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Middle School Students' Motivation for Learning Technology in South Korea

Hyuksoo Kwon
Kongju National University, SOUTH KOREA

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This study aims to develop a feasible instrument for determining middle school students' motivation to learn technology in South Korea. The authors translated Glynn's motivational instrument and modified it to measure Korean middle school students' motivation to learn technology. The instrument was applied to 441 students of grade 8 and 9 from six different middle schools in metropolitan cities in South Korea. We conducted both exploratory factor analysis and confirmatory factor analysis to validate the modified instrument. In addition, we investigated motivational differences by gender and career pursuit using an independent t-test and identified factors affecting preference for technology subject. In terms of the results, first, we identified five sub-factors governing the motivation to learn technology. Second, we confirmed three factors that affect the preference for technology subjects, namely, intrinsic motivation, career motivation, and teacher preference. This study provides meaningful insights for technology educators into teaching and learning strategies to consider diverse motivational factors and students' gender and career pursuit.

Keywords: Motivation, technology education, Republic of Korea, factor analysis

INTRODUCTION

In the process of learning, motivation to learn sustains students' attention and interests in achieving the established learning objectives. Learning motivation toward a school subject influences the positive attitudinal transitions toward and academic achievement in the subject (Bryan, Glynn, & Kittleson, 2001; Gilman & Anderman, 2006; Rezabek, 1995). Research has consistently revealed that motivation is one of the significant determinants of student learning, performance, and school success (Shernoff, Csikszentmiahlyi, Schneider, & Shernoff, 2003). Therefore, educational communities have continuously investigated students' motivations to learn.

Technology education professionals have considered investigating students' motivation as a significant strategy for increasing students' motivation to learn technology subjects (Atkinson, 1999; Campbell & Jane, 2012). Additionally, students' motivation is a crucial factor in students' decision or registration for technology education subjects. In a few countries that offer technology subject as electives, researchers have investigated K-12 students' motivation to learn technology subject

Correspondence: Hyuksoo Kwon,
Department of Technology & Home Economics Education, Kongju National University, Gongjudahakro 56, Gongju, Chungnam, South Korea.
E-mail: hskwon@kongju.ac.kr
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as a strategy for driving more students to technology education classrooms (Autio, Hietanoro, & Ruismäki, 2011; Campbell & Jane, 2012). Furthermore, researchers have attempted to increase female students' motivation and participation in technology education classrooms because traditionally, it has been considered that more male students prefer technology subjects than female students (Chatoney & Andreucci, 2009; Rasinen et al., 2009).

A diverse set of factors affects students' learning motivations. Atkinson (1999) explored key factors affecting 15/16 year old students' motivation to take design and technology courses. Internal and external factors such as student's performance and skills in design and technology projects, student's goal orientation and cognitive style, and teacher-related factors were identified (Atkinson, 1999). In other subject areas, many factors for students' learning motivation were examined. Britner (2008) examined the effect of gender on school students' motivation to opt for life, physical, and earth science classes. In the life science and physical science classes, girls reported feeling higher levels of science anxiety. Bryan et al. (2011) confirmed the impact of high school students' motivation for academic achievement and that of gender differences as sub-factors of learning motivation. In particular, girls had lower intrinsic motivation than the boys to take up science education. Salta and Koulougliotis (2015) investigated Greek secondary school students' motivation to learn chemistry, and confirmed gender and age differences in the students' career motivations and intrinsic motivations.

State of the literature

- Motivation to learn has been about the disposition of students to arouse, direct, and sustain certain behaviors.
- Motivation has been broadly considered as the primary determinant of students' achievement, performance, and success in school life.
- Several social cognitive models have been proposed to formulate strategies for motivating students to learn.

Contribution of this paper to the literature

- Under the Korean educational environment and system, technology education has suffered from students' poor perception of technology and technology education.
- There is insufficient support for technology classrooms because Korean technology education is not included in entrance exams for college.
- The technology education profession in South Korea has focused on key strategies for motivating students to learn technology.

In South Korea, technology education has been offered as a national curriculum subject since 1970. The name of the subject associated with technology education was changed from "technology" to "technology and home-economics" via a national curriculum revision (National Curriculum Information Center, 2015). In other words, technology education was a compulsory subject for Korean secondary school students until 2012. However, in the recent national curriculum revision, the length of the middle school technology education class was decreased, and high school technology education was made an elective subject. Korean practitioners and researchers in the area of technology education have pointed out the significance of improving motivation to learn technology.

LITERATURE REVIEW

The literature review for this study consists of two parts. The first part investigates motivation and its sub-constructs based on social cognitive theory. The second part describes contemporary issues and challenges of Korean technology education, and students' motivation toward learning technology.

Learning motivation

The term motivation means "to move" in Latin, and it can be defined as "the internal state that arouses, directs, and sustains goal-oriented behavior" (Brophy, 2004). Hence, motivational theories have explored the reasons why individuals move toward specific activities or tasks (Pintrich & Schunk, 2002). In education, motivation to learn has been about the disposition of students to arouse, direct, and sustain certain behaviors (Koballa & Glynn, 2007). Motivation has been broadly considered as the primary determinant of students' achievement, performance, and success in school life (Autio et al., 2011; Brophy, 1983; Shernoff et al., 2003).

Therefore, a number of researchers have investigated key strategies for motivating students to learn. Several social cognitive models have been proposed to formulate strategies for motivating students to learn. For example, Bandura (2001) and Pintrich (2003)'s social cognitive theory confirmed that students learn most efficiently when they self-regulate. The social cognitive perspective of self-regulated learning emphasizes connection with self-efficacy beliefs and goal setting when regulating behavior (Eccles & Wigfield, 2002).

Motivational theorists in the field of social cognitive theory have proposed that there were at least five key constructs in students' comprehensive motivation to learn (Bandura, 2001; Glynn, Brickman, Armstrong, & Taasoobshirazi, 2011; Schunk, 2001; Taasoobshirazi & Carr, 2009). First, intrinsic motivation refers to an inherent interest in learning for its own sake. It is positively correlated with students' performance and school achievements. Additionally, there is extrinsic motivation, for example, achieving a good grade or attaining a career goal. Second, goal orientation is one of the most significant factors for successful learning (Cavallo, Rozman, Blinkenstaff, & Walker, 2003). The third is self-determination. Self-determination means students having a choice(s) or control(s) over their learning. For example, when students believe they can select a part(s) of their learning situation, their motivation to learn is increased (Reeve et al., 2003). The fourth is self-efficacy, suggested by Bandura (1997) and defined as "belief in one's capabilities to organize and execute the courses of action required to produce given attainments" (p. 3). The fifth is assessment anxiety, and it is a factor for hindering students' motivation and achievements (Cassady & Johnson, 2002).

Students' motivation to learn technology in South Korea

Education in South Korea follows a single track of elementary school (six years), middle school (three years), high school (three years), and thereafter, junior college, college and university undergraduate (two or three, four or six years) (Kwon & Chang, 2009). The South Korean education system is well-known for being highly centralized. In other words, the government maintains strong control over K-12 curricula, teachers' education, school budgets, and national entrance exams for college (Ihm, 2007; Seog, Hendricks, & González-Moreno, 2011). The national entrance exam for college is one of the most critical factors for admission to college, and it is considered as a top priority by high school students in South Korea (Wollam, 1992). This emphasis on entrance exams has led to social problems such as extreme competition and insufficient diversity and equality in the educational experience (Kim & Lee, 2001). The extreme competition might not provide educational experiences based on student interests and talents, and people in Korean society are concerned about the disadvantages of the extremely college-bound education system (Chae & Gentry, 2011; Seog et al., 2011).

Under the Korean educational environment and system, technology education has suffered from students' poor perception of technology and technology education. Essentially, there is insufficient support for technology classrooms because Korean technology education is not included in entrance exams for college, and does not have enough time to deliver hands-on based technology classes. Hence, the technology education profession in South Korea has focused on key strategies for motivating students to learn technology.

METHODS

The researchers started an instrumentation process with the following goal – investigate middle school students' motivation to learn technology in South Korea. The specific objectives of conducting this study were as follows:

RQ1: How valid is the Korean version of the modified "Science Motivation Questionnaire II" for measuring middle school students' motivation to learn technology?

RQ2: What are the differences in Korean students' motivation to learn technology across genders and career aspirations?

RQ3: What are the key factors affecting Korean students' preference toward technology education?

Participants

In South Korea, technology education is currently compulsory for all students from the 7th grade to the 9th grade under a subject called Technology and Home-Economics. All students from the 7th grade to the 9th grade should learn the same learning content under the Korean national curriculum. The Korean national curriculum has established the total weekly hours of instruction for technology and home-economics, and the subject is normally offered for two or three years depending on the school environment. Therefore, this study purposefully selected participants (8th or 9th graders) who had completed two or more semesters of technology and home-economics classes. This study also made an effort to reduce selection bias caused by location, gender, and grade level. The participants were 441 students (209 male and 232 female) in grades 8 (n = 213, 48.3%) and 9 (n = 228, 51.7%) from six public middle schools located in rural city, urban city, and metropolitan city of South Korea. Among the participants, 207 students were pursuing technological careers, and 234 were pursuing non-technological careers.

Instrument

In this study, we searched for instruments recently developed to measure students' learning motivation regardless of the subject area. Students' learning motivation toward a specific school subject affects their academic achievements and career pursuits associated with the school subject. Moreover, it was required that a valid and reliable instrument be used to gauge students' learning motivation. This study employed the SMQ II (Science Motivation Questionnaire II) developed and validated by science educators (Glynn et al., 2011). Glynn and colleagues originally developed a motivational scale to measure college students' motivation toward learning science (Glynn, Taasoobshirazi, & Brickman, 2007). The construct validity of this instrument was confirmed by exploratory and confirmatory factor analyses (Glynn et al., 2011). SMQ II was based on the social cognitive theory developed by Bandura (2006), and it measured sub-constructs such as external motivation (grade and career) and internal motivation (intrinsic motivation, self-determination, and self-efficacy) (Glynn & Koballa, 2006; Glynn et al., 2009; Glynn et al., 2011). The instrument has been employed in studies of secondary schools, other subjects, and other countries. In particular, prior studies were conducted for measuring secondary school students' motivation to learn science in other countries (Salta & Koulougliotis, 2015; Tosun, 2013). SMQ consists of 25 items covering five sub-constructs: intrinsic motivation, self-determination, self-efficacy, career motivation, and grade motivation. Students answer to each item on a five-point Likert scale: never (0), rarely (1), sometimes (2), often (3), or always (4). The possible score range on each construct is from 0 to 20.

To accomplish the purpose of this study, we obtained permission to use and modify SMQ II from its developers. SMQ II was translated into Korean and adapted to the Korean technology education scenario. The translation procedure was performed to retain the meaning and conceptual equivalence of each item (Hambleton, 2001; Sumathipala & Murray, 2000). We first invited three middle school English teachers, who held master's degrees in English education and lived in the United States for over three years, to translate the 25 items of SMQ II individually. The authors then compared the three different translations of each item by involving two in-service technology teachers in the exercise, arrived at a consensus on mismatched items among the translations, and compiled the modified, Korean-translated version of the instrument.

Each of the aforementioned in-service teachers had a Ph.D. and expertise in the field of educational measurement in technology education. We discussed process of reviewing each item in the instrument with the two reviewers. We found six items under three motivational sub-factors (intrinsic motivation, self-determination, and self-efficacy) to be irrelevant to the settings of learning technology in South Korea. For instance, the word 'life' in two items, "The technology I learn is relevant to my life" and "Learning technology makes my life more meaningful," within the intrinsic motivation factor, could be interpreted to have a vocational meaning to Korean students rather than an intrinsically motivated concept.

Accordingly, the modified instrument comprised 5 factors covering 19 items: intrinsic motivation (3 items), self-determination (3 items), self-efficacy (3 items), career motivation (5 items), and grade motivation (5 items). In addition, we employed a five-point Likert scale from 0 (never), 1 (rarely), 2 (sometimes), 3 (often), and 4 (always) for grading responses.

We added gender, career pursuit, preference toward technology subjects, and preference toward technology teachers for investigating the variables affecting middle school students' motivation to learn technology. The career section was subdivided into two sections, namely, technological career and non-technological career. Students' preferences toward technology subjects and teachers were measured independently using a five-point Likert scale from 0 (never) to 4 (like very much).

Data collection

Data for this study were collected via a survey. First, six public middle schools from urban areas were selected by contacting data collection organizers, who were technology teachers in the selected schools. Researchers visited the schools to take school technology teachers' consent and conducted a meeting to specify the guidelines for administering the survey. Administration of the instrument was completed during regular technology education class (sixteenth week out of seventeen weeks) in 2014 fall semester. The participants answered the instrument individually and anonymously after their technology teachers explained to them that the survey was voluntary.

Analysis

Data analysis was performed from three perspectives: First, this study conducted both EFA (exploratory factor analysis) and CFA (confirmatory factor analysis) for validating for the modified SMQ instrument used in this study. We used two factor analyses to identify key components of the students' motivation to learn technology and confirm the sub-construct of the instrument. Second, we compared the differences in students' motivation to learn technology by gender and by career pursuit using an independent t-test. Third, we investigated key variables affecting the preference toward technology education classrooms using hierarchical multiple regression. Statistical programs such as SPSS 21 and AMOS 20 were used for data analysis in this study.

FINDINGS

Factor analyses

Exploratory factor analysis

We checked whether these 19 items could be used in an exploratory factor analysis based on their KMO (Kaiser Meyer Olkin) value and the results of Barlett's sphericity test. It was found that the items could indeed be used for the factor analysis because the KMO value was .945 and the p value of Barlett's sphericity test was .000 (p<.05). We performed a Scree test for identifying the number of key factors. As a result, we determined that the tool for measuring motivation to learn technology should comprise five dimensions, thus legitimating the five-dimensional factor structure described earlier. Hence, we defined a total of five motivational components when implementing exploratory factor analysis for the aforementioned 19 items. The varimax rotational factor analysis method, an orthogonal rotation method, was incorporated in the factor analysis method for principal component analysis, the result of which is represented in Table 1.

According to the analysis, the accumulated explanatory power of five analyzed motivational factors was 74.37%. As for the items comprising these factors, factor 1 (comprising five items) deals with grade motivation, factor 2 (five items) with career motivation, factor 3 (three items) with self-determination, factor 4 (three items) with intrinsic motivation, and factor 5 (three items) with self-efficacy. The factors were titled as done by Glynn et al. (2011). Eigenvalues and explanatory variances were, 4.05 and 21. 33%, respectively, for grade motivation, 3.98 and 20.92%, for career motivation, 2.13 and 11.22% for self-determination, 2.06 and 10.85%, for intrinsic motivation, and 1.91 and 10.05%, for self-efficacy, with all eigenvalues and explanatory variances being greater 1.0 and 10%, respectively. In addition, a factor coefficient above .5 was deemed valid.

Table 1. Result of exploratory factor analysis

	Factor 1	**Factor 2**	**Factor 3**	**Factor 4**	**Factor 5**
Grade4	*.850*	.146	.126	.094	.158
Grade2	*.828*	.163	.214	.158	.127
Grade1	*.821*	.101	.260	.182	-.035
Grade5	*.705*	.184	.154	.139	.350
Grade3	*.690*	.205	.229	.018	.318
Career1	.052	*.810*	.311	.179	-.039
Career3	.235	*.802*	.073	.196	.180
Career2	.206	*.789*	.082	.273	.163
Career5	.132	*.784*	.101	.178	.214
Career4	.199	*.741*	.123	.153	.334
Determination2	.330	.107	*.728*	.119	.182
Determination1	.351	.250	*.672*	.270	.185
Determination3	.372	.247	*.591*	.136	.394
Intrinsic2	.190	.347	.024	*.765*	.209
Intrinsic1	.108	.413	.391	*.679*	.083
Intrinsic5	.236	.287	.305	*.640*	.344
Efficacy3	.201	.336	.261	.245	*.666*
Efficacy4	.411	.267	.236	.299	*.547*
Efficacy5	.396	.257	.301	.249	*.539*
Eigen value	4.053	3.976	2.131	2.062	1.909
% Variance	21.332	20.924	11.215	10.851	10.048
% Accumulated	21.332	42.256	53.471	64.323	74.370

Meanwhile, the five factor measurement tool for motivation to learn technology was deemed legitimate as the reliabilities of grade motivation (.904), career motivation (.908), self-determination (.812), intrinsic motivation (.832), self-efficacy (.810) were observed fairly high.

Confirmatory factor analysis

Verifying that a total of 19 items were classified into five different factors, the authors performed confirmatory factor analysis to verify the construct validity of the instrument. The goodness-of-fit indices referred to when evaluating models validity as part of the confirmatory factor analysis were x^2/df, CFI(Comparative Fit Index), GFI(Goodness Fit Index), RMSEA(Root Mean Square Error of Approximation), SRMR(Standardized Root Mean Residual), and so on.

According to Kline (2011), a model with x^2/df lower than 3 is deemed valid, and the authors verified that x^2/df for the model used herein was 2.968, which is lower than 3. According to Byrne (2010) and Hu and Bentler (1999), a model with both CFI and GFI lower than .9 is deemed valid, the authors verified that CFI and GFI for the model herein were .951 and .906, respectively, thus validating the model. When considering that RMSEA and SRMR values lower than .05 represent a close fit, .08 represents a reasonable fit, and .10 a mediocre fit, the authors verified that the RMSEA and SRMR values for the model used herein were .067 and .038, respectively, thus validating the model.

Differences by gender and career pursuit

The authors verified that the measurement tool is feasible, for both exploratory and confirmatory factor analyses. Previous studies have shown that grade motivation is influenced by variables such as gender and major. As an extension, our study tested how the motivation to learn technology varies with the variables. Considering that the participants of the study were middle school students, major was replaced with career pursuit. Meanwhile, teacher preference and subject preference were also expected to vary with the conventional variables such as gender and career pursuit.

Analyzing difference by gender

In order to test the difference by gender, the authors have categorized the groups by gender and performed independent t-test for a total of five sub-factors of the motivation to learn technology, including teacher preference and subject preference, the results of which are as illustrated in Table 2. According to the t-test, the male group had higher intrinsic motivation, career motivation and subject preference

Table 2. Difference in motivation and related factors by gender (Boy : 209, Girl : 232)

Factor	Gender	Mean	SD	*t*
Intrinsic motivation	Boy	9.670	2.436	3.929***
	Girl	8.733	2.558	
Grade motivation	Boy	16.545	4.381	-.823
	Girl	16.879	4.134	
Career motivation	Boy	16.703	4.030	4.834***
	Girl	14.858	3.980	
Self-determination	Boy	9.359	2.390	-.208
	Girl	9.405	2.277	
Self-efficacy	Boy	9.354	2.432	1.909
	Girl	8.918	2.361	
Teacher preference	Boy	2.828	.904	1.743
	Girl	2.677	.913	
Subject preference	Boy	2.311	.863	5.218***
	Girl	1.845	.999	

****p<0.001*

with statistical significance compared to the female group, with no statistically significant inter-group difference observed in grade motivation, self-determination, self-efficacy and teacher preference.

Analyzing Difference by Career Pursuit

To test the difference by career pursuit, we categorized the groups into either the technology related group and non-technology related group, and performed the t-test for a total of five factors that drive the motivation to learn technology, including teacher preference and subject preference. The results are shown in Table 3. According to the t-test, the technology related career pursuit group had higher intrinsic motivation, career motivation, self-efficacy, and subject preference with statistical significance compared to the non-technology related group. Furthermore, there were statistically significant inter-group differences among grade motivation, self-determination, and teacher preference.

Correlational analyses

To analyze correlation among a total of five factors, teacher preference, and subject preference, we performed correlational analyses, the results of which are shown in Table 4. According to the analyses, motivational factors and other variables had statistically significant positive correlation among them, best represented by the correlations among the factors of motivation to learn technology, varying from $r = .456$ to $r = .723$. Self-efficacy showed remarkably higher correlation with other factors such as self-determination($r = .723$, $p < .001$), intrinsic motivation($r = .648$, $p < .001$), grade motivation($r = .682$, $p < .001$), and career motivation($r = .648$, $p < .001$). Correlation between the factors of motivation to learn technology, being teacher preference varied from $r = .297$ to $r = .436$, less correlated than the factors of motivation to learn technology. The correlation between the

Table 3. Differences in motivation and related factors by career pursuit (Non-technological career: 234, Technological career: 207)

Factor	Career area	Mean	SD	*t*
Intrinsic motivation	Non-technological career	8.726	2.370	-4.024***
	Technological career	9.686	2.637	
Grade motivation	Non-technological career	16.564	4.307	-.824
	Technological career	16.899	4.191	
Career motivation	Non-technological career	14.859	3.746	-4.835***
	Technological career	16.720	4.272	
Self-determination	Non-technological career	9.295	2.308	-.847
	Technological career	9.483	2.354	
Self-efficacy	Non-technological career	8.842	2.385	-2.647**
	Technological career	9.444	2.386	
Teacher preference	Non-technological career	2.705	.928	-1.058
	Technological career	2.797	.891	
Subject preference	Non-technological career	1.889	.920	-4.156***
	Technological career	2.266	.976	

***p<0.01 ***p<0.001*

Table 4. Correlational analysis of motivation and related factors

Variables	1	2	3	4	5	6	7
1. Intrinsic motivation	-						
2. Grade motivation	.490***	-					
3. Career motivation	.709***	.465***	-				
4. Self-determination	.624***	.687***	.535***	-			
5. Self-efficacy	.693***	.682***	.648***	.723***	-		
6. Teacher preference	.436***	.349***	.297***	.424***	.360***	-	
7. Subject preference	.683***	.374***	.613***	.472***	.567***	.417***	-

****p<0.001*

factors of motivation to learn technology, teacher preference and teacher preference, being subject preference varied from r = .374 at the lowest to r = .683 at the highest.

Hierarchical multiple regression

To analyze comparative influential factors between subject preference and motivation to learn technology or teacher preference, we performed hierarchical multiple regression analysis to determine the feasibility of multicollinearity considering the significant inter-factor correlation. Tolerance between the factors of motivation to learn technology, an independent variable, and teacher preference varied from .375 to 1.00, with a variance inflation factor (VIF) of 1.000 to 2.668 and a Durbin-Watson ratio of 1.977, evidencing no correlation among the residuals to conclude multicollinearity. Hence, the authors deemed that the regression analysis was inclusive of independent variable factors. The hierarchical multiple regression analysis was performed for dependent variables in order of their correlation coefficients with subject preference, followed by factoring in the independent variables in order of their correlation coefficients by further reflecting self-efficacy, the result of which is shown in Table 5

Table 5. Result of Hierarchical multiple regression

Variables	B	SE B	β	R^2	adjust R^2	ΔR^2
Model 1				.467	.466	
Intrinsic motivation	.259	.013	.683***			
Model 2				.500	.498	.033
Intrinsic motivation	.190	.018	.501***			
Career motivation	.061	.011	.258***			
Model 3				.506	.503	.006
Intrinsic motivation	.170	.020	.448***			
Career motivation	.052	.012	.222***			
Self-efficacy	.045	.020	.112*			
Model 4				.523	.518	.017
Intrinsic motivation	.149	.021	.392***			
Career motivation	.054	.012	.231***			
Self-efficacy	.037	.019	.093			
Teacher preference	.153	.039	.144***			

*$p<0.05$
***$p<0.001$

According to analysis of influence of the factors of motivation to learn technology (teacher preference on subject preference in Model 1), intrinsic motivation represented an explanatory power of 46.7%. Further regressing career motivation in addition to Model 1, Model 2 yielded an explanatory power of 50.0%, 3.3% greater than that of Model 1. Further regressing self-efficacy in addition to Model 2, Model 3 yielded an explanatory power of 50.6%, 6% greater than that of Model 2. Further regressing teacher preference in addition to Model 3, Model 4 yielded an explanatory power of 52.3%, 1.7% greater than that of Model 3. Overall, we determined that in Model 4, intrinsic motivation, career motivation, and teacher preference had statistically significant influences on subject preference, whereas self-efficacy had no statistical significance in terms of such influence.

CONCLUSION AND IMPLICATIONS

In an attempt to develop a reliable, feasible measurement tool for motivation to learn technology in the context of South Korea, the authors decided to incorporate the motivational instrument developed by Glynn et al. (2011), which best represents the Korean educational environment. Originally developed for measuring university students' motivation to learn science-related subjects, the tool has been modified for application to other subjects and secondary school students.

In this study, we translated the measurement tool of Glynn et al. (2011), as suggested by Hambleton (2001) and Sumathipala & Murray (2000). Comprising a total 19 questions categorized under five different factors, the instrument modified by the authors was administered to 441 students of grade 8 and 9 from six different middle schools located in metropolitan cities in South Korea.

To verify the feasibility of this instrument, we performed EFA and CFA, independent t-test to understand differences in the motivation to learn technology by gender and career pursuit, and step-wise hierarchical regression analysis to investigate influence of factors and major variables on the preference for technology subjects.

The conclusions of this study are summarized as follows. First, according to the EFA based on a total of 19 questions categorized under five different factors, the accumulated explanatory power of the five factors was 74.37%, which is fairly high. According to the CFA, the major goodness-of-fit indices such as x2/df, CFI, GFI, RMSEA, SRMR and RMSEA were all deemed valid, thus confirming the feasibility of the instrument when used to analyze the factors that motivate students in South Korea to learn technology. Second, according to difference in the motivational sub-factors to learn technology by gender, the male group had higher intrinsic motivation and career motivation than the female group. According to the analysis of the difference by career pursuit, the technological career group had higher intrinsic motivation, career motivation, self-efficacy, and subject preference with statistical significance compared to the non technological career group. According to analysis of the difference in teacher preference and subject preference by gender and career pursuit, the male group and technological career group had higher subject preference, thus evidencing the difference in the motivational factors to learn technology and related variables by gender and career pursuit. Last but not least, according to hierarchical regression analysis to analyze the comparative influential factors between subject preference and the motivation to learn technology or teacher preference, we found that intrinsic motivation, career motivation and teacher preference influenced subject preference with statistical significance.

The implications of the study are as follows. First, it has been verified that, by analyzing EFA and CFA, the factors of motivation to learn technology include latent variables such as intrinsic motivation, which represents an innate preference toward technology subjects; self-efficacy, which represents belief in the self in terms of working on technology subjects; self-determination, which represents belief in self-determined learning; grade motivation, which represents a strong desire to achieve higher grades in technology subjects; and career motivation, which represents a strong desire to get an admired technology-related job. These results coincide with the conclusions of previous studies (Glynn et al., 2011; Tosun, 2013; Zeyer et al., 2013). It is thus advised that teachers take multiple perspectives toward motivational factors into consideration to increase students' motivation to learn technology.

Second, some factors represented the differences in the factors of motivation to learn technology, in terms of gender and career pursuit. The male group had higher intrinsic motivation and career motivation compared to the female group, due mostly to the facts that the technology-related subjects have been male-dominated (Rasinen et al., 2009) and we are barely able to see female students learning technology, or female professional engineers and technicians (Chatoney & Andreucci, 2009, McCarthy, 2009; Mitts, 2008; Sanders, 2001). Much effort has been invested in inducing female students to learn technology, which is why we need to further develop gender-specific educational approaches (Mammes, 2004). Along the lines of Rasinen et al. (2009), it is thus advised that technology education programs should take gender difference into consideration to attract greater numbers of female students. Also notable is the study conducted by McSpadden and Kelley (2012), which hinted at the necessity of a brand-new method of education targeted specifically at female students.

Meanwhile, the technological career group had higher intrinsic motivation, career motivation and self-efficacy than the non-technological career group. In the study conducted by Lawanto and Stewardson (2009), the students preferring engineering-related subjects fared much better in related engineering programs, implying the difference in motivation by preference. It is thus advised that the educational approach consider students' preferences.

Third, intrinsic motivation was the factor that had the greatest influence on preference for technology-related subjects, signifying that a higher intrinsic motivation would guarantee the induction of a greater number of students. The Revised Curriculum of 2009 in South Korea, which has been in effect since 2013, is a good example of how intrinsic motivation can be increased, because it mandated more than 30% of the subjects in Grades 7 through 9 to involve first-hand experience activities.

The next most influential factor was career motivation, signifying the importance of granting technology-related career motivation to students, by introducing technology-related jobs for interest's sake. It is thus advised that teachers spare time to introduce technology-related jobs or students' textbooks provide information related to technology-related jobs.

Last but not least, is teacher preference, signifying that teacher preference influences subject preference. The role of the technology instructors is thus a cardinal factor because they can make or break students' preference for technology-related subjects. It is thus advised that the curricula for teacher education in universities be solidified to create passion on the very base of the teachers to-be. With a mere four universities in South Korea running curricula for technology teacher education, the establishment of universities specialized in training technology teachers is a dire need.

In this study, we developed a feasible instrument for measuring students' motivation to learn technology and explored how to increase their motivation to learn technology. Although this study covered only middle school students, further studies will be extended to wider populations such as high school students or students outside the country for analyzing the motivation to learn technology. Such follow-up studies would further check how educational materials and media improve and influence the factors of motivation to learn technology.

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