Critical Thinking Profiles across Korean, Turkish, and U.S. Students

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Abstract

Critical thinking (CT) skills enable individuals to actively use their knowledge and problem-solving skills to overcome life challenges (Ananiadou & Claro, 2009). Educators, employers, and policymakers focus on CT skills to foster scientific thinking in education (Hitchcock, 2018). In many countries, developing CT skills have become a critical component in science education (Vieira et al., 2011), and a significant role in the development of societies (Ananiadou & Claro, 2009; Facione, 2006). However, CT can be defined and taught in different formats across different countries (Ananiadou & Claro, 2009). There is a dearth of knowledge of how these skills develop in different countries. Given the importance of CT skills in a globalized society, this study examined CT profiles among middle school students from Korea, Turkey, and the United States. Latent profile analysis (LPA) and multi-group LPA (MLPA) explored CT profiles based on configural, structural, dispersion, and distributional similarities. We hypothesized that there would be no difference among CT profiles across countries. The results provided partial support for our hypothesis. Investigation of the similarity of latent profiles suggested a 3-profile solution (configural) and no level difference (structural) for CT indicators (i.e. induction, deduction, credibility, and assumption) across countries. However, we found differences in indicator variability (dispersion) and size of profiles (distributional) across countries. These results add to the conversation concerning cross-cultural differences in how CT skills are taught across the countries, and whether these differences may lead to differences in scientific curriculum and learning.

Introduction

- Critical thinking (CT) is an important 21st century skill that fosters problem-solving, inquiry, and discovery (Abrami et al., 2008; Thompson, 2011).
- Globally, schools aim to better equip students with CT skills (Fisher, 2011) to develop scientific thinkers in our societies (Hitchcock, 2018).
- Education policymakers are aware of the importance of developing CT skills and, in many countries, developing CT skills have become a critical component in science education (Vieira et al., 2011).
- CT is an area to be developed in educational settings (Dwyer et al., 2014; Vieira et al., 2011) with practice (Mulnix, 2012; Peter, 2012). However, CT can be often conceptualized and taught in many formats across different countries (Ananiadou & Claro, 2009).
- There is no indication in the CT literature that profiles should differ across countries. However, evidence of the generalizability of CT profiles is needed.
- Multi-group latent profile analysis is a rigorous method to assess the generalizability of latent profiles across countries (Morin et al., 2016).

Current Study

- We investigate the CT profiles across Korean, Turkish, and U.S. students, hypothesizing that there will be no differences in the profile solutions across countries in terms of configural, structural, dispersion, and distributional similarities.

Methods

Sample: Middle school students (N = 3,115) completed a CT assessment in their perspective languages during their normal class schedules.

- Korean (n = 520), Turkish (n = 996), U.S. (n = 1,599); Female and male representation was approximately equal.

Instrument: Cornell Critical Thinking Test (CCTT - Form X; 71 items)

- Subdomains: induction, deduction, credibility, and assumptions
- Internal consistency reliability estimate for subdomains: r_{range} = .67 - .90
- Correlation with similar CT tests = r_{range} .40 – .74

Analysis Steps

Multi-group Latent Profile Analysis (MLPA)

1. *Configural*: Examines if the same number of profiles exist across the groups based on the following model indices (McLachlan & Peel, 2000):
   - -2LL, AIC, BIC, SABIC, and LMLRT (Lower preferred)
   - Entropy (Higher preferred)
   - Statistical significance (p < .05)
2. *Structural*: Examines if the subdomain levels across each profile are similar.
3. *Dispersion*: Examines if the variability (i.e., homogeneity) within each profile is similar.
4. *Distributional*: Examines if the relative size (i.e., percentage of students) in each profile is similar.

Results

Configural (Step 1): Fit indices suggested a five-profile solution for Korean and U.S. samples and four-profile solution for the Turkish sample (Table 1). However, there were only level differences between certain profiles and no shape differences. The most parsimonious and interpretable solution with unique profiles was a three-profile solution across all three groups (Figure 1).

Table 1. *Fit Results from Latent Profile Analysis for Korean, Turkish, and U.S. Students*

Model	*df*	-2LL	AIC	BIC	SABIC	Entropy	LMLRT	*p*
Single-group Analyses								
Korean								
Two Profiles	13	5419.68	5445.68	5500.98	5459.72	.797	464.25	<0.001
Three Profiles	**18**	**5316.44**	**5352.44**	**5429.01**	**5371.87**	**.762**	**100.04**	**0.030**
Four Profiles	23	5237.86	5283.86	5381.70	5308.69	.777	76.15	0.027
Five Profiles	28	5179.30	5235.30	5354.41	5265.53	.735	66.84	0.006
Six Profiles	33	5130.50	5196.50	5336.87	5232.13	.770	47.29	0.074
U.S.								
Two Profiles	13	16790.07	16816.07	16885.97	16844.67	.762	1321.18	<0.001
Three Profiles	**18**	**16403.00**	**16438.10**	**16535.79**	**16478.60**	**.743**	**376.85**	**<0.001**
Four Profiles	23	16197.36	16243.36	16367.03	16293.97	.773	200.21	0.001
Five Profiles	28	16016.62	16072.62	16223.18	16134.23	.743	175.97	<0.001
Six Profiles	33	15927.27	15993.27	16170.72	16065.88	.769	86.99	0.064
Turkish								
Two Profiles	13	10548.92	10574.92	10638.67	10597.38	.628	370.68	<0.001
Three Profiles	**18**	**10406.31**	**10442.31**	**10530.58**	**10473.41**	**.697**	**138.59**	**<0.001**
Four Profiles	23	10313.17	10359.17	10471.95	10398.90	.640	90.52	0.008
Five Profiles	28	10271.56	10327.56	10464.87	10375.94	.639	40.43	0.184
Six Profiles	33	10221.87	10287.87	10449.70	10344.89	.676	49.55	0.057

Note: df = degrees of freedom; -2LL = -2 Log Likelihood; AIC = Akaike Information Criterion; BIC = Bayesian Information Criterion, SABIC = Sample-Adjusted BIC; LMRT = Lo-Mendell-Rubin Adjusted LRT Test, p < .01.

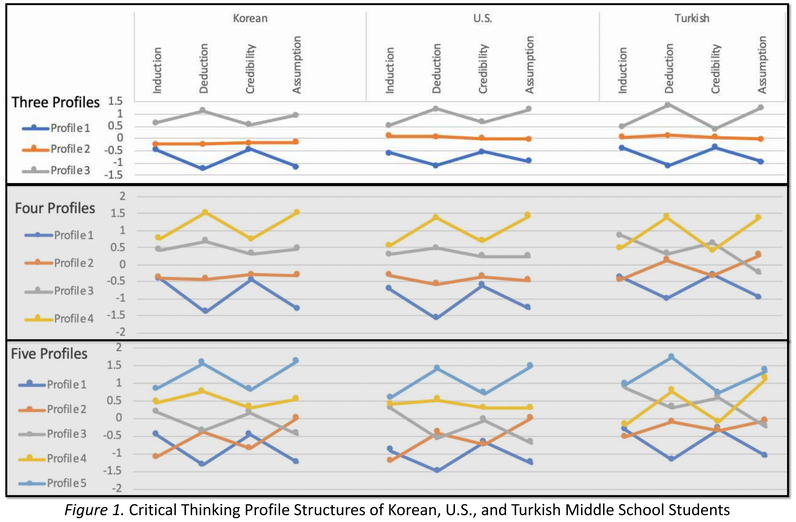

Figure 1. Critical Thinking Profile Structures of Korean, U.S., and Turkish Middle School Students

Results

Structural (Step 2): The Structural similarity model showed lower fit values compared to the configural model, expect for -2LL (Table 2), supporting structural similarity of the 3-profile solution across groups.

Dispersion (Step 3): The Dispersion similarity model showed higher values across the fit indices except for the BIC (Table 2), indicating that the dispersion similarity was not fully supported for the 3-profile solution across the groups.

Table 2. *Cross-national Similarity of the 3-Profile Solution*

Model	*df*	-2LL	AIC	BIC	SABIC	Entropy
Configural	56	38391.45	38503.45	38841.91	38663.98	.865
Structural (Means)	32	38437.91	38501.91	38695.31	38593.64	.859
Dispersion (Means and Variances)	24	38481.54	38529.54	38674.59	38598.34	.860
Distributional (Means, variances, and probabilities)	20	38495.16	38535.16	38656.04	38592.49	.860

Note: df = degrees of freedom; -2LL = -2 Log Likelihood; AIC = Akaike Information Criterion; BIC = Bayesian Information Criterion, SABIC = Sample-Adjusted BIC.

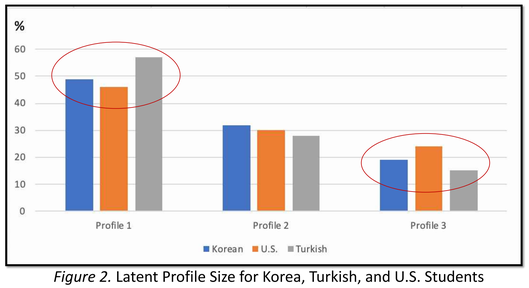

Figure 2. Latent Profile Size for Korea, Turkish, and U.S. Students

Distributional (Step 4): The distributional similarity model revealed that there was not a consistent decrease in fit indices, suggesting profile sizes may differ across groups, as seen in Figure 2.

Conclusions

- We found partial support for our hypothesis:
  - The same number of profiles and the same indicator levels were obtained across all three countries (i.e., Configural and Structural similarity).
  - Subdomain variability, or the homogeneity of the suggested profiles, differed across all three countries (i.e., Dispersion similarity).
  - The relative size of the latent profiles, or percentage of students in each profile, differed across all three countries (i.e., Distribution similarity).
- We posit that such differences in CT profiles may reflect how CT skills are developed and taught across multiple cultural contexts.
- There is a lack of clarity if such differences are related to scientific curriculum, student learning, or instrumental effects of how CT is measured.
- Future research should (a) replicate results, (b) examine partial similarity across countries, (c) examine the predictive similarity of the profiles, and (d) explore newer methods of measuring CT skills (e.g., interviews, open-ended assessments).

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