CPSE factor, which contain subscales fluency(1-4), flexibility(5-8), elaboration(9-12), originality(13-16) (former factor) and domain(17-20), field(21-24), and person/individual(25-28) (latter factor). A permission was secured via email from the original tool developer Daniel Abbott to utilize it in Persian language. Then the scale was translated into Persian by the first author, which was then translated back into English by another translator. Afterwards, two psychologists examined and matched the Persian and English versions, removed the semantic errors and, eventually confirmed that Persian version of CSE inventory is appropriate to conduct.

3.2.2. Openness to Experience Subscale

To measure this variable 4-item intellect/imagination subscale of five factors personality Mini-IPIP scale (Donnellan, Oswald, Baird, & Lucas, 2006) was used. The Mini-IPIP, a 20-item short form of the 50-item International Personality Item Pool—Five-Factor Model measure (Goldberg, 1999), was developed and validated across five studies by Donnellan, Oswald, Baird, & Lucas (2006).This scale consists of 20 questions that each personality factor of the five-factor model (Extraversion, Agreeableness, Conscientiousness, Neuroticism, and Intellect/Imagination (or Open-ness/ Openness to Experience) is measured by 4 questions using a five-point Likert scale (completely disagree to completely agree). Kheir Joo, Herfeh Doost and Rastgoo (2017) translated and studied this scale in Iran. They reported acceptable psychometric properties and validity (χ^2 =719.69, df=160, CFI=.87, GFI=.88, RMSEA=0.074). In the researches of Donnellan et al (2006), Kheir Joo et al (2017) and current study, Cronbach's alpha of the intellect/imagination or open-ness/ openness to Experience subscale (questions 5-10-15-20) was equal to 0.79, .78 and .77, respectively.

3.3. Ethical consideration

Informed consent was obtained from the participants. There was no obligation to participate in the research. The researchers ensured the participants that the privacy of their' information was completely preserved.

3.4. Data analysis

Before testing the research hypotheses, the normality of the variables and then reliability through inter-rater agreement and internal consistency reliability were examined. To determine the underlying dimensions of the 28-item study inventory exploratory factor analysis was performed. Convergent validity and Confirmatory Factor Analysis (CFA) were used to examine construct validity. Furthermore, to examine the differences in CSE, the factors, and the subscales regarding gender and age, independent t-test and one-way ANOVA were used, respectively. CFA was executed using AMOS and the data was analysed by SPSS software.

4. Results

4.1. Inter-rater Reliability

Inter-rater reliability (IRR) refers to the reproducibility or consistency of decisions between two reviewers and is a necessary component of validity (Cook & Beckman, 2006). To examine inter-rater agreement or inter-rater reliability, two educational psychologists with PhD were recruited. The value of Pearson's R or inter-rater reliability for CTSE and CPSE subscales was 0.96 and 0.97 respectively ($p<0.01$). The both figures indicate adequate and acceptable reliability levels**.**

4.2. Internal Consistency Reliability

To examine internal consistency reliability, Cronbach's alpha was used. All alpha values are in acceptable range (fluency =.96, flexibility=.98, elaboration=.92, originality=.94, CTSE=.883; domain=.95, field=.95, person/individual=.95, CPSE=.95 & CSE= .93). Therefore, the Persian version of CSE Inventory has an acceptable reliability and internal stability.

4.3. Convergent Validity

To examine convergent validity, openness to experience subscale from Mini-IPIP scale (Donnellan et al., 2006) was used. The correlation between openness to experience and CSE (0.61) and the components (0.13-0.82) was positive and significant (Table 3). Hence, correlation coefficients pattern of the components and total score of the inventory with this subscale confirmed a good convergent validity and acceptable construct validity of CSE.

4.4. Internal Consistency of the Test

Internal consistency was examined using Pearson's correlation coefficient matrix (Table 3). As listed, there is a moderate correlation between CPSE and CTSE (0.45), while the correlation between the CPSE and CSE (0.83) and between CTSE and CSE (0.87) is strong. In other words, along with each factor's independence, they are also components of a general factor due to the correlation. In addition, correlation coefficient of CTSE components and this sub-scale (0.56-0.79) and CPSE components and this sub-scale (0.89-0.90) reveal a moderate to strong internal correlation. The correlation between these components and total score of the inventory is also in a desirable range (0.51-0.71). Therefore, the results confirm internal consistency between the components and the subscales with a total inventory score and a weak correlation between the two factors. Therefore, CPSE and CTSE factors measure different dimensions of one construct -i.e., CSE.

4.5. Exploratory factor analysis(EFA)

Sampling adequacy tests were found to be satisfactory for conducting CFA: Kaiser- Meyer-Olkin (KMO) =.909 ; BTS (Chi-Square=13675.078, df=378, P<.001). On this basis, EFA was supported by the data for this study. To determine the underlying dimensions of the 28-item study inventory, the principal component analysis and varimax rotation method was performed as a part of EFA. To define factors, 0.50 was taken as the cutoff point for loadings and eigenvalues retained which were greater than 1. The results showed that 7 interpretable factors were identified by the EFA, with loading exceeding 0.50. As expected, all items loaded uniquely on their related factors. These 7 factors were retained with 88.179 % of the total variance. The first, second, third, fourth, fifth, sixth and seventh factors accounted for 35.090%, 17.538, 11.964, 8.411, 7.421, 5.525 and 2.229 of variances, respectively. The results of the rotated component matrix for the factors were: (factor1, items 25 to 28=.863, .873, .870, 875), (factor2, items 5 to 8=.908, .912, .921, .910), (factor 3, items 1 to 4=.946, .952, .872, .948), (factor 4, items 13 to 16= .888, .906, .898, .906), (factor 5, items 17 to 20= .868, .895, .877, .833), (factor 6, items 9 to 12= .872, .861, .866, .824) and (factor 7, items 21 to 24= .847, .872, .842, .844). Then 28 items were located in seven groups. Since the results were similar to the Abbott's work, the factors extracted in the current study named based on his work: factor 1= Personality, factor 2= Flexibility, factor 3= Fluency, factor 4= Originality, factor 5= Domain, factor 6= Elaboration and factor 7= Field. In order to uncover the structure of the inventory, EFA was conducted for these 7 factors as the previous phase (principal component analysis and varimax rotation method, 0.50 as the cutoff point for loadings and eigenvalues greater than 1). The results showed that two factors were identified by the EFA, with eigenvalues greater than 1. These two factors were retained with 59.529 % of the total variance. The first factor and the second one accounted for 40.043% and 19.486 of variances, respectively. The results of the rotated component matrix for the factors, were: (factor1: Domain = .566, Field = .918, Personality =.911) and (factor2: Fluency =.504, Flexibility =.858, Elaboration =.617, Originality =.718). According to the literature and Abbott's work, factor 1 was named CTSE and factor 2 was named CPSE. Table 2 presents questions and results of this section. In the next part the findings of the investigation of fitness for this two-factor model was reported.

4.6. Confirmatory Factor Analysis (CFA)

To examine the two-dimensional applicability of the study's CSE inventory, a one-factor model and two-factor model for its 28 items were estimated and compared with the use of CFA. The CFA results of CSE Inventory for two-factor model are represented in Fgure 1**.** According to Fgure 1, all standard factor loadings of the items are above 0.50 so that none of the items was removed from the model(P=.000<.001). The results of CFA indicated that the one-factor model did not fit the data of this study (χ^2 =9795.571, df=350, p=0.000, CMIN/ DF=27.987, NFI=.65, CFI=.60, RMR=0.44, RMSEA=0.260). Regarding CFA for two-factor model, value of Chi-square divided by degree of freedom is less than 3 (χ^2 = 848.96, df = 342, p = 0.000, CMIN/DF = 2.48), which places within acceptable fitness scope of the model. Moreover, values of indices NFI and CFI both are higher than 0.90 (NFI = .94, CFI = .963) and the values of SRMR and RMSEA are less than 0.08 (SRMR = 0.064, RMSEA = 0.061). Therefore, all indices of two-factor model fitness are in acceptable range, and the two-factor CSE model has an adequate fitness.

4.7. Differences of CSE in Terms of Gender

Given the normal distribution of the variables, independent t-test as a parametric test was used to compare mean value of CSE, the factors, and the subscales in terms of gender (Table 4).

Table 2. Questions and results of the exploratory factor analysis of the creative self-efficacy scale

Number of the question	Question	Factorial load	Component	Factorial load	Factor
1	Get a large number of different ideas or responses?	.946	Fluency	.504	Creative Thinking Self-Efficacy (CTSE)
2	Come up with many possible solutions to a situation.	.952			
3	Arrive at a variety of conclusions given a difficult situation.	.872			
4	Think of many answers to a difficult problem or situation.	.948			
5	Come up with different kinds of responses, not just different responses?	.908	Flexibility	.558	
6	Answer problems in different ways, each of which are unique and special?	.912			
7	Think of many types of ideas while considering a problem?	.921			
8	Answer problems in different forms or styles?	.910			
9	Think of ways to defend a 'crazy' thought, by thinking back on what you already know?	.872	Elaboration	.617	
10	Talk to your friends about wild ideas, and make them sound reasonable?	.861			
11	Tell stories based on dreams you had, even if you need to fill in answers?	.866			
12	Connect day-dreams or new ideas to things you have already learned?	.824			
13	Be the first in a group to come up with an original suggestion?	.888	Originality	.718	
14	Arrive at a novel solution before other people?	.906			
15	Beat other people in imagining a brand new idea first?	.899			
16	Think of ideas no one else has?	.906			
17	Make sense of something you want to learn to do?	.868	Domain	.566	Creative Performance Self-Efficacy (CPSE)
18	Start to learn to do something, even if there are obstacles to doing so?	.895			
19	Teach yourself how to do something new?	.877			
20	Choose do something that is more important within your culture?	.833			
21	Create a novelty that people will choose, over other novelties available?	.847	Field	.918	
22	Find an audience that is well-connected to others in society?	.875			
23	Network with people to convince them that what you made is the best?	.842			
24	Convince others that you have made a valuable contribution?	.844			
25	Be motivated to come up with new ideas?	.863	Personality	.911	
26	Have fun coming up with new ideas, after having learned from others?	.873			
27	Wake up feeling like you can come up with new ideas if you want to?	.870			
28	Sustain wonder about something, even after working with it for years or decades?	.875			

Taking into account Leven's test p-value (to examine homogeneity of variances) the homogeneity of variances between the two gender groups is confirmed. A comparison between average values in the two groups indicates no significant difference between them in terms of CSE and the elements. The effect-size (Cohen's d-value) for each test is listed in Table 4 and since t-test value is not significant, the effect sizes are very trivial.

4.8. Differences of CSE in Terms of Age Groups

Taking into account the normal distribution of variables, one-way ANOVA was used to examine differences of CSE in terms of age groups.

Table 5 shows the significancy of F-value for CSE and all its elements (except for personality) ($p \leq 0.05$). Therefore, there is a significant difference in CSE in terms of age groups, so that the mean score of CSE increases with age.

Post-Hoc Scheffe' test was conducted on the variables which their means were significantly different between different age groups (Table 6).

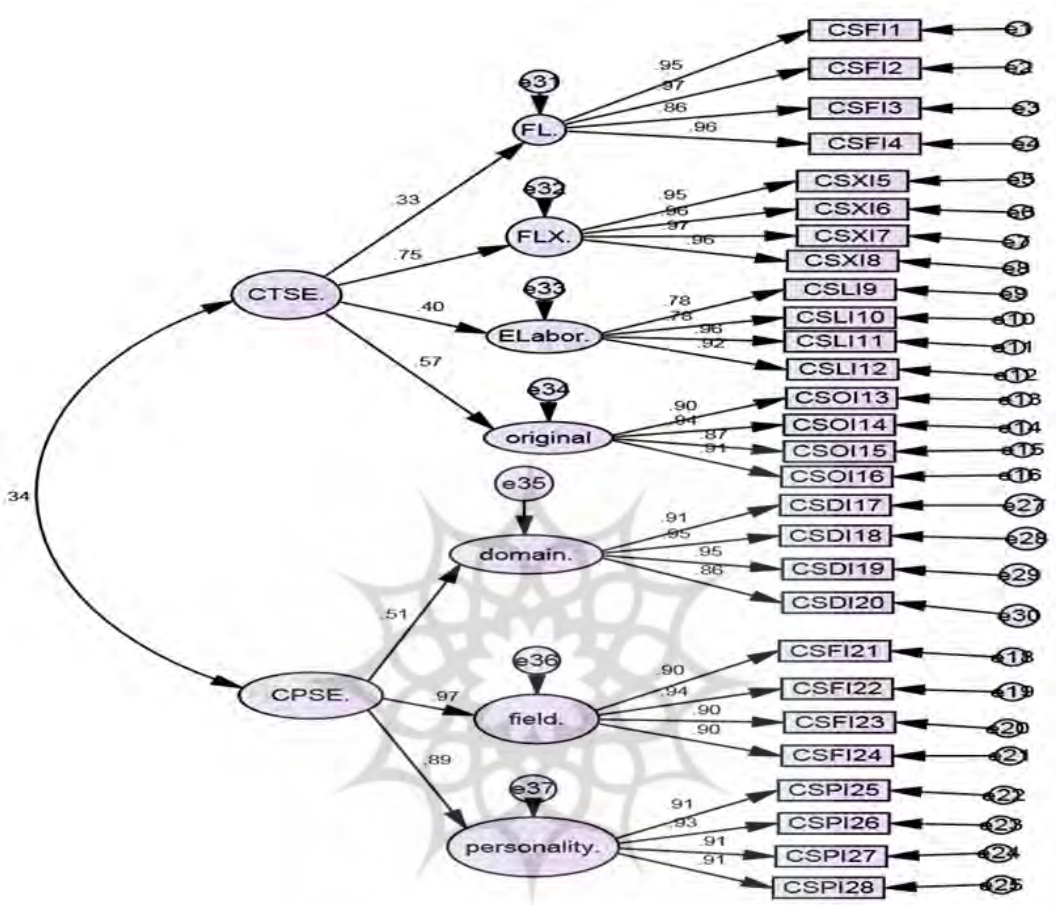

Figure 1. Construct validity of creative self-efficacy with standardized coefficients.

Table 3. Descriptive statistics and intercorrelations for the research variables

		1	2	3	4	5	6	7	8	9	10	11
1	Fluency	1										
2	Flexibility	0.301**	1									
3	Elaboration	0.059	0.258**	1								
4	Originality	0.100*	0.444**	0.154**	1							
5	CTSE	0.587**	0.785**	0.563**	0.638**	1						
6	Domain	0.284**	0.353**	0.312**	0.230**	0.460**	1					
7	Field	0.195**	0.138**	0.438**	0.147**	0.354**	0.469**	1				
8	Personality	0.170**	0.092	0.417**	0.145**	0.317**	0.425**	0.324**	1			
9	CPSE	0.257**	0.233**	0.459**	0.207**	0.448**	0.755**	0.896**	0.885**	1		
10	CSE	0.508**	0.619**	0.604**	0.512**	0.871**	0.702**	0.714**	0.685**	0.83**	1	
11	Opennes to experience	0.207**	0.13**	0.382**	0.148**	0.335**	0.356**	0.658**	0.816**	0.721**	0.606**	1
	M (S_D)	21.09 (5.52)	17.24 (5.5)	16.69 (5.14)	14.93 (4.87)	69.96 (13.58)	15.41 (4.89)	15.45 (4.37)	15.44 (4.9)	46.31 (11.95)	116.27 (21.74)	27.23 (6.92)

Note. CTSE.= Creative Thinking Self-Efficacy; CPSE.= Creative Performance Self-Efficacy; CSE = Creative Self-Efficacy, ** significant at the 0.01 level ; * significant at the 0.05 level

Table 4. Results of two-sample t-test for gender groups.

Variable	Group	Number	Mean	Std.Deviation	Leven's sig	t	df	sig	d	Results
Fluency	Female Male	211 189	21.16 21.005	5.31 5.76	0.127	0.29	398	0.772	0.02	Insignificant difference
Flexibility	Female Male	211 189	17.18 17.3	5.35 5.68	0.289	-0.211	398	0.833	0.014	Insignificant difference
Elaboration	Female Male	211 189	16.56 16.83	5.22 5.07	0.31	-0.507	398	0.612	0.034	Insignificant difference
Originality	Female Male	211 189	14.91 14.96	4.76 5.004	0.392	-0.099	398	0.921	0.009	Insignificant difference
CTSE	Female Male	211 189	69.83 70.1	13.63 13.55	0.68	-0.196	398	0.845	0.019	Insignificant difference
Domain	Female Male	211 189	15.36 15.48	4.68 5.12	0.087	-0.247	398	0.805	0.024	Insignificant difference
Field	Female Male	211 189	15.54 15.35	4.33 4.44	0.512	0.423	398	0.672	0.041	Insignificant difference
Personality	Female Male	211 189	15.57 15.3	4.84 4.98	0.783	0.542	398	0.588	0.054	Insignificant difference
CPSE	Female Male	211 189	46.47 46.14	11.92 12.02	0.969	0.276	398	0.783	0.095	Insignificant difference
CSE	Female Male	211 189	116.208 116.24	21.84 21.69	0.95	0.03	398	0.976	0.004	Insignificant difference

Note. CTSE.= Creative Thinking Self-Efficacy; CPSE.= Creative Performance Self-Efficacy; CSE = Creative Self-Efficacy

Table 5. Results of ANOVA for age groups.

	Group	Number	Mean	Std.Deviation	Leven's sig	F	Sig	Results
Fluency	<=13 14-16 >=17	113 171 116	20.69 20.55 22.26	5.31 5.66 5.38	0.453	3.77	0.024	Significant difference
Flexibility	<=13 14-16 >=17	113 171 116	12.10 16.59 23.19	3.94 3.88 2.36	0.590	287.78	0.00	Significant difference
Elaboration	<=13 14-16 >=17	113 171 116	15.38 16.14 18.76	4.94 4.86 5.17	0.347	14.97	0.00	Significant difference
Originality	<=13 14-16 >=17	113 171 116	12.53 14.35 18.13	3.04 4.25 5.48	0.332	49.71	0.00	Significant difference
CTSE	<=13 14-16 >=17	113 171 116	60.72 67.64 82.37	10.64 10.5 10.91	0.823	124.9	0.00	Significant difference
Domain	<=13 14-16 >=17	113 171 116	13.16 15.80 17.03	4.63 4.49 4.94	0.130	20.67	0.00	Significant difference
Field	<=13 14-16 >=17	113 171 116	15.38 14.88 16.35	3.87 4.03 5.14	0.052	3.94	0.02	Significant difference
Personality	<=13 14-16 >=17	113 171 116	15.31 15.16 15.98	4.77 4.49 5.56	0.089	1.004	0.367	Significant difference
CPSE	<=13 14-16 >=17	113 171 116	43.86 45.86 49.37	11.06 10.79 13.74	0.054	6.44	0.002	Significant difference
CSE	<=13 14-16 >=17	113 171 116	104.59 113.5 131.74	18.21 17.13 22.28	0.064	61.22	0.00	Significant difference

Note. CTSE.= Creative Thinking Self-Efficacy; CPSE.= Creative Performance Self-Efficacy; CSE = Creative Self-Efficacy

Table 6. Results of Scheffé test for age groups.

Variable	i	j	Mean difference(i-j)	Sig	Result
Fluency	<=13	14-16	0.13	0.98	No difference
		>=17	-1.57	0.096	No difference
	14-16	>=17	0.66	0.036	Significant difference
Flexibility	<=13	14-16	-4.48	0.00	Significant difference
		>=17	-11.09	0.00	Significant difference
	14-16	>=17	-6.607	0.00	Significant difference
Elaboration	<=13	14-16	-0.75	0.45	No difference
		>=17	-3.37	0.00	Significant difference
	14-16	>=17	-2.62	0.00	Significant difference
Originality	<=13	14-16	-1.81	0.003	Significant difference
		>=17	-5.59	0.00	Significant difference
	14-16	>=17	-3.78	0.00	Significant difference
CTSE	<=13	14-16	-6.91	0.00	Significant difference
		>=17	-21.64	0.00	Significant difference
	14-16	>=17	-14.72	0.00	Significant difference
Domain	<=13	14-16	-2.63	0.00	Significant difference
		>=17	-3.86	0.00	Significant difference
	14-16	>=17	-1.22	0.093	No difference
Field	<=13	14-16	0.49	0.64	No difference
		>=17	-0.97	0.24	No difference
	14-16	>=17	-1.46	0.021	Significant difference
CPSE	<=13	14-16	-1.99	0.378	No difference
		>=17	-5.5	0.002	Significant difference
	14-16	>=17	-3.505	0.049	Significant difference
CSE	<=13	14-16	-8.91	0.001	Significant difference
		>=17	-27.14	0.00	Significant difference
	14-16	>=17	-18.23	0.00	Significant difference

Note. CTSE.= Creative Thinking Self-Efficacy; CPSE.= Creative Performance Self-Efficacy; CSE = Creative Self-Efficacy

As listed, the mean scores of CSE in age groups <13, 14-16, and 17< were significantly different. In addition, the mean scores of CSE in age groups 14-16 and 17< were significantly different; so that the CSE score in age group 17< was significantly higher than the two other groups. In general, with age, the mean score of almost all variables increased except for fluency, which was higher in 14-16 age group compared to 17< group (sig=0.04, δM=0.66). Therefore, there is a direct relationship between age and CSE.

5. Discussion

Innovation and creativity have been and still are the foundation and centerpiece of all human civilization advances. The concept of creative self-efficacy or CSE is a new construct in this field, which is probably one of the main elements of creative thinking and behavior (Abbott, 2010). Multiple instruments and measures are developed for this construct, and each one has been criticized for being one-dimensional, short or of low reliability and validity. Therefore, researchers in this field should focus on multi-dimensional and comprehensive tools to cover all concept dimensions. Here, a Persian version of CSE Inventory for Iranian sample was investigeted. The results are presented in the following sections.

The findings revealed adequate stability and internal consistency. Therefore, CSE Inventory can be used to measure CSE in Iranian adolescents as a stable and valid tool. Reliability coefficients of raters for creative thinking self-efficacy or CTSE and creative performance self-efficacy or CPSE were 0.96 and 0.97 respectively ($p<0.01$). In addition, internal consistency of the whole scale, CPSE, and CTSE based on Cronbach's alpha was 0.95, 0.88, and 0.93 respectively. In his research

on a group of outstanding native Arab students, Alotaibi (2016) reported adequate reliability and internal consistency for the inventory (α_{total}=0.87, α_{CTSE} = 0.88, α_{CPSE} =0.84).

The reliability of the first and second factors subscales calculated in the range of 0.76 (flexibility) to 0.92(originality) and 0.74 (personality) to 0.87(domain), respectively. According to Abbott (2010), internal consistency and test-retest reliability scores were in acceptable range (rtt=0.73 and α=0.87).

The results showed that 7 interpretable factors were identified by the Exploratory factor analysis(EFA), with loading exceeding 0.50. As expected, all items loaded uniquely on their related factors. These 7 factors were retained with 88.179 % of the total variance. In order to uncover the structure of the inventory, EFA was conducted for these 7 factors as the previous phase. The results showed that two factors were identified by the EFA, with eigenvalues greater than 1. These two factors were retained with 59.529 % of the total variance. The first factor(CTSE) and the second one(CPSE) accounted for 40.043% and 19.486 of variances, respectively. The results of study of Alotaibi (2016) showed that two interpretable factors were identified by the EFA, with loading exceeding 0.40. These two factors were retained with 77.0% of the total variance. The first factor (CTSE) accounted for 43.1%, and the second one (CPSE) accounted for 33.9% of variances.

In parallel with the current study, Abbott (2010) and Alotaibi (2016) through CFA, found the unacceptability of the fitness of one-factor structure and adequacy of fitness of the two-factor structure, including CTSE and CPSE. Thus, creative self-efficacy is a multi-dimensional construct.

Another method to examine construct validity of CSE Inventory was to determine convergent validity by calculating the correlation of CSE Inventory with the subscale openness to experience from Mini-IPIP scale (Donnellan et al., 2006). The results indicated an acceptable correlation between the scores of this subscale with CSE scores and its components ($p<0.001$). The strongest correlation of the subscale was with field, personality, CPSE, and CSE. Here, the correlations between openness to experience and CTSE and CPSE were 0.335 and 0.721, respectively. According to Abbott (2010), openness to experience had correlation with CPSE (r=0.53) and CTSE (r=0.45) at $p<0.001$. To explain the correlation of openness to experience and CSE, the relationship between this personality trait and creativity is notable, which has been supported by several studies (Puryear, Kettler, and Rinn, 2019; Shi, Dail, and Lu, 2016). According to Eysenck's theory of creativity (1997) personal factors in creativity, such as openness to experience, make the context conducive to generating novel idea. Therefore, this trait as a fundamental mechanism determines that to what extent an individual utilizes their own cognitive resources to create new beliefs and opinions (Shi, Dai, and Lu, 2016). For example, an individual with a high level of openness to experience level is more interested in engaging in new experiences. Also, he/she displays characteristics such as adventure and imagination, creativity, and cleverness (Ingram, Boan-Lenzo, and Yuyk, 2013) that leads them to demonstrate more creativity.

In addition, Pearson correlation coefficients was used to examine internal consistency of CSE Inventory. The correlation coefficients were in the 0.51 to 0.87 range. As indicated, the correlation score between the subscales themselves was low, while their correlation with the total score was high; moreover, the correlation of the components with the total score and the corresponding subscale was higher. Therefore, each subscale covers a different dimension of one construct. These findings indicate good psychometric properties of the inventory, which is consistent with similar studies in other cultures and languages (Karwowski, 2011; Sangsuka and Siriparpb, 2015).

Another finding of the study referes to absence of significant difference in CSE, the components, and factors between gender groups. However, some studies have shown that women outperform men in CTSE (e.g. Baer and Kaffman, 2008) and men outperform women

in CPSE (e.g. Reilly, Neumann, and Anderw, 2019). In addition, according to some evidence, in comparison with women, men reported higher levels of CSE (e.g. Hora et al., 2021). Apparently, these differences could be related to different environments and the facilities provided. In other words, environment can be a provoking or a hindering factor of creativity capabilities (e.g. Karwowski, 2011). For example, existence of gender and cultural clichés underestimates women's abilities of generating creative activities in many scientific and athletic fields and then, provide women with fewer opportunities to demonstrate creative activities. Therefore, women's appriasal of their successful creative performance is negative, which degrades their courage to break the boundaries and dictated norms; so that they experience a lower level of SE. Nevertheless, it appears that today women's beliefs and their environment is not creativity deterrent as before. As in recent years, a worldwide increase in the opportunities for women's education and development in top-ranked universities in the world for instance, Oxford University (Bilton, 2018), testifies to that. Furthermore, while at one time, the men in the science-analytic and sports field and the women just in social-communication and visual arts activities evaluated their own CSE at a higher level (Baer and Kaufman, 2008); now it is anticipated that the difference in CSE between the two genders will be decreased or totally eliminated given the outstanding achievements of women in all fields including diverse sport Olympiads (Ripa, 2021). The point is that the recent achievements by women can affect their and society's assessment of women's efficacy in the fields entailing creativity and innovation, particularly there was no difference between men and women as to creative capabilities (Baer and Kaufman, 2008). Women in Iran have also stepped beyond the clichés and restraining thoughts about choosing a field of study or career, so it has been many years that the number of women in different fields of study is higher than men in many universities(Shavarini, 2005). Therefore, along with the decline in gender clichés about activities and achievements, the likelihood of the nonexistence of gender differences in creative abilities perception or CSE increased. In addition, using multi-dimensional scales to measure CSE, which yield more accurate and comprehensive results, could be another explanation for the different findings of the present study from some others.

Moreover, it was revealed that CSE increased with age. While there has been no study specifically on the association between CSE and age, some research indicated that with age, the creative scores of the participants increased (e.g. Wei and Dzeng, 2013). According to Runco (1999) along with growing and gaining more experiences in life, one's creativity changes and fluctuates over time. Neurological studies have also shown that creative activities and thoughts are related to neural activities of definite and different regions of the brain and specific brainwaves (Grabner and Fink, 2016), and at the other hand, the brain regions and its physical and functional structures also grow and change over time (e.g. Blakemore, 2011). Thus, alongside the growing up and development of the physical and functional structure of the brain, conducting creative intellectual and practical activities get improved, which affects one's belief about their'creative capabilities or CSE and boost it.

6. Limitation and Recommendation

The study was not free of limitations. For example, self-reported instruments were used to examine validity of CSE, which creates some concerns. Future works can use other tools to this end such as others and peers' rating to examine validity of this measure. Moreover, experimental environments that enable researchers to manipulate creative problem solving and performance can be employed to examine validity of the tool.

7. Conclusion

In summary, using different methods, the current research revealed that psychometric properties, including internal consistency, reliability, and validity of the CSE Inventory for the Iranian sample, are adequate. Furthermore, the structure of the CSE was multi-dimentional for the Iranian sample too. Therefore, the inventory can be conducted to assess creative self-efficacy and CTSE and CPSE in Iranian native-Persian speaker adolescents in future research. Additionally, in order to fill the gap in the literature, differences of CSE regarding gender and age were examined. According to findings, there was no difference between the genders in terms of CSE, while CSE and age were directly related.

8. Author Contributions

Author 1. presenting the research concept, designing the study procedures, analyzing and interpreting the research data, writing and reviewing the paper, confirming the final draft, being accountable for all aspects of research. Author 2, writing and reviewing the paper, analyzing and interpreting the research data; Collecting the research data. All authors discussed the results, reviewed and approved the final version of the manuscript.

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10. Conflicts of Interest

The authors declare no conflict of interests.

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