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Exploratory Research for the Development of a SDLT (Self-directed Learning Test) for Young Children

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Abstract

The purpose of this study was to develop a self-directed learning measurement tool for early childhood, which can be used for counseling and planning in the educational setting. The subjects were 150 infants aged from 3 to 5 years in kindergartens and day care centers in Seoul and Gyeonggi Province, Korea. The questionnaire was administered to these student's homeroom teachers. The collected data were statistically processed by the SPSS WIN 24.0 program to calculate reliability and exploratory factor analysis. The results of this study were as follows: First, the relevant factors dictating the self-directed learning ability of young children were cognition, affection, and behavior. The cognitive factor in turn consisted of cognition, meta-cognition, and problem-solving ability, the affective factor consisted of intrinsic motivation and future-oriented motivation, self-efficacy, and the behavior factors consisted of seeking help and managing the physical environment and time. Second, through the calculation of KMO and Bartlett's test of sphericity a valid factor structure of .946 (cognition), .937 (affection), .945 (behavior) was found. Therefore, it will be possible to use the SDLT (self-directed learning test) developed in this study in the field of early childhood education, and it is suggested that this tool is utilized to grasp the state of learning ability of infants and in educational planning and counseling.

Keywords

SDLT, Self-directed Learning, Young Children, Cognition, Affection, Behavior

1. Introduction

In a rapidly changing global knowledge and information society, it is necessary to be able to creatively integrate existing knowledge and new information beyond the level of storing and utilizing knowledge. In other words, in the future, talented individuals must be able to both find and solve problems on their own, and control and direct their thoughts, motives and behavior. To help achieve this, in the school education system, students should also function as their own teachers, leading their learning in accordance with their individual situation and needs. Therefore, the psychological variable that needs to be consistently emphasized from early childhood education right through to university education is students' self-directed learning ability (Lee Kyunghwa, Kim Sooyeon, Park Hyesung, 2017). Successful learners are those who have a more efficient and effective learning strategy to access and use knowledge rather than those who simply have more knowledge than others. They are self-directed learners who can synchronize themselves, check their behavior, and change their behavior when learning does

not happen (Han, Sunmi, 2006).

Knowles (1975) insisted that self-directed learning is a process in which a learner takes the initiative in self-learning, diagnoses his or her learning needs, plans and sets learning objectives to secure the necessary human and material resources for learning, and then evaluates the results of accomplished learning. Therefore, those with this initiative in regards to learning will learn more easily and more efficiently than those who lack it, and as the educational environment changes gradually, learner's self-initiative is becoming more demanding. In a previous study on self-directed learning, Lee Ji-hye (2010) examined the structural relationship between academic achievement, learning commitment, self-directed learning ability, metacognition, and self-determination learning motivation. In addition, So Yeon-hee (2011) confirmed the structural relationship between learning commitment, self-directed learning, academic achievement, and teacher's perceived learning activities, Kim A-young (2014) developed a self-directed learning ability scale consisting of three sub-factors: learning strategy, learning motivation, and learning self-concept. However, in many studies concerned with self - directed learning in Korea, there is a tendency to equate the two concepts of self - directed learning and self - regulated learning. In Korea, most research on self - directed learning has been initiated and developed in the field of lifelong education focusing on adult education, not psychology, so that a comprehensive theoretical foundation has not been well established. In other words, the conceptual consensus on self - directed learning has not yet been derived, so the development of a test that can measure it has not been taken into consideration in terms of developmental perspective.

Existing research on self-directed learning of young children has revealed the relationship between self-directed learning and young children's self-concept (Park Yeon-ju, Shin In-sook, 2003), the interaction between self-directed activities and young children's creativity (Kang, Kyunghee, 2008) and the relationship between mothers' parenting and self-directed learning (Lee, Ok-hee, 2008). However, the tools to measure appropriately this self - directed learning ability of infants considering the developmental characteristics in connection with the early - middle school period have not been fully developed.

Tennant (2006) suggested that it is not possible to determine learner's dependency and independence with age, and that children play a social role by acting in accordance with social situations. It is important to note that self-directed learning is a learning process based on self-control and planning rather than learning without the help of others.

The development of reliable and valid tests that measure the psychological characteristics of children can help educate children to achieve harmonious development. Therefore, not only reliability and validity, but also practicality and ease of use should be considered, especially for infants. Parents and teachers, who spend a lot of time with their children, are the best people to monitor their infants and record their developmental changes. However, they are often time-strapped and busy or preoccupied with other tasks. Thus the easier the test is to use the more chance it has of being properly and frequently administered. .

It is axiomatic that education for improving the self-directed learning ability of infants needs to be able to measure the self-directed learning ability of infants. Therefore, in this study, a self - directed learning test for children aged 3, 4, and 5 years was developed and validated. This test can help parents and teachers to easily measure the self - directed learning ability of young children.

2. Research Method

2.1. Participants

The participants were children from 150 kindergartens (83.3%), child care houses (6.7%) and early childhood education institutions (10%) in Seoul and Gyeonggi. There was a similar distribution of boys (52%) and girls (48%), and an even distribution of 3, 4, and 5 year olds. The test was conducted by homeroom teachers who knew the infants and responded after making observations on the infants being tested.

2.2. The Basis of Development of Measuring Tool and Composition of Test Items

The basis of the self-directed learning test for infants was the self-directed learning test for elementary students developed by K. Lee and S. Kim (2017). Based on this tool, each item was revised and adjusted so as to be appropriate for infants after considering their developmental levels. The children's self-directed learning ability test items consisted of three domains: the cognitive domain, the affective domain, and the behavioral domain. The sub-variables of the cognitive domain were cognition, metacognition, and problem solving ability. The sub-variables of the affective domain were intrinsic and future motivation and self-efficacy. And the behavioral domain was composed of help seeking, physical environment management, and time management. The total number of questions was 45 items (Table 1).

Table 1. Compositon of self-directed learning ability test items.

	Sub-variable	Number of items	Number
Cognition	Cognition	5	1~5
	Meta cognition	5	6~10
	Problem solving	5	11~15
Affection	Intrinsic motivation	5	16~20
	Future motivation	5	21~25
	Self-efficacy	5	26~30
Behavior	Help seeking	5	31~35
	Physical environment management	5	36~40
	Time management	5	41~45
Total		45	

2.3. Research Procedure: Statistical Processing

The data collected in this study were analyzed using the SPSS WIN 24.0 program. In order to examine the degree of independence of the three domains and nine sub-factors of the developed scale, we examined the appropriateness of the sample through the Kaiser-Meyer-Oklin (KMO) measure and the Bartlett's sphere formation test. Kaiser and Rice (1974) modified the factor analysis data matrices. The Kaiser-Meyer-Olkin Measure of sampling adequacy is a statistic that indicates the proportion of variance in variables that might be caused by underlying factors. High values (close to 1.0) generally indicate that a factor analysis may be useful with data. If the value is less than 0.50, the results of the factor analysis probably won't be very useful.

Bartlett’s test of sphericity tests the hypothesis that your correlation matrix is an identity matrix, which indicates that variables are unrelated and therefore unsuitable for structure detection. Small values (less than 0.05) of the significance level indicate that a factor analysis may be useful with your data.

Lastly, exploratory factor analysis was performed by determining the number of factors by referring to eigenvalues and scree

plot results calculated using principal component analysis by Varimax rotation.

3. Results

3.1. Factor Analysis: Cognitive Domain

The results of the factor analysis of the sub-factors in the cognitive domain for the self-directed learning ability of infants are presented in Tables 2 and 3 immediately below. The results of the principal component analysis of the cognitive domain are set out in Table 2. They show that the Kaiser-Meyer-Olkin measure of sample appropriateness was .946 as a result of KMO and Bartlett's sphere formation test, and the Chi square value was statistically significant. As a result exploratory factor analysis was performed by principal component analysis on cognitive factors of self - directed learning ability of infants. As a result of factor analysis, factor 1 explained 67.59%, factor 2 explained 6.97%, and 2 the factors explained 74.56% of the total.

Table 2. Eigenvalue and variance ratio: principal component analysis of cognitive domain.

Item	initial eigenvalue			extraction sum of squares load		
	total	%	cumulative %	Total	%	cumulative %
1	10.138	67.587	67.587	10.138	67.587	67.587
2	1.045	6.969	74.556	1.045	6.969	74.556
3	0.777	5.177	79.733			
4	0.588	3.918	83.651			
5	0.398	2.654	86.305			
6	0.352	2.345	88.651			
7	0.319	2.130	90.780			
8	0.255	1.702	92.483			
9	0.220	1.464	93.947			
10	0.200	1.334	95.281			
11	0.170	1.132	96.413			
12	0.161	1.076	97.489			
13	0.146	0.974	98.463			
14	0.129	0.859	99.321			
15	0.102	0.679	100			

Kaiser-Meyer-Olkin (KMO) Test for Sampling Adequacy		.946
Bartlett's test of sphericity	approx. chi-square	2272.823
	df	105
	Sig.	.000

The results of the exploratory factor analysis in the cognitive domain are shown in Table 3, along with the factor names representing the characteristics of each factor and the related sub-questions by two factors, factor 1 being meta-cognitive / problem-solving ability and factor 2 being cognition.

Table 3. Exploratory factor analysis of cognitive domain.

	1	2	commonality
meta-cognition 5	.832	.282	.837
meta-cognition 4	.806	.389	.818
meta-cognition 2	.806	.183	.794
problem-solving 1	.782	.314	.778
problem-solving 2	.727	.381	.789
problem-solving 5	.706	.522	.662
meta-cognition 3	.700	.377	.684
problem-solving 3	.669	.516	.632
problem-solving 4	.650	.571	.801
cognition 1	.131	.905	.772
cognition 2	.376	.823	.710
cognition 3	.490	.744	.674
cognition 5	.582	.671	.714
cognition 4	.621	.627	.748
cognition 6	.556	.594	.771
Factor name	Meta-cognition/ Problem-solving ability	Cognition	

3.2. Factor Analysis: Affective Domain

The results of the factor analysis of the sub-factors of the affective domain for the self-directed learning ability of infants are presented in Tables 4 and 5 immediately below. As shown in Table 4, the Kaiser-Meyer-Olkin measure of sample appropriateness was .934 as a result of KMO and Bartlett's sphere formation test, and the Chi square value was statistically significant. As a result, exploratory factor analysis was performed by principal component analysis on the affective factors of self - directed learning ability of infants. As a result of factor analysis, factor 1 explained 57.51%, factor 2 explained 9.53%, and the 2 factors explained 64.04% of the total.

The results of the Exploratory factor analysis in the affective domain are shown in Table 5, and the factor names representing the characteristics of each factor and the related sub-questions by two factors, factor 1 being future-oriented motivation and factor 2 being intrinsic motivation / self-efficacy.

Table 4. Eigenvalue and variance ratio: principal component analysis of affective domain.

Item	initial eigenvalue			extraction sum of squares load		
	total	%	cumulative %	Total	%	cumulative %
1	8.627	57.512	57.512	8.627	57.512	57.512
2	1.429	9.527	67.038	1.429	9.527	67.038
3	0.915	6.101	73.139			
4	0.909	6.058	79.197			
5	0.589	3.929	83.126			
6	0.440	2.933	86.060			
7	0.359	2.393	88.452			
8	0.320	2.133	90.585			
9	0.294	1.962	92.546			
10	0.246	1.640	94.186			
11	0.219	1.462	95.648			
12	0.207	1.377	67.026			
13	0.159	1.063	98.089			
14	0.150	1.000	99.089			
15	0.137	0.911	100			
Kaiser-Meyer-Olkin (KMO) Test for Sampling Adequacy				.934		
Bartlett's test of sphericity			approx. chi-square	1808.213		
			df	105		
			Sig.	.000		

Table 5. Exploratory factor analysis of affective domain.

	1	2	commonality
future-oriented motivation 4	.888	.101	.744
future-oriented motivation 3	.861	.290	.783
future-oriented motivation 2	.840	.253	.796
future-oriented motivation 6	.782	.564	.665
future-oriented motivation 1	.727	.556	.154
future-oriented motivation 5	.706	.558	.714
self-efficacy 5	.700	.095	.770
intrinsic motivation 2	.389	.884	.826

Continued Table 5

intrinsic motivation 1	.051	.858	.798
intrinsic motivation 3	.087	.768	.712
intrinsic motivation 4	.455	.664	.776
self-efficacy 1	.473	.655	.713
self-efficacy 2	.589	.635	.752
self-efficacy 4	.557	.605	.691
intrinsic motivation 5	.570	.350	.160
Factor name	future-oriented motivation	intrinsic motivation/ self-efficacy	

3.3. Factor analysis: Behavior domain

The results of the factor analysis of the sub factors of the behvior domain for the self-directed learning ability of infants are presented in Tables 6 and 7 below. As shown in Table 6, the Kaiser-Meyer-Olkin measure of sample appropriateness was .945 as a result of KMO and Bartlett's sphere formation test, and the Chi square value was statistically significant. As a result, exploratory factor analysis was performed by principal component analysis on the behavioral factors of self - directed learning ability of infants. As a result of factor analysis, factor 1 explained 61.67%, factor 2 explained 8.32%, and the 2 factors explained 70.0% of the total.

Table 6. Eigenvalue and variance ratio: principal component analysis of behavioral domain.

Item	initial eigenvalue			extraction sum of squares load		
	total	%	cumulative %	Total	%	cumulative %
1	9.251	61.671	61.671	9.251	61.671	61.671
2	1.249	8.324	69.995	1.249	8.324	69.995
3	0.865	5.764	75.76			
4	0.749	4.992	80.752			
5	0.577	3.846	84.599			
6	0.437	2.915	87.513			
7	0.346	2.305	89.819			
8	0.266	1.772	91.591			
9	0.254	1.695	93.286			
10	0.227	1.513	94.799			
11	0.214	10426	96.226			
12	0.192	1.283	97.509			

Continued Table 6

13	0.163	1.089	98.598		
14	0.111	0.741	99.339		
15	0.099	0.661	100		
Kaiser-Meyer-Olkin (KMO) Test for Sampling Adequacy				.945	
Bartlett's test of sphericity			approx. chi-square	2020.605	
			df	105	
			Sig.	.000	

The results of the Exploratory Factor analysis in the affective domain are shown in Table 7, and the factor names representing the characteristics of each factor and the related sub-questions by two factors, factor 1 being time and environment management and factor 2 being intrinsic motivation / self-efficacy.

Table 7. Exploratory factor analysis of behavior domain.

	1	2	commonality
time management 4	.869	.255	.636
time management 3	.849	.352	.511
time management 5	.832	.286	.674
environment management 5	.828	.154	.770
time management 1	.824	.311	.767
time management 2	.803	.390	.726
environment management 3	.785	.373	.205
environment management 4	.782	.347	.756
environment management 1	.719	.456	.732
getting help 4	.271	.834	.798
getting help 1	.489	.727	.845
getting help 2	.040	.714	.821
getting help 3	.433	.697	.774
Factor name	time and environment management	getting help	

3.4. Final SDLT

The construction of the final SDLT (self-directed learning test) is shown in Table 8. The items of the SDLT came from three

domains: the cognitive, affective and behavioral. Two sub-variables of the cognitive domain are meta-cognitive/problem-solving ability and cognition. Two sub-variables of the affective domain are future-oriented motivation and intrinsic motivation/self-efficacy. And two sub-variables of the behavior domain are time and environment management and getting help.

Table 8. SDLT construction.

Domain	Sub-variable	Item number	number
Cognition	Meta-cognition/ Problem-solving ability Cognition		15
Affection	future-oriented motivation intrinsic motivation /self-efficacy		15
Behavior	time and environment management getting help	31~45	15
	Total		45

4. Conclusion

In this study, we developed a self-directed learning ability test for young children and identified validity through exploratory factor analysis. As a result, it was confirmed that the SDLT was a reliable and valid measurement tool. It consisted of three domains: the cognitive, affective and behavioral domains. This test allows us to easily diagnose the self - directed learning ability of young children at home and in early childhood education institutions, and will both assist students to optimize their learning potential and facilitate educational planning and counseling.

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