Developing an Educational Performance Indicator for New Millennium Learners

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Abstract

Educational performance based on the learning outcomes of formal schooling in a future knowledge society could be significantly different from that of today. This study investigates the possibilities of developing an educational performance indicator for new-millennium learners (NMLs). The researchers conducted literature reviews, a meeting of experts, pilot studies, and a nationwide survey to define and refine a concept of educational performance required by a knowledge society. The study identified cognitive, affective, and sociocultural domains as core constructs of the indicator. We conducted exploratory and confirmatory factor analysis to validate the indicator. We have identified three domains with four factors in each have to measure the educational performance of NMLs. Information management, knowledge construction, knowledge utilization, and problem-solving abilities are four factors in the cognitive domain. The affective domain consists of self-identity, self-value, self-directedness, and self-accountability factors. Finally, the sociocultural domain includes social membership, social receptivity, socialization, and social fulfillment factors. (Keywords: Educational performance, new millennium learners, cognitive domain, affective domain, sociocultural domain)

Information and knowledge are essential sources for maintaining prosperity and stimulating economic growth in a knowledge society (Cowan & Paal, 2000). A person's income is often determined by his/her knowledge and skills acquired through education and training. The labor market is also looking for human capital and invests in human resources

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with creative knowledge and skills. This trend forces individuals to acquire valuable knowledge and skills and to master sociocultural tools, such as language and information and communication technology (ICT) tools. It also transforms school curricula and learning environments. Knowledge acquisition has evolved from declarative knowledge, which is "knowing what," to procedural knowledge, which is "knowing how." That means an individual who knows how, when, and where to use acquired knowledge performs better than one who just has a massive amount of knowledge. In an industrial society, an "intellectual" refers to an individual with abundant information. Conversely, it refers to an individual who utilizes knowledge to design new products and efficient processes and solve complex real-life problems in a knowledge society. From this viewpoint, individuals who live in a knowledge society should have substantial capabilities such as problem-solving and creative and critical thinking skills. Similarly, information processing skills, including searching, analyzing, and synthesizing, should also be considered key competencies.

In addition to these cognitive skills, modified social skills are needed in the 21st century. Recently, our world has become ever more fragmented and globalized at the same time. The existing social bonds forged by geographic conditions and economic barriers have become weaker, and new ones have been built up. Countries are made up of more diverse races, cultures, and languages than ever before. Even Korea is no longer a racially homogeneous nation, and people from various countries and cultures have transformed Korea's ethnic and cultural landscape. Many had negative attitudes toward this trend at first. Nowadays, however, it is assumed that cultural diversity increases the range of options open to everyone.

Cultural diversity is one of the roots of development in terms of economic growth and a means to realize a more satisfactory intellectual, emotional, moral, and spiritual existence. The cultures of different nations, however, can only be exchanged, not replaced. In fact, recognizing and respecting the diversity of world cultures has become one of the norms governing international relations generally accepted by the majority of countries (UNESCO, 2002). In our increasingly diverse societies, it is essential to ensure harmonious interaction among people and groups with plural, varied, and dynamic cultural identities.

Individuals should therefore be able to develop skills and attitudes to cope with cultural diversity. Some of the most important skills are interpersonal, including effective communication, teamwork skills, language skills, awareness of cultural differences, and conflict resolution skills. Well-developed social skills can also promote personal competencies in the affective domain, such as self-esteem, motivation, perseverance, and initiative (Eurydice, 2002). New-millennium learners (NMLs) born after 1980 have been raised on state-of-the-art digital technologies that have tremendous influence on our society as well as daily lives. The teaching and learning environment

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for NMLs is especially influenced by cutting-edge computer and Internet technologies. These technological and social changes make NMLs more unique, confident, and team- and goal-oriented (Howe & Strauss, 2007). Teachers, therefore, should be able to craft appropriate pedagogical strategies to accommodate the distinctiveness of NMLs. To substantiate appropriate instruction for future learners, the core competencies of NMLs should be precisely extracted from a sound research background including 21st century skills, and an appropriate measuring instrument should be developed. The purpose of the present study is to identify critical factors expected in NMLs' competencies to prepare for their future and to develop an indicator with valid and reliable criteria.

Framework of Educational Performance for NMLs

To define the concept of educational performance, it might be useful to begin with the competencies NMLs will need to face the complex challenges in today's society. In accordance with previous studies, we have categorized the key competencies into three domains: cognitive, affective, and sociocultural (Livingston & Bober, 2005; OECD, 2003; White, 1997). Among various factors in these domains, problem-solving skills, information technology usage skills, communication skills, and collaboration skills are common factors that researchers recommend (Carnevale, 1991; Eurydice, 2002; Fastad, 2004; Partnership for 21st Century Skills, 2008; SCANS, 1991). Although there are factors that belong to the affective and sociocultural domains, studies have mostly emphasized the cognitive domain. Because ICTs have advanced and cultural diversity is strongly recognized, social bonds forged by geographical conditions and economic barriers have become weaker. Harmonious interaction with others from different cultures is more important and will in turn promote personal cognitive as well as affective competencies, such as knowledge construction, self-esteem, and motivation (Eurydice, 2002). The following is the concept of the cognitive, affective, and sociocultural domains in educational performance.

Cognitive Domain

As our society transforms into a knowledge society where NMLs are exposed to a massive amount of information and knowledge, the ability to search, analyze, and integrate information has become an essential skill for learners (Resnik, 2002). Managing information, constructing knowledge, and developing real-life problem-solving skills could be core competencies for NMLs. In other words, the ability to select proper information depending on one's needs through critical analysis and proper evaluation could be far more important than receiving or remembering it without critical thinking (Park, 2003). Because ICT use facilitates the acquisition of information processing and utilization skills, learners might spend more time engaged in high-level thinking and improve their skills in the areas of

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problem solving, critical analysis, and creativity (Choi & Chun, 2002; Choi & Kim, 2003; Daud & Husin, 2004; Kang & Han, 2000; Macdonald, Heap, & Mason, 2001; Wheeler, Waite, & Bromfield, 2002). That means "knowing how, when, and where" is getting to be more important than "knowing what" in the area of educational performance. To enhance one's intelligence in the cognitive domain, the ability to manage information, construct and utilize knowledge, and solve problems could be a core factor.

Affective Domain

Granger and Bowman (2003) mentioned that ICT use may provide learners with various opportunities to learn differently depending on their needs. An ICT-based, learner-centered environment, in turn, enables learners to make their own decisions according to their interests, learning styles, learning goals, and strategies. As a result, learners are able to choose and construct learning environments independently and design their own learning content. In this regard, each learner's self-accountability, self-conception, self-identity, and self-value are considered critical factors for successful learning. Research that investigated the relationship between ICT use and the affective domain in educational performance has addressed affective variables, such as a sense of confidence (Garland & Noyes, 2005), self-directedness (Jung, 2003), and self-efficacy (Roberts, 2005). The affective domain in this study consists of four factors: self-identity, self-value, self-directedness, and self-accountability.

Sociocultural Domain

As ICT advances, new experiences in cyberspace, which are different from previous ones, are widely open to NMLs. In this newly created dimension, learners interact with others near or far and with those from different cultural backgrounds. Learners will be able to construct new knowledge by sharing information and ideas beyond the limits of time and space. Therefore, the abilities to communicate (Kennewell & Morgan, 2006; Wild, 1996) and to respect diversity (Glimps & Ford, 2008) are required competencies to prosper in an ICT-driven society. They should be able to maintain an open mind and strong ties with people to learn successfully. Moreover, learners will have more and more opportunities to organize collaborative project teams with those from different backgrounds and geographic regions. They do not have to meet coworkers face to face to carry out cooperative projects. To facilitate this kind of social and collaborative learning, social membership, social receptivity, socializing ability, and social fulfillment are core factors that NMLs require.

Based on previous studies, we have identified educational performance indicators within three domains of competencies that are assumed to be critical to NMLs. In this study, educational performance for NMLs is defined as the process as well as outcome of learning, which in turn are labeled

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Table 1: Conceptual Framework of Educational Performance for NMLs

Domain	Internal Competencies (more toward the learner's internal construction of the domain)	External Competencies (more toward the external application of the domain)
Cognitive	Information management ability: Collecting and selecting information Knowledge construction ability: Constructing knowledge	Knowledge utilization ability: Applying knowledge Problem-solving ability: Producing creative solutions
Affective	Self-identity: Acknowledging the uniqueness of self Self-value: Setting up one's personal value system	Self-directedness: Having self-directed/active attitudes Self-accountability: Having proactive attitudes
Sociocultural	Social membership: Acknowledging the existence of community and his/her membership Social receptivity: Accepting others	Socializing ability: Communicating with other community members Social fulfillment: Assuming a proactive role

internal and external competencies. Key indicators for each domain are specified in Table 1.

Developing and Validating the Indicator

Based on the framework, we developed an educational performance indicator through three major stages: developing, validating, and finalizing the measurement scale. The initial scale for measuring educational performance comprised 72 items total, which measured students' perceived competencies using a 4-point scale.

Meeting of Experts

To evaluate the framework and validate the scale, a total of 17 experts participated in the meeting. These included 14 local experts and 3 international experts from the Organization for Economic Cooperation and Development (OECD). The majority of the experts agreed that the framework of educational performance was constructed with valid components. They advised, however, that the differences in the operational definitions of the terms and the items of affective and sociocultural competencies be made clear. Lastly, feedback on the initial draft scale included clarifying the direction of the instrument, clearly stating the items that could be eliminated for less redundancy, using a larger scale for item distinction, and considering problems regarding measurement.

Pilot Test 1

In Pilot Test 1, face validity was examined through one-on-one evaluation of the four individual participants. We gave all students the draft version of items and asked them to respond and give comments. In addition, we interviewed them for some specific responses. We revised items based on respondents' understanding, clarity, amount of time to respond, and the redundancy and attractiveness of the items.

After testing the face validity of the revised scale, we conducted another Pilot Test 1 with 115 high school freshmen. We distributed two sets of separately ordered items to reduce bias. After eliminating 21 cases with

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Table 2: EFA Results of the Cognitive Domain (*n* = 272)

Item Code	Factor 1	Factor 2	Factor 3	Factor 4
EP11	0.696			
EP12	0.645			
EP10	0.633			
EP07	0.625			
EP08	0.558			
EP09	0.552			
EP04		0.697		
EP01		0.666		
EP03		0.618		
EP02		0.519		
EP16			0.658	
EP18			0.564	
EP15			0.526	
EP14			0.515	
EP23				0.744
EP22				0.684
EP21				0.672
EP19				0.565
EP24				0.473

outliers, a total of 94 cases used to analyze the internal consistency of the educational performance items showed Cronbach's α = 0.92. To measure students' perceived competencies exactly, we tested the item distinctiveness of the educational performance scales. We examined the item distinctiveness of the education performance items based on three criteria: (a) whether the mean of the items was above 3.0 or below 1.0, (b) whether item-total correlation by domain showed below 0.3 or negative correlation, (c) whether inter-item correlation by domain showed below 0.1 or negative correlation (Seong, 2002). We considered revising items that showed biased meanings or led to low or negative correlation among the three criteria.

Based on the results of the above Pilot Test 1, we modified the contents of items for educational performance. We added 72 items for educational performance produced by the revision of items and 1 item for sociocultural competencies.

Pilot Test 2 (Exploratory Factor Analysis)

We conducted Pilot Test 2 with 400 high school students after screening for 107 outliers. We used 72 items in the analysis, which followed a procedure that was similar to Pilot Test 1. The result for the internal consistency of educational performance items was Cronbach's α = 0.95.

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Table 3: EFA Results of the Affective Domain (*n* = 272)

Item Code	Factor 1	Factor 2	Factor 3	Factor 4
EP44	0.736			
EP45	0.732			
EP48	0.502			
EP28		0.573		
EP30		0.570		
EP29		0.555		
EP27		0.540		
EP38			0.702	
EP37			0.687	
EP39			0.638	
EP35				0.692
EP33				0.648
EP32				0.569
EP34				0.518

We tested the item distinctiveness of the educational performance items. In addition, we conducted an EFA to test the construct validity of items of educational performance. First, Kaiser-Meyer-Olkin (KMO) and Bartlett's test of sphericity validated the adequacy of the data for factor analysis. Next, we conducted an EFA using the principle axis factoring and direct oblimin method with four factors in each category (Yang, 2006). We confirmed the numbers of the factors in each EFA based on the results of eigen value (>1) and scree plots. We eliminated some items by criteria for being below communality 0.30, being below factor loading 0.40, and double loading (Seong, 2002; Yang, 2006). In addition, a professor of the Korean language refined the language of the items.

In the cognitive domain, the measure of sampling adequacy (MSA) of KMO was 0.889, and the result of Bartlett's test of sphericity was 0.01 ($p < 0.05$). We eliminated five items based on these criteria. Table 2 presents the 19 items left: 6 items for Factor 1, 4 for Factor 2, 4 for Factor 3, and 5 for Factor 4. Factors 1–4 were labeled as *information management ability, knowledge construction ability, knowledge utilization ability,* and *problem-solving ability.*

In the affective domain, the MSA of KMO was 0.874, and the result of Bartlett's test of sphericity was 0.01 ($p < 0.05$). We eliminated 10 items based on these criteria. Table 3 presents the 14 items left: 3 for Factor 1, 4 for Factor 2, 3 for Factor 3, and 4 for Factor 4. Factors 1–4 were labeled as *self-accountability, self-identity, self-directedness,* and *self-value.*

In the sociocultural domain, the MSA of KMO was 0.884, and the result of Bartlett's test of sphericity was 0.01($p < 0.05$). We eliminated six items based on these criteria. Table 4 (p. 164) presents the 19 items left: 5 for Factor 1, 4 for Factor 2, 4 for Factor 3, and 6 for Factor 4. The sociocultural

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Table 4: EFA Results of the Sociocultural Domain (*n* = 272)

Item Code	Factor 1	Factor 2	Factor 3	Factor 4
EP61	0.764			
EP63	0.748			
EP62	0.643			
EP64	0.552			
EP65	0.541			
EP68		-0.824		
EP67		-0.714		
EP69		-0.706		
EP70		-0.497		
EP57			0.712	
EP56			0.658	
EP55			0.631	
EP58			0.607	
EP54				0.689
EP53				0.630
EP50				0.619
EP49				0.588
EP52				0.584
EP51				0.538

domain factors 1–4 were labeled as s*ocializing, social fulfillment, social receptivity,* and *social fulfillment.*

Pilot Test 3 (Confirmatory Factor Analysis)

Three hundred high school students participated in Pilot Test 3. In the analysis of the educational performance scale, the internal consistency of items was Cronbach's α = 0.94. Also, the previously mentioned criteria validated item distinctiveness. Based on all the results of the analyses, we revised items and refined them to 33 items. Using AMOS 7.0, we chose four factors for each of the category models and examined the CFA.

Descriptive analysis. To perform the CFA, the multivariate normality of the variables was proven. The skewness of all the variables was less than 2, and the kurtosis was less than 7, so parameters can be estimated by the model (Curran, West, & Finch, 1996). Through this analysis, we verified skewness and kurtosis and established the multivariate normality. The reliability of the latent variables—cognitive, affective, and socio-cultural—was 0.81, 0.82, and 0.83, respectively.

Correlation analysis. All the correlations among the latent variables are significant, as Table 5 shows. The correlation coefficient of the cognitive variables with the affective factors ($r = 0.50$, $p < 0.05$) and with the sociocultural factors ($r = 0.36$, $p < 0.05$) are each statistically significant. Also, the correlation coef-

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Table 5: Correlation among Latent Variables ($n = 300$)

Latent Variables	1	2	3
Cognitive	-		
Affective	0.50*	-	
Sociocultural	0.36*	0.61*	-

* $p < .05$

Table 6: Model Fit Summary of the Cognitive Category ($n = 300$)

Index	c^2	*df*	*p*	RMSEA	GFI	CFI
Model	377.14	59	0.01	0.07	0.95	0.94
Criteria				< 0.08	> 0.09	> 0.09

Table 7: Regression Weights of the Cognitive Domain ($n = 300$)

Latent Variables	Observed Variables	Standardized Estimates	SE	CR
Information Managing	EP01	0.78	-	-
	EP02	0.71	0.04	22.64*
	EP03	0.74	0.05	23.62*
	EP04	0.76	0.05	23.95*
Knowledge Construction	EP05	0.63	-	-
	EP06	0.73	0.06	18.87*
	EP07	0.79	0.07	19.89*
	EP08	0.74	0.07	19.04*
Knowledge Utilization	EP09	0.60	-	-
	EP10	0.72	0.07	16.8*
Problem Solving	EP11	0.68	-	-
	EP12	0.79	0.06	20.08*
	EP13	0.72	0.06	19.18*

* $p < .05$

ficient of the affective and sociocultural variables is statistically significant ($r = 0\ .61$, $p < 0\ .05$) and slightly higher than the other correlations. Because the coefficient of determination (r^2) consists of the percentage of variance, 25% of the cognitive domain variance is accounted for by the affective domain and vice versa. A variance of approximately 13% in the cognitive and sociocultural domains is common, whereas a variance of approximately 36% is common in the affective and sociocultural domains. The shared variance between the affective and sociocultural domains is the highest among the three domains.

CFA of cognitive domain variables. Table 6 describes model fit indices of the cognitive domain. For the cognitive category, the RMSEA score is less than 0.07, whereas the CFI and GFI are both greater than 0.90, which indicates the model fit is reasonable and acceptable.

Next, Table 7 reports analysis of the relationship of latent variables and observed variables. The CR of standardized estimates was more than 1.96, and all of the standardized estimates were significant.

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Table 8: Model Fit Summary of the Affective Category (*n* = 300)

Index	c^2	*df*	*p*	RMSEA	GFI	CFI
Model	101.62	29	0.01	0.05	0.98	0.97
Criteria				< 0.08	> 0.09	> 0.09

Table 9: Regression Weights of the Affective Domain (*n* = 300)

Latent Variables	Observed Variables	Standardized Estimates	SE	C.R
Self-Identity	EP14	0.59	-	-
	EP15	0.64	0.12	11.27*
Self-Value	EP16	0.72	-	-
	EP17	0.69	0.05	17.49*
	EP18	0.62	0.05	16.33*
Self-Directedness	EP19	0.56	-	-
	EP20	0.66	0.10	13.37*
Self-Accountability	EP21	0.67	-	-
	EP22	0.81	0.06	20.25*
	EP23	0.65	0.06	17.60*

* $p < .05$

CFA of affective domain variables. Table 8 (p. 166) describes model fit indices of the affective domain. For the affective category, the RMSEA score is less than 0.05, and the CFI and GFI are all greater than 0.90. Therefore, the cognitive category model provided a reasonable model fit to the data.

Table 9 reports the analysis of the relationship of latent variables and observed variables. The CR of the standardized estimates was more than 1.96, and all of the standardized estimates were significant.

CFA of sociocultural domain variables. Table 10 describes sociocultural factors of model fit indices. The RMSEA score is less than 0.06, whereas the CFI and GFI are both greater than 0.90. Therefore, the cognitive category model provided a reasonable model fit to the data.

Table 11 reports that analysis of the relationship of latent variables and observed variables of the sociocultural domain. The CR of standardized estimates was more than 1.96, and all of the standardized estimates were significant.

Final Version of the Measurement Scale

The measurement scale of educational performance consisted of 13 cognitive items, 10 affective items, and 10 sociocultural items, as outlined in Table 12 (p. 168).

Conclusion and Implications

The purpose of this study was to develop the conceptual frameworks of NMLs' educational performance and to construct an indicator of educational performance with valid and reliable scales. We developed the measurement of educational performance for NMLs on the basis of previous

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Table 10: Model Fit Summary of Sociocultural Category (n = 300)

Index	c^2	df	p	RMSEA	GFI	CFI
Model	127.36	29	0.01	0.06	0.98	0.97
Criteria				< 0.08	> 0.09	> 0.09

Table 11: Regression Weights of the Sociocultural Category (n = 300)

Latent Variables	Observed Variables	Standardized Estimates	SE	CR
Social Membership	EP24	0.53	-	-
	EP25	0.57	0.09	12.09*
Social Receptivity	EP26	0.65	-	-
	EP27	0.68	0.08	15.23*
	EP28	0.57	0.07	13.79*
Socializing	EP29	0.72	-	-
	EP30	0.78	0.06	20.04*
Social Fulfillment	EP31	0.74	-	-
	EP32	0.80	0.04	22.91*
	EP33	0.74	0.04	21.59*

* $p < .05$

research and theoretical background related to 21st century competencies for NMLs. As the study progressed from a conceptual framework to EFA and CFA analyses, the indicator of educational performance was validated. We drew the following conclusions from the results.

First, the study suggests that future learners might need core competencies in the cognitive, affective, and sociocultural aspects of educational performance in the future. To equip learners with these competencies, learning objectives and activities should be designed to foster an authentic environment. Second, our educational system should be able to determine intellectual as well as educational performance levels more accurately. To foster an authentic learning environment, activity-centered or process-centered teaching and learning methods, such as problem-based learning and project-based learning, should be implemented to increase the transferability of abstract knowledge to the performance level.

The ultimate goal of the educational system is to develop long-term competencies in our students. Although short-term mechanisms are comparably important in some cases, learners' cognitive, affective, and sociocultural competencies should be equally considered from a long-term perspective.

Author Notes

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Table 12: Final Scale: Educational Performance

Domain	Subdomain	Code	Item
Cognitive	Information Management	EP01	When I study, I collect necessary data.
		EP02	I usually make use of other sources of data than the textbook.
		EP03	When I study, I look for answers on the Internet or in the library.
		EP04	I can locate and make use of data or information that are helpful to my studies.
	Knowledge Construction	EP05	I usually ask myself whether I understood class content well.
		EP06	I usually reflect upon the content even if I understood it well.
		EP07	When I study, I try to find answers to my questions.
		EP08	If I cannot understand the content, I try to fully make sense of it by asking other people.
	Knowledge Utilization	EP09	I try to apply things I learned in class to the real world.
		EP10	I usually raise questions on ordinary thoughts and look for alternatives.
	Problem Solving	EP11	I provide solutions that no one else thought of.
		EP12	I can find solutions even though the problem is complex.
		EP13	I usually think of the solution and deal with the problem calmly.
Affective	Self-Identity	EP14	I know my strengths and weaknesses.
		EP15	I have dreams and goals that I can clearly explain to others.
	Self-Value	EP16	I try to maintain integrity in my life.
		EP17	When I did something dishonest, I try to rectify it.
		EP18	I try my best to keep promises I made with myself or with others.
	Self-Directedness	EP19	I take good care of the list of things I have to do.
		EP20	If I get lower grades than I expected, I try to find out why.
	Self-Accountability	EP21	I am usually reliable in a group learning situation.
		EP22	I try my best to perform my role in a group learning situation.
		EP23	I usually submit school assignments on time.
Sociocultural	Social Participation	EP24	I think it is important to have chances to meet new people through extracurricular (club) activities.
		EP25	I have others besides school friends with whom I can share my feelings.
	Social Receptivity	EP26	I am usually nice to new students in the class.
		EP27	I can hang around with classmates with personalities and interests very different from mine.
		EP28	I don't think ethnicity has anything to do with making friends.
	Socialization	EP29	I usually cooperate and work well with others.
		EP30	I am confident that I can gain the trust of my friends.
	Social Fulfillment	EP31	I try to be a leader in a group learning situation.
		EP32	In a situation where we need to make decisions together, my friends usually follow my choice.
		EP33	I contribute more than an average amount when I am in a group learning activity.

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