

# Cognitive and Psychological Constructs of Korean Physical Literacy Scale in Children

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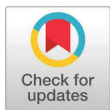
Received: March 3, 2023

Accepted: April 6, 2023

Published online: April 30, 2023

## Keywords:

Physical Literacy  
Physical Activity  
Korean Physical Literacy Scale



## ABSTRACT

**OBJECTIVES** The current study examined the cognitive and psychological factors of Canadian Assessment of Physical Literacy-2 (CAPL-2) using a cross-sectional design. Also, this study assessed the measurement and structural invariance of the CAPL-2.

**METHODS** The survey was conducted on 539 elementary school students in Seoul, Korea. Among the collected data, 274 datasets were used for confirmatory factor analysis, and 25 datasets for test-retest reliability analysis and 240 datasets for differences by group. Confirmatory factor analysis, reliability analysis, and criterion-related validity analysis were carried out by using SPSS 23.0 and AMOS 23.0.

**RESULTS** Results indicated that the Korean physical literacy scale consists of four factors (interest, motivation, competence, and understanding with 15 items). In addition, the findings revealed that all factors in physical literacy differed by the stage of physical activity ( $\lambda = .723, F = 5.59, p < .001$ ).

**CONCLUSIONS** This study was the first to validate the CAPL-2 into the Korean children. The Korean physical literacy scale offers the possibility of assessing physical literacy to researchers and practitioners and Korean children's physical activity enhancement could be easily tracked in school and community settings.

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## Introduction

It is broadly recognized that regular physical activity is an essential health-promoting behavior for the overall development of children, such as physical growth, psychological stability, cognitive-function improvement, and smooth social networking [1]. In particular, it is very important to make regular physical activities a daily life from childhood because adolescents with a lot of physical experience are likely to continue physical activities even when they become

adults. However, the lack of physical activity among children and adolescents in Korea is serious that a recent study suggests that Korea is the world's worst youth physical activity lack country [2]. In addition, physical education in Korea is mostly largely focused on measuring physical factors such as 100m running or sit-ups or performing and learning skills in some sports events (basketball, volleyball, soccer, badminton, etc.). Therefore, if you lack basic physical strength or are not good at the sports, it is likely to be perceived as a person who is not good at sports [3]. And it appears as a phenomenon of avoiding physical or sports activities, and this phenomenon helps to become a country with the world's worst lack of physical activity.

Recently, the term, physical literacy (PL) has frequently

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appeared in physical education at home and abroad. First proposed by Margaret Whitehead at the International Association of Physical Education and Sport for Girls and Women Congress in Australia in 1993 [4]. PL does not simply refer to regular physical engagement and functional aspects of physical activity. It is a concept that includes an understanding of the knowledge needed to sustain physical activity, the beneficial effects of physical activity on health, interactions with the social environment, and psychological characteristics (confidence, motivation, faith, etc.) required to regularly participate in physical activity.

As the importance of PL has emerged at domestically and internationally, it is a concept that has also attracted attention in the fields of education, sports, physical activity (PA), recreation, and health care [5]. However, the definition of PL has not yet been clearly agreed upon [6]. The evaluation method also shows some differences among scholars [7, 8]. [9] defines PL as “motivation, confidence, physical competence, knowledge, and understanding to recognize and take responsibility for the value of participating in physical activities whole life.” However, PL is also defined as the achievement of physical education [10] or the ability, confidence, and aspiration required for physical activity [11]. Furthermore, in Australia, PL is defined as a lifelong holistic learning process acquired and applied in the context of movement and physical activity [12].

Canadian Assessment of Physical Literacy (CAPL), Physical Literacy Assessment for Youth (PLAY), Passport for Life (PEL), Perceived Physical Literacy Inventory (PPLI), and PE Metrics [13] have been developed as evaluation tools to measure the multifaceted aspects of PL. In general, the measurement tool of PL is determined by the concept of PL defined by institutions, organizations, and scholars [14], and the most studied evaluation tool is CAPL developed in Canada [15]. Currently, a new version of CAPL-2 is being used, and [16] proposed the possibility of international standardization of Canadian measurement tools (CAPL-2) through research. In addition, [17] explained the applicability of PL in health education and health promotion sites in the United States and emphasized the relationship between physical activity and health and PL. [14] confirmed the validity and reliabil-

ity of the measurement tool in applying the CAPL-2 evaluation tool developed in Canada to Chinese children. [18] developed a defined and standardized conceptual model of PL through the Delphi survey method and argued that this model consists of four educational areas (physical, psychological, cognitive, and social). However, in the case of Korea, there are only some opinions suggesting the necessity or educational content and direction of the concept of PL as an alternative concept to replace existing knowledge [19, 20]. In addition, studies have been suggested in Korea that cognitive parts related to physical activity do not have much influence on factors affecting physical activity [21, 22]. Nevertheless, some studies argue that knowledge related to physical activity which is a cognitive domain, plays an important role in leading individual decision-making and health-oriented behavior. [23] Looking at these conflicting research results, it is necessary to verify the validity and reliability of the constituent factors included in PL in Korea. And this study investigates whether the scale developed abroad is applicable to domestic students. In particular, when foreign-developed test papers are used in Korea, there may be differences in cognitive, psychological, and social questions, so this study will focus on the psychological, cognitive, and social questions of CAPL-2, excluding physical fitness factors. In addition, this study confirmed the subjects' responses according to gender and exercise stages to confirm the possibility of CAPL-2 as a useful tool for measuring PL.

## Methods

### Participants

In this study, elementary school students in Korea were selected as the population to measure the validity of CAPL-2 for Korean children. Elementary school students living in Seoul and Gyeonggi-do, Korea, participated in the study. A total of 539 students (284 boys, 255 girls, mean age=10.65±.66) participated in the study. Of the 539 students, 274 students (149 boys, 125 girls, mean age=10.77±.74) participated in the study to identify the constituent factors of the specific Korean version of CAPL-2. The sample size of the subjects was set based on the basis that the sample size of

200 to 400 or less is appropriate for the maximum likelihood estimation [24]. Specifically, the physical activity stages of the study participants were 55 students (20.1%) in precontemplation, 48 students (17.5%) in contemplation, 37 students (13.5%) in preparation, 51 students (18.6%) in action, and 83 students (30.3%) in maintenance.

The test-retest reliability test in this study was contributed by 25 elementary school students (13 boys, 12 girls, mean age=10.8±.5) with the same criteria as the study participants. Their physical activity stages are 4 students (16%) in precontemplation, 4 students (16%) in contemplation, 4 students (16%) in preparation, 6 students (24%) in action, and 7 students (28%) of maintenance.

In addition, 240 students (127 boys, 113 girls, mean age=10.49±.53) participated in the study to verify differences by group. We conducted a statistical G-power analysis to estimate a required sample size. We set power at 0.95 and an  $\alpha$ -error probability of .05, and we assumed an effect size of 0.28. Our power analysis then yielded an estimated required sample size of 240 participants, based on G\*Power 3.1.9.7. software (Heinrich-Heine University, Düsseldorf, Germany). Their physical activity stages are 41 students (17.1%) in precontemplation, 55 students (22.9%) in contemplation, 39 students (16.3%) of preparation, 38 students (15.8%) of action, and 67 students (27.9%) of maintenance.

A total of 10 experts participated in the design process and its content analysis of this study, and all of them participated in the design process because they were proficient in English phrases. Among them, four were professors majoring in physical education, four doctors in sports and physical education, and two exercise field leaders.

All participants provided their informed consent in compliance with the approval of the Institutional Review Board and the study was carried out in accordance with the International Declaration of Helsinki guidelines.

## Measures

The English CAPL-2 was adapted and modified to suit Korean culture and language to produce a Korean version of PL. In this version, the test paper that completed the translation using the translation-reverse translation method and

the two-person translation comparison method was re-modified and supplemented after verifying the content validity through a meeting with a group of experts [25]. The expert meeting was conducted focusing on whether the content of CAPL-2 translated into Korean matches the content to be measured. In addition, a preliminary face validity was conducted on 10 elementary school students to verify whether the tool could be used appropriately for general elementary school students and whether the sentences were easy to understand and clear and simple. The knowledge and understanding (a 10-item questionnaire), motivation and confidence (a 12-item questionnaire) areas of the Korean version of the physical literacy measurement tool consist of a total of 22 questions and 5 Likert scales (1 point: not at all ~ 5 point: very much).

In addition, gender and age were asked to respond in an open questionnaire form. The “Stage of physical activity Change Scale” scale was developed by Marcus, Rossi, Selby, Niaura and Abranms [26]. This questionnaire was translated into Korean, which is used to classify the stages of change in physical activity into five stages. This questionnaire is a dichotomous scale related to regular physical activity and intentions, and when responding to the questionnaire, individuals are categorized into one of five stages of physical activity change.

## Procedure

For the study, a Korean version of the PL scale was organized and produced to facilitate measuring the PL of elementary school students. After explaining the purpose of the study to 300 elementary school students, a Korean version of the physical literacy scale, which had been verified for facial validity in advance, was conducted. Prior to meeting the survey subjects in person and conducting the survey, the researcher explained the purpose and content of the study to the subject’s legal representative and agreed to participate in the survey. If the legal representative of the survey subject did not agree to participate in the survey or if the survey subject did not intend to participate, he did not participate in the survey. In addition, the questionnaire that the participant responded to the questionnaire but responded to the

questionnaire in an unfaithful manner was excluded from the analysis. Therefore, data of 274 students were used for analysis in this study. It took about 10 minutes for the survey subjects to respond to the survey. The collected data was immediately entered into the computer, and after data cleaning, analysis began.

For the analysis of the data obtained at this time, item analysis, reliability analysis, and confirmation analysis were performed. After confirmatory factor analysis, a test-retest reliability test was conducted. Twenty-five study participants responded to the first question and a retest was conducted two weeks later. Then, the correlation of the obtained data is analyzed to secure the test-retest reliability.

After confirming the structure of physical literacy through confirmatory factor analysis and test-retest reliability test, the discrimination power between groups was confirmed to secure the external validity of the measurement tool. In order to confirm the difference in sub-variables according to gender and physical activity stage, 250 elementary school 3rd to 5th graders were explained the purpose of the study, and a questionnaire including the Korean version of the physical literacy scale, gender and physical activity stage was provided. In the second survey, since the research participant is not an adult, the survey was distributed to the research participants after receiving consent from the legal representative to agree to participate in the survey. The contents of 240 responses were used for analysis, except for responses that refused to participate in the study or responded to the survey insincerely. For the analysis of the data obtained at this time, t-test and MANOVA were conducted with item analysis, reliability analysis, and performance physical activity stage as independent variables, and sub-variables of physical literacy as dependent variables. If a significant difference

was found, post Hoc was conducted.

For item analysis, reliability analysis, and analysis of variance was used SPSS (version 23.0; IBM Corp., Armonk, NY, USA). And the confirmatory factors were analyzed using AMOS 23.0 (IBM Corp., Armonk, NY, USA). Maximum Likelihood Estimation (MLE) was used as an estimation method for the parameter.

## Results

### Item analysis

Item analysis was conducted to validate the Korean version of the PL. As a result of frequency analysis, there were no questions showing excessive frequency, and no problematic questions were found, as can be seen in <Table 1> for mean, standard deviation, skewness, and kurtosis. 22 items in the cognitive and psychological areas of CAPL-2 were used for analysis.

### Confirmatory factor analysis

A confirmatory factor analysis was conducted based on the survey of elementary school student study participants in 274. As a result, the score of  $\chi^2$  was 665.31 ( $p < .001$ ) and, the score of  $Q(\chi^2/df)$  was 3.34, RMR was .037, TLI was .820, CFI was .845 and RMSEA was .093. Considering the criteria evaluated with a good model (RMR, RMSEA  $< .08$ , TLI, CFI  $> .90$ ), the TLI, CFI, and RMSEA of this study were insufficient for the criteria. Therefore, I1, U1 and U4 items and knowledge factor were excluded in consideration of modification indices and estimates. As a result of analyzing the modified model, the score of  $\chi^2$  was 221.914 ( $p < .001$ ), the score of  $Q(\chi^2/df)$  was 2.674, RMR was .033, TLI was .933, CFI was .947 and then RMSEA was .078. Overall, the model was adopted

**Table 1.** The extracted factors from cognitive and psychological constructs.

	I1	I2	I3	I4	I5	I6	M1	M2	M3	C1	C2	C3	K1	K2	K3	K4	U1	U2	U3	U4	U5	U6
M	3.62	3.57	3.48	3.25	2.99	3.35	4.25	4.12	4.23	3.75	3.58	3.6	.28	.59	.80	.82	.84	.82	.73	.66	.72	.69
SD	.83	.86	.83	.90	.93	.84	.93	1.0	.92	1.0	1.	1.13	.45	.49	.40	.38	.36	.39	.44	.47	.45	.46
Skewness	-1.5	-1.4	-1.5	-1.1	-.69	-1.1	-1.1	-.85	-.88	-.38	-.32	-.29	.98	-.39	-1.5	-1.7	-1.9	-1.6	-1.1	-.68	-1.0	-.82
kurtosis	1.64	1.65	1.43	.27	-.35	.47	.53	-.16	-.20	-.54	-.73	-.76	-1.0	-1.6	.35	.96	1.5	.74	-.88	-1.5	-1.0	-1.3

I: Interest; M: Motivation; C: Competence; K: Knowledge; U: Understanding

as the fitness index of this model satisfies the appropriate criteria [27].

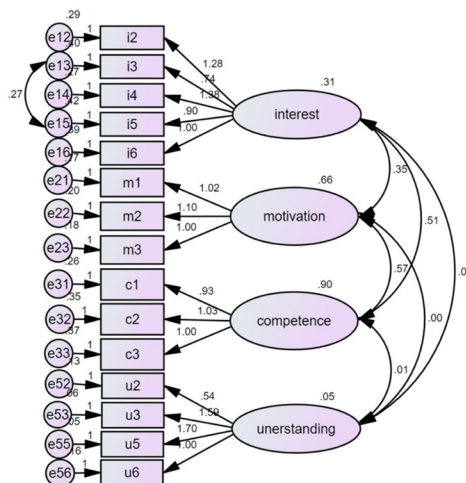
The <Table 2> shows the regression coefficient, standard error, rejection rate, and standard regression coefficient as the estimation of the maximum likelihood parameter of the measurement model. In this table, each item showed a meaningful parameter estimate ( $p < .001$ ), the rejection rate (CR) of all paths is higher than threshold 1.96, and all variables are meaningfully related to their own unique concepts, proving the relationship established between predictors and concepts.

And then, Paths with a standard error of 2.5 or higher do not appear [28], so they are suitable for recognizing each model.

The validity of the confirmatory factor analysis was confirmed through Standard Regression Weight (SRW), and the convergence validity was confirmed by calculating Average Variation Extracted and Construct Reliability (CR). In general, the SRW value is .5 or higher, and the AVE is .5 or higher, and the CR.7 and above are considered valid [29]. <Figure 1> is a factor structure model of the final 15 items.

**Table 2.** Confirmatory analysis of cognitive and psychological constructs.

	Estimate	S.E.	C.R.	SRW	CR	AVE	$\alpha$
I2 ← interest	1.281	.111	11.589	.799	.852	.496	.840
I3 ← interest	.740	.089	8.309	.548			
I4 ← interest	1.378	.115	11.946	.829			
I5 ← interest	.902	.098	9.209	.613			
I6 ← interest	1.00			.666			
C1 ← competence	.929	.052	17.771	.865	.882	.655	.921
C2 ← competence	1.034	.059	17.484	.856			
C3 ← competence	1.00			.840			
M1 ← motivation	1.018	.049	20.971	.893	.921	.796	.889
M2 ← motivation	1.097	.052	21.081	.895			
M3 ← motivation	1.00			.889			
U2 ← understanding	.536	.12	4.456	.321	.746	.454	.727
U3 ← understanding	1.591	.201	7.916	.833			
U5 ← understanding	1.698	.218	7.777	.878			
U6 ← understanding	1.00			.500			



**Figure 1.** Factorial Structural Model.

If there are multiple panels, they should be listed as: (a) Description of what is contained in the first panel; (b) Description of what is contained in the second panel.

### Correlation analysis of test-retest

A test-retest was performed to confirm the reliability of the scale used in this study. Two surveys were conducted on 25 participants at 1-month intervals. As a result, as shown in <Table 3>, the correlation coefficient between the 15 questions and the re-test is .833 ~ .972 ( $p < .001$ ). This indicates that the reliability of the scale has been secured.

### Differences in sub-factors of the PL scale by sex and physical activity stage

MANOVA were conducted to find out the difference in PL sub-factors by the stage of physical activity. In <Table 4>, it was confirmed that the sub-factors of PL of elementary

school students partially showed statistically significant differences according to the physical activity stage ( $\lambda = .723$ ,  $F = 5.59$ ,  $p < .001$ ). Additionally, there was no difference in sub-factors of the PL scale by gender. However, the findings revealed that the participants in the action and maintenance stages are more likely have higher scores on interest, internal motivation, and competence than those in the precontemplation and contemplation stages.

### Discussion

The purpose of this study was to confirm whether cognitive and psychological factors of CAPL-2 scale, which are

**Table 3.** Correlation analysis of the items.

	I1	I2	I3	I4	I5	M1	M2	M3	C1	C2	C3	U2	U3	U5	U6
Test-retest (r)	.796	.833	.883	.903	.876	.933	.929	.937	.958	.946	.972	.802	.890	.901	.802
p	.000	.000	.000	.000	.000	.000	.000	.000	.000	.000	.000	.000	.000	.000	.000

I: Interest; M: Motivation; C: Competence; U: Understanding

**Table 4.** Differences in sub-factors of the PL scale by gender and physical activity stage.

	inter	Internal movement	competence	Under competence
male	3.615 (.741)	4.213 (.846)	3.473 (1.028)	.715 (.331)
female	3.212 (.656)	4.189 (.924)	3.523 (.944)	.772 (.313)
F	.189	.094	1.144	1.136
$\lambda = .985, F = .987, p = .415$				
1	2.964 (.729)	3.849 (.968)	3.103 (.829)	.632 (.366)
2	3.073 (.77)	4.194 (.927)	3.347 (.96)	.766 (.303)
3	3.081 (.755)	3.82 (.866)	3.369 (1.048)	.831 (.257)
4	3.294 (.556)	4.157 (.77)	3.608 (.84)	.701 (.35)
5	3.65 (.522)	4.639 (.661)	4.313 (.817)	.783 (.299)
F	11.2***	10.04***	18.05***	3.12*
	1 < 4, 1,2,3,4 < 5	1 < 2,3 1,2,3,4 < 5	1 < 4, 1,2,3,4 < 5	1 < 2,3,5

$\lambda = .723, F = 5.59, p < .001$

frequently used to measure PL, are also applicable in Korea. As a result of the analysis to confirm this, in the existing CAPL-2 scale, 3 items were excluded from the “motivation and confidence” factor, and 6 items were excluded from the “knowledge and understanding” factor. Then The original CAPL-2 scale included “motivation”, “competence”, “predilection”, and “adequacy” item questions as “motivation and confidence” factors. However, in the Korean version of CAPL-2, questions about “predilection and adequacy” were responded as a single factor, and through expert meetings, that factor has been named as “interest”. As a result, the findings indicated that the Korean PL scale consists of 4 sub-factors with 15 items (Interest=5 items, Motivation= 3 items, Competence=3 items, Understanding=4 items).

It has witnessed that CAPL-2 has been widely applied to measure PL and revised into different languages such as Chinese [14], Greek [30], Latin [13] and African [31]. Based on such broad applicability of the CAPL-2, the current study was attempted to confirm whether CAPL-2 is a valid to assess PL among Korean children. In specific, the current study reported that “knowledge” factor with all items in CAPL-2 was excluded. These findings are supported in previous studies [14, 30], demonstrating that “knowledge” and “understanding” factors showed low reliability. In contrast, the current findings indicated that the reliability and validity of “motivation” and “competence” factors were high and supported by previous studies. It is plausible to explain that reliability is sensitive to the number of items, and hence the small number of items in “knowledge” and “understanding” factors may be the reason for low reliability [32].

In addition, “motivation” and “competence” factors have a Likert scale of response, but in the case of “knowledge” and “understanding” factors relating to physical activity, the response to the item is evaluated by dichotomous scale (“right” or “wrong”), which may result in low reliability [16, 33]. Additionally, the “knowledge” factor does not show low reliability and validity in the current study, but some previous studies were found to be reliable and valid, although they were of the same type of scale as CAPL-2 [21, 34]. Therefore, it should be careful to apply the findings for further research. There is a need for further study to see whether it is an as-

pect of Korean sample. Regarding “knowledge” factor, Park and Kim [21] also suggested that this factor has no influence on the behavioral practice of Korean adults. However, Sveibi [35] explained that knowledge is the ability to act and necessary to conceptualize our goals, predict events, and change. Although knowledge may not respond immediately, it is argued that it's significant because it leads to behavioral changes in the long term [36]. Regarding these various results, Whitehead [37] explained that the concept of PL may not be appropriate in all countries because it is socially constructed. In other words, in this study conducted on Korean children, factors related to knowledge raise the need to change the scale and modify the contents considering the Korean curriculum.

Moreover, the current study investigated how PL differs by gender and or the stage of physical activity. The findings indicated that there was no difference in PL by gender, but sub-factors of PL showed significant differences by the stage of physical activity. The current findings on gender are different from previous studies, demonstrating that boys have higher PL or physical activity than girls [30]. Although it is generally suggested that physical activity and PL decreases with increasing in age [38, 39], there was no difference between gender in the current study. This is contrary to the results of a study in which male students generally have more physical activity than female students [40]. However, there are studies in which there was no difference in physical activity according to gender in the lower grades before the secondary sexual characteristics appeared [41, 42]. In this study, it is interpreted that this result was shown as a large number of students in the 3rd to 4th grades of elementary school participated.

The current findings indicated that the participants in the action and maintenance stages of physical activity show higher scores in PL than those in the precontemplation and contemplation stages. It is plausible to interpret that that the higher the amount of physical activity, and the higher stages of physical activity (i.e., action and maintenance), the higher the positive psychological variables (i.e., motivation, competence etc.) related to physical activity [43, 44]. Kang [45] explained that as the level of physical activity among elemen-

tary school student increases, positive psychological attributes such as self-resilience and prosocial behavior increases, meanwhile negative psychological attributes such as anxiety and stress decreases.

## Conclusions

The current study attempted to confirm the applicability of CAPL-2, which measures PL for Korean population, and revealed that “motivation” and “competence” factors of CAPL-2 were apparently confirmed as a significant factor of the Korean PL scale. Meanwhile, the finding indicated that “knowledge” and “understanding” factors should be further studied to be validated. Therefore, further study is necessary to secure the reliability and validity of the Korean PL scale by supplementing the correction or response responses to the content related to “knowledge” and “understanding” factors of the Korean PL scale. This study was the first to validate the CAPL-2 into the Korean children. The Korean PL scale, partly developed in this study, offers the possibility of assessing PL to researchers and practitioners and Korean children’s physical activity enhancement could be easily tracked in school and community settings.

## Acknowledgments

This work was supported by the Ministry of Education of the Republic of Korea and the National Research Foundation of Korea (NRF-2022S1A5B5A16053293).

## Conflicts of Interest

Declare conflicts of interest or state “The authors declare no conflict of interest.”

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