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Development and Validity Testing of a Chinese-Language Version of FourSight

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Abstract

The purpose of the current study was twofold: its first objective was to evaluate 151 Taiwanese high school students' creative process preferences using FourSight and its second, to assess the reliability and validity of FourSight's Chinese-language version. The results show that the highest proportion of our participants were high-Clarifiers (51%) and the lowest proportion, high-Ideators (28%), with high-Developers (32%) and high-Implementers (40%) occupying middle positions relative to the other two types. Our respondents may be influenced by the country's standardized-test-based educational system. Based on a series of factor analysis, our final 18-item Chinese-language version of FourSight with a five-factor construct was a reliable and valid measure, against the original 36-item English version with a four-factor construct. This discrepancy may have resulted from translation issues or cultural ones, or both. It is possible that the idea of CPS was itself quite new for our Taiwanese respondents.

Keywords: Creative problem solving, FourSight, Assessment, Taiwanese students

1. Introduction

Asubstantial number of empirical studies have included creative problem solving (CPS) as a component of creative thought (e.g., Byrne, Shipman, & Mumford, 2010; Eubanks, Murphy, & Mumford, 2010; Mumford et al., 2012). The scholars engaged in such research believe that CPS consists of a two-part cycle of processing skills:(a) the early-cycle creative thinking skills, including problem definition, information gathering, concept selection, and conceptual combination; and (b) the late-cycle processing skills, comprising idea generation, idea evaluation, implementation planning, and solution monitoring. This hypothesis suggests that

CPS involves knowledge structures and processing operations that are different from those involved in idea generation. In addition, the same research cited above found that the quality and originality of CPS performance can be boosted via proper training. Based on these findings, it can be said that mental models, intelligence, divergent thinking, and expertise play important roles in individuals' CPS performance.

Puccio (2002) developed an instrument for identifying individuals' creative-process preferences related to the CPS model, and proposed that unique mental activities related to each of the CPS steps. *FourSight*, initially called the *Buffalo Creative Process Inventory*, uses statements that describe the activities associated with the CPS process, and asks people to provide direct responses regarding the mental activities that are involved in these activities.

FourSight is an evolving measure and the current version, FourSight 6.1 (Puccio, 2002), involves 36 statements grouped into four preferences, with nine items for each Puccio's four preference dimensions are labeled *Clarifier* (arising from a respondent's preference for data-finding and problem-finding statements); *Ideator* (mess-finding and idea-finding items); *Developer* (statements related to solution-finding and the planning aspect of acceptance-finding); and *Implementer* (the taking-action aspect of acceptance-finding). Each statement is responded to via a 10-pointLikert-type scale, ranging from 1 ("not like me at all") to 10 ("very much like me"). Puccio reported Cronbach's alpha coefficients for FourSight as follows: Clarifier = .78; Ideator = .81; Developer = .79; and Implementer = .81.

With regards to validity, Puccio (2002) compared FourSight to four other measures: the Kirton Adaption Innovation Inventory (KAI; Kirton, 1976); the Creative Problem Solving Profile Inventory (CPSP; Basadur, Graen, & Wakabayashi, 1990); the Myers-Briggs Type Indicator (MBTI; Myers & McCaulley, 1985); and the Adjective Check List (ACL; Gough & Helburn, 1983). He found that FourSight was not biased towards one of Kirton's creativity styles. Innovators seemed to be related to ideation, while adaptors appeared to be drawn to clarification and the refinement of solutions. Correlation coefficients between FourSight and MBTI further indicated that Puccio's Ideator type had a significantly positive correlation with Myers and McCaulley's Sensing-Intuition dimension (r = .68) and their Judging-Perceiving dimension (r = .33). Puccio's Clarifier and Developer profiles were both significantly negatively correlated with Myers and McCaulley's Judging-Perceiving dimension (r = -.52 and r = -.54, respectively).

Correlations between FourSight and the CPSP showed that Puccio's Ideator type was significantly positively correlated with Basadur et al.'s Generator type (r = .37). However, Puccio's Implementer had a significantly negative correlation with the CPSP's Optimizer (r = -.40), and his Ideator was significantly negatively correlated with the CPSP's Implement or (r = -.46). Finally, all four FourSight preferences were related to high levels of creative ability, as measured by the ACL. Taken together, these findings provide strong evidence of FourSight's validity.

Puccio, Wheeler, and Cassandro (2004) used FourSight to evaluate participants' reactions to the various elements of CPS training; specifically, to find out the extent to which people's cognitive-style preferences were related to such CPS training. The results of regression analysis revealed that individuals with different process profiles had the opposite reactions to the same aspect of CPS. For example, high Clarifiers enjoyed the gathering-data stage of CPS, but did not enjoy its plan-for-action step, while high Ideators had stronger preferences for the prepare-for-action step.

2. Purpose

The purpose of the current study was to extend the above-described line of research in two ways. Its first objective was to evaluate Taiwanese high school students' creative process preferences using FourSight and its second, to assess the reliability and validity of FourSight's Chinese-language version.

3. Research Questions

Guided by the purpose of the study, two research questions were asked:

1) What are the FourSight CPS profiles of our Taiwanese sample?

2) Is the Chinese version of FourSight a reliable and valid measure?

4. Methods

4.1 Participants

Our sample comprised 61 male and 90 female Taiwanese students, of whom 114 were in their second-year of high school and 37 their third-year. Their average age was 16.3 years (*SD* = .47).

4.2 Measure and Procedure

FourSight 6.1 (Puccio, 2002) was used to the current study. A sample statement for the Clarifier style was "I like taking the time to clarify the exact nature of the problem." One of the Ideator statements was "I enjoy coming up with unique ways of looking at a problem." A sample Developer statement was "I like to break a broad problem apart to examine it from all angles", and an Implementer one was "I enjoy taking the necessary steps to put one of my ideas into action." Unlike the 10-point Likert-type scale used in the original version of FourSight, the scoring of the 6.1 version was on a 5-point scale ranging from 1 "completely disagree" to 5 "completely agree".

The Chinese version of FourSight 6.1 was translated by the researcher into Traditional Chinese (Mandarin). Then, two high school teachers were invited to check the translation to confirm that its content fit into the study's context. Based on their feedback, the researcher created revised revisions of both instruments–i.e., Mandarin and English–and presented them to an independent translator for back-translation. Following comparison of the back-translated version against the original English version, several further changes of wording were made, and the Mandarin version presented for re-review to the same two high school teachers. The finalized Mandarin version of FourSight6.1 was then administered to all the participants, and took them approximately 10 minutes to complete. All participation was on a voluntary basis, and all respondents were informed of the purpose of the research.

5. Results

5.1 Descriptive Analysis

Means and standard deviations are shown in Table 1. The highest mean was 3.70 (*SD* = .89), for item 17: "When working on a problem I like to come up with the best way of stating it." The lowest was 2.74 (*SD* = 1.02), for item 33:"My natural tendency is not to generate lots and lots of ideas for problems." The majority of items (86.1%) had means of 3 or above, and only five (items 7, 11, 14, 33, and 35) has means lower than 3. As far as the four CPS styles were concerned, Developer had a mean of 3.32 (*SD* = .46); Clarifier, a mean of 3.42 (*SD* = .43); Ideator, 3.34 (*SD* = .44); and Implementer, 3.37 (*SD* = .46).

Table 1. Means and standard deviations for scores on FourSight (N = 151)

Item	*M*	*SD*
1. I like testing and then revising my ideas before coming up with the final solution or product.	3.62	.81
2. I like taking the time to clarify the exact nature of the problem.	3.62	.83
3. I enjoy taking the necessary steps to put one of my ideas into action.	3.65	.79
4. I like to break a broad problem apart to examine it from all angles.	3.32	.88
5. I find it difficult to come up with unusual ideas for solving a problem.	3.07	1.02
6. I like identifying the most relevant facts pertaining to a problem.	3.58	.79
7. I find I don't have the temperament to sit back and try to isolate specific causes of a problem.	2.84	1.08
8. I enjoy coming up with unique ways of looking at a problem.	3.40	.85
9. I like to generate all the pluses and minuses of a potential solution.	3.18	.96
10. Before implementing a solution to a problem I like to break it down into steps.	3.19	.98
11. Transforming ideas into action is not the part of the creative process that I enjoy most.	2.77	.92
12. I like to generate criteria that can be used to identify the best option(s).	3.56	.80
13. I enjoy spending time looking beyond the initial view of the problem.	3.30	.94
14. I find I don't naturally spend much time focusing on defining the exact problem to be solved.	2.91	1.03
15. I like to take in a situation by looking at the big picture.	3.59	.85

16. I enjoy working on ill-defined, novel problems.	3.44	1.00
17. When working on a problem I like to come up with the best way of stating it.	3.70	.89
18. I enjoy making things happen.	3.32	.96
19. I like to focus on creating a precisely stated problem.	3.57	.91
20. I enjoy stretching my imagination to produce many ideas.	3.64	.90
21. I like to focus on the key information within a challenging situation.	3.60	.83
22. I enjoy taking the time to perfect an idea.	3.54	.91
23. When it comes to implementing my ideas I find it difficult to bring them to fruition.	3.34	.87
24. I enjoy turning rough ideas into concrete solutions.	3.36	.89
25. I like to think about all the things I need to do to implement an idea.	3.40	.93
26. I really enjoy implementing an idea.	3.54	.90
27. Before moving forward I like to have a clear statement of the problem.	3.53	.85
28. I like to work with unique ideas.	3.57	.96
29. I enjoy putting my ideas into action.	3.46	.88
30. I like to explore the strengths and weaknesses of a potential solution.	3.48	.83
31. I enjoy gathering information so that I can identify the root causes of aparticular problem.	3.40	.84
32. I enjoy the type of analysis and effort it takes to transform a rough concept intoa workable idea.	3.24	.86
33. My natural tendency is not to generate lots and lots of ideas for problems.	2.74	1.02
34. I enjoy using metaphors and analogies to come up with new ideas for problems.	3.34	.86
35. I find that I have little patience for the effort it takes to refine or polish an idea.	2.79	1.07
36.I tend to look for a quick solution and then fly with it.	3.50	.92
Developer	3.32	.46
Clarifier	3.42	.43
Ideator	3.34	.44
Implementer	3.37	.46

5.2 Internal Consistency Reliability

Internal consistency reliability testing resulted in a Cronbach's alpha of .862 for the Mandarin version of FourSight as a whole. Thee Cronbach's alphas for each of the four dimensions, however, were .640 for Developer, .569 for Clarifier, .550 for Ideator, and .652 for Implementer. In order to attain the minimum Cronbach's alpha level of .70 in each of these categories, seven items (#5, 7, 11, 14, 23, 33, and 35) were rejected based on item-total statistics. After these items were dropped, Cronbach's alpha was rechecked for the remaining 29 items. This resulted in a revised overall α of .924, with Developer at .782, Clarifier at .805, Ideator at .739, and Implementer at .784, indicating good internal consistency among the remaining 29 items, which were therefore retained for further analysis.

5.3 Exploratory Factor Analysis (EFA)

A varimax-rotated component analysis factor matrix was applied, and the results of which are presented in Table 2. A Kaiser-Meyer-Olkin measure of sampling adequacy (.873) and a Bartlett test of sphericity ($p < .001$) both indicated the appropriateness of the factor analysis. When we applied the latent root criterion of retaining factors with eigen values greater than 1.0, eight factors were retained, the sums of whose squares were 9.41, 2.01, 1.56, 1.30, 1.22, 1.13, 1.07, and 1.00. The percentages of variance explained by the eight factors were 12.36%, 8.99%, 8.36%, 8.29%, 7.85%, 7.19%, 6.96%, and 4.44%, respectively, and the total variance extracted by the eight-factor solution was 64.44%. As recommended by Hair, Black, Babin, and Anderson (2010, p. 117), in light of our sample size of 151, factor loadings of .45 and above were considered significant for interpretative purposes. In the rotated solution, each of the variables had a significant loading (defined as a loading above .40) on only one factor, with the exception of item 21, which cross-loaded on two factors (1 and 7). In addition, the factor loadings on two items were less than .45, with the highest factor loading for item 4 being .432 and for item 17, .423. Lastly, items 1 and 15 had communalities of less than .50, and could therefore be considered as having insufficient explanatory value for the variables that are adequately accounted for by the factor solution. To deal with these three issues (i.e., nonsignificant loadings, cross-loadings, and unacceptable communalities), we decided to begin by deleting items 1 and 15 and then re-run the factor analysis.

Table 2. Factor loadings for the varimax orthogonal eight-factor solution for the 29-item second version of the Mandarin FourSight 6.1

	Factor loadings								
Item	1	2	3	4	5	6	7	8	h^2
1	.108	.201	.194	.226	.110	.103	**.552**	.120	.482
2	**.573**	.052	.139	.108	.038	.351	.314	-.068	.590
3	.079	.246	.174	**.662**	.064	-.011	.158	.268	.637
4	**.432**	.293	-.102	.318	.143	.213	-.005	-.422	.627

6	.260	**.459**	.289	-.010	.140	.071	.442	-.241	.639
8	.055	**.593**	.283	.085	.413	-.003	.124	-.157	.652
9	.189	**.747**	.028	.168	.228	.061	.035	.131	.697
10	.154	**.640**	.099	.282	-.026	.164	.334	.135	.681
12	**.530**	.427	.123	-.033	-.191	.223	.170	.020	.594
13	**.727**	.194	.108	-.030	.104	.044	.152	-.034	.616
15	**.484**	.079	-.050	.291	.100	.246	.199	-.097	.422
16	**.518**	.014	.213	.402	.288	-.075	-.207	.078	.613
17	.338	.265	.192	**.423**	.063	.040	.305	.100	.509
18	**.559**	-.038	.338	.163	.040	-.090	.400	.294	.711
19	.058	.034	.072	.216	.060	**.765**	.316	.096	.754
20	.105	.117	.016	.148	**.717**	.107	.260	.142	.660
21	.449	.179	-.001	.045	.200	.186	**.601**	-.162	.698
22	.120	.026	.360	.156	**.555**	.116	.375	.054	.635
24	-.044	.102	.288	**.593**	.176	.187	.325	-.182	.652
25	.309	.127	**.670**	.369	.047	.118	.022	-.180	.746
26	.098	.075	**.631**	.138	.334	.088	.307	.276	.722
27	.317	.268	.413	-.030	.172	**.516**	-.074	.178	.676
28	.118	.210	.181	.053	**.802**	.120	-.090	.070	.764
29	.059	.189	**.757**	.213	.137	.191	.141	.008	.733
30	**.606**	.200	.095	.301	.120	.218	.018	.026	.570
31	.294	.122	.164	.108	.162	**.753**	-.017	-.047	.735
32	.284	-.022	.175	**.665**	.116	.286	-.001	.040	.651
34	.441	**.501**	.139	-.043	.129	.107	.020	.304	.588
36	-.005	.223	-.013	.188	.278	.129	.002	**.674**	.633
									Total
Eigen value	9.41	2.01	1.56	1.30	1.22	1.13	1.07	1.00	18.7
% of variance	12.36	8.99	8.36	8.29	7.85	7.19	6.96	4.44	64.44

Note. **Boldface** indicates highest factor loadings. h^2 = communality.

Table 3 presents the second-run factor analysis with varimax rotation resulting in the seven-factor model, which accounts for 63.08% of variance. All communalities were over .50; however, items 9, 10, 32, 34 were now found to have substantial cross-loadings. We decided to delete these four items and re-run factor analysis again. The results showed that issues of cross-loadings and unacceptable communalities were still present. Therefore, these problematic items were deleted, resulting in our varimax-rotated five-factor solution, which is shown in Table 4. For this model, which has 18 items, no cross-loadings were found; each variable attained significant loadings; and all communalities were over .50. Factor one consists of five items (# 3, 24, 25, 26, and 29); factor two of five items (#2, 6, 12, 13, and 21); factor three, of four items (# 8, 20, 22, and 28); factor four, of three items (#19, 27, and 31); and factor five, of a single item (#16). This five-factor model accounts for 62.74% of the total variance. A factor with fewer than three items is generally weak and unstable and in Puccio's (2002) study he used Quartimax; as a result, we decided to delete the item #16 and use quartimax-rotated factor solution to rerun factor analysis. Table 5 shows the final 17-item version of the FourSight. Figure 1 shows that four-factor model was appropriate, which accounts for 59.146% of the total variance. Factor one consists of five items (# 3, 24, 25, 26, and 29); factor two of four items (#2, 6, 12, 13, and 21); factor three, of four items (# 8, 20, 22, and 28); factor four, of three items (#19, 27, and 31).

Table 3. Factor loadings for the varimax orthogonal seven-factor solution for the 27-item third version of the Mandarin FourSight 6.1

	Factor loadings							
Item	1	2	3	4	5	6	7	h^2
2	**.504**	.023	.067	.406	.232	.296	-.074	.570
3	.072	.062	**.640**	.008	.192	.223	.372	.644
4	**.469**	.172	.273	.196	-.281	.381	-.167	.614
6	**.648**	.314	.235	.070	.170	-.060	-.093	.619
8	.393	**.603**	.264	-.055	.046	-.059	.127	.613
9	**.481**	.365	.247	-.002	-.146	.070	**.479**	.681
10	**.537**	.114	**.456**	.123	.041	-.082	.394	.687
12	**.685**	-.105	.033	.213	.098	.122	.184	.585
13	**.633**	.081	-.094	.089	.201	.384	.026	.612
16	.103	.212	.135	-.011	.149	**.741**	.110	.657
17	.384	.082	**.445**	.071	.250	.227	.190	.508
18	.371	-.020	.098	.003	**.643**	.291	.156	.669

19	.140	.054	.279	**.781**	.118	-.079	.099	.741
20	.079	**.662**	.112	.141	.137	.112	.167	.536
21	**.635**	.208	.159	.222	.192	.024	-.130	.575
22	.116	**.570**	.204	.180	.418	.104	-.013	.598
24	.079	.240	**.696**	.211	.180	.093	-.116	.648
25	.253	.152	.428	.157	.443	.320	-.117	.607
26	.094	.388	.234	.150	**.682**	.016	.188	.737
27	.272	.253	-.041	**.523**	.248	.188	.268	.583
28	.027	**.802**	-.014	.133	.072	.240	.175	.755
29	.155	.285	.380	.220	**.554**	.023	.036	.607
30	.425	.091	.152	.255	.070	**.539**	.135	.591
31	.240	.182	.076	**.765**	.004	.226	.039	.734
32	.017	.060	**.488**	.340	.104	**.546**	.075	.672
34	**.493**	.193	-.070	.095	.123	.194	**.481**	.579
36	-.096	.214	.082	.134	.135	.064	**.711**	.607
								Total
Eigen value	8.90	1.94	1.55	1.25	1.21	1.12	1.07	17.04
% of variance	14.26	9.89	8.98	8.23	7.90	7.65	6.19	63.08

Note. **Boldface** indicates factor loadings> .45. h^2 = communality.

Table 4. Factor loadings for the varimax orthogonal five-factor solution for the 18-item fourth version of the Mandarin FourSight 6.1

	Factor loadings					
Item	1	2	3	4	5	h^2
2	.167	**.598**	.038	.398	.153	.569
3	**.659**	.058	.083	.067	.221	.498
6	.282	**.667**	.279	.022	-.119	.618
8	.319	.315	**.555**	-.080	-.005	.515
12	.096	**.669**	-.080	.233	.227	.569
13	.069	**.703**	.109	.085	.346	.638

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16	.220	.152	.211	.079	**.767**	.710
19	.235	.115	.114	**.820**	-.162	.779
20	.139	.087	**.732**	.178	.075	.600
21	.133	**.724**	.281	.187	-.206	.698
22	.400	.195	**.605**	.138	-.044	.585
24	**.678**	.105	.173	.208	-.121	.559
25	**.663**	.324	.044	.138	.297	.654
26	**.633**	.125	.422	.128	.012	.611
27	.209	.241	.242	**.540**	.280	.530
28	.071	-.013	**.812**	.183	.324	.803
29	**.735**	.147	.210	.185	.099	.651
31	.131	.261	.135	**.759**	.169	.709
						Total
Eigen value	6.30	1.68	1.17	1.13	1.03	11.31
% of variance	15.92	15.18	13.56	11.17	6.92	62.74

Note. **Boldface** indicates factor loadings> .45. h^2 = communality.

Table 5. Factor loadings for the quartimax orthogonal four-factor solution for the 17-item fifth (final) version of the Mandarin FourSight 6.1

Factor loadings					
Item	1	2	3	4	h^2
2	.205	**.645**	.015	.335	.570
3	**.679**	.081	.033	.041	.470
6	.303	**.645**	.212	-.082	.560
8	.364	.317	**.510**	-.152	.516
12	.119	**.709**	-.097	.177	.558
13	.108	**.752**	.095	.034	.587
19	.281	.162	.094	**.769**	.705
20	.218	.134	**.719**	.139	.602
21	.160	**.704**	.218	.079	.574

22	.457	.209	**.554**	.068	.565
24	**.693**	.090	.093	.145	.517
25	**.688**	.360	-.010	.089	.611
26	**.674**	.138	.362	.062	.608
27	.277	.333	.247	**.508**	.507
28	.169	.073	**.823**	.176	.742
29	**.767**	.171	.152	.124	.656
31	.195	.349	.135	**.727**	.707
					Total
Eigen value	6.090	1.674	1.163	1.127	10.054
% of variance	19.132	17.735	12.497	9.783	59.146

Note. **Boldface** indicates factor loadings> .45. h^2 = communality.

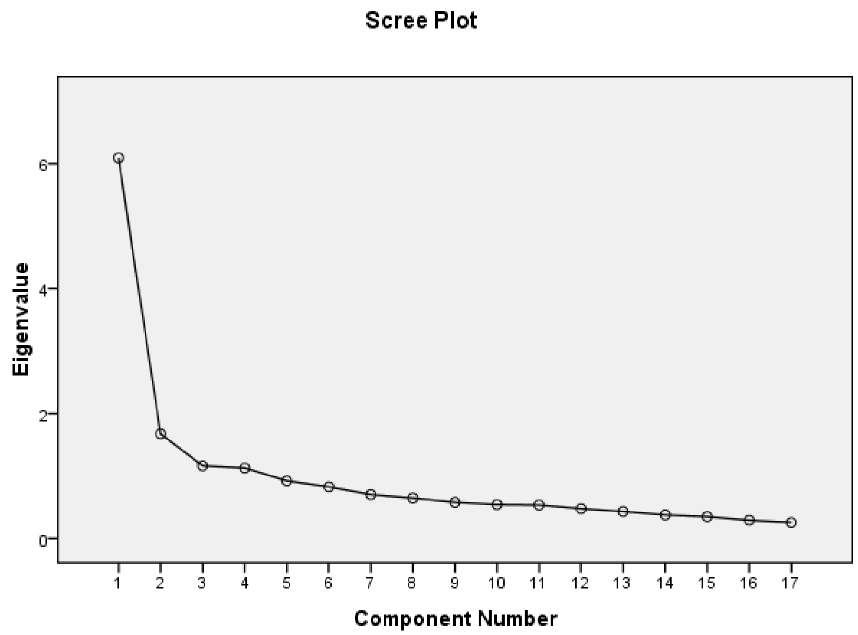

Figure 1. Scree plot for 17-item fifth (final) version of the Mandarin FourSight 6.1

6. Discussion

When the CPS styles of 151 Taiwanese high school students were assessed via FourSight, the means of five items were quite low. There five items were “I find I don’t have the temperament to sit back and try to isolate specific causes of a problem" (item 7); "Transforming ideas into action is not the part of the creative process that enjoy most" (item 11); "I find I don't naturally spend much time focusing on defining the exact problem to be solved" (item 14); "My natural tendency is not to generate lots and lots of ideas for problems" (item 33); and "I find that I have little patience for the effort it takes to refine or polish an idea" (item 35). Among them, items 7 and 14 were indicators of the Clarifier profile, items 33 and 35 were on the Ideator subscale, and item 11 was part of the Implementer type. Our participants' highest mean scores were on Clarifier items (M = 3.42; SD = .43) and the lowest on Developer ones (M = 3.32; SD = .46). The highest proportion of our participants were high-Clarifiers (51%) and the lowest proportion, high-Ideators (28%),with high-Developers (32%) and high-Implementers (40%) occupying middle positions relative to the other two types. These results may reflect that, when confronting the pressures of a high-stakes test, Taiwanese high school students have been trained to clarify the issues first in order to solve problems, but lack training in generating ideas. This may also be influenced by the country's standardized-test-based educational system, in which students are required to memorize correct answers and not expected to develop their creative/divergent thinking skills or generate novel ideas.

When comparing the original 36-item English version of FourSight 6.1 against our final 17-item Chinese version, several important differences should be noted. First, according to factor analysis, the initial version of FourSight is a four-factor construct, whereas our abridged Chinese version is a four-factor construct, but the number of variables has shrunk from the original's nine items per factor to around three items per factor. Our first factor analysis on the initial 36-item version of the Chinese-language FourSight showed that an eight-factor solution was adequate, but this result differed strongly from the four-factor construct of the English version with the same number of items. This discrepancy may have resulted from translation issues or cultural ones, or both. It is possible that the idea of CPS was itself quite new for our Taiwanese respondents.

7. Limitations

When interpreting the results of the current study, several limitations should be noted. First, we recruited all of our participants from a single institution. Future studies could use larger samples from multiple institutions. Second, our sample consisted of high school students, and it is recommended that future researchers recruit undergraduates and older adults, thereby adding to the generalizability of the results. Finally, we only used EFA to assess the FourSight; confirmatory factor analysis would be another useful tool with which to validate this scale.

8. Conclusion

Our 17-item Chinese-language version of FourSight is reliable and valid from a statistical viewpoint, and therefore potentially of use for assessing students' CPS styles in Chinese educational settings. However, its factor construct differs markedly from the original 36-item English version. The large discrepancy in terms of number of extracted factors between the original and the translated version of the scale could due to cultural/educational and/or translational issues. In order to develop a more robust Chinese version, future researcher should use confirmatory factor analysis to validate this measure.

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