Analysis of the relationship of students' self-efficacy, test anxiety, and parental involvement toward learning strategy and achievement in Korean middle school mathematics

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Abstract: This research used the third year survey data of 6,212 ninth graders from the 3-year Korea Educational Longitudinal Study (2005-2007) in order to examine the relationship of students' self-efficacy, test anxiety, and parental academic involvement toward learning strategy and academic achievement in middle school mathematics in South Korea by applying structural equation modeling. After satisfying the standard fit of both the measurement model (TLI=.979, CFI=.989 RMSEA=.040) and the structural model (TLI=.969, CFI=.983 RMSEA=.046), the authors verified the positive effect of academic self-efficacy (B=.21, β =.47) and parental academic involvement (B=.06, β =.15) as well as the negative effect of test anxiety (B=-.05, β =-.13) on learning strategy. Moreover, the positive effect of all variables on academic achievement proved to be statistically significant based on the following results: academic self-efficacy (B=33.51, β =.36), test anxiety (B=3.35, β =.04), parental academic involvement (B=9.81, β =.12), and learning strategy(B=7.89, β =.04). These results show that students' academic self-efficacy had the greatest effect on learning strategy and academic achievement, suggesting that educators should increase students' academic self-efficacy, promote parental academic involvement, and decrease test anxiety in order to improve learning strategy and academic achievement in middle school mathematics in South Korea.

Keywords: *self-efficacy, test anxiety, parental academic involvement, mathematics education, structural equation modeling*

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I. Purpose of study

The evaluation of the students' educational achievement is very important in measuring the extent to which the students achieve the educational objectives guided by the curricula and to improve teaching and learning methods. In South Korea, the Korea Institute of Curriculum and Evaluation has been nationally evaluating academic achievement since 2008. At an international level, most notable examples are the PISA (Program for International Student Assessment), an international comparative study of academic achievement on reading, mathematics, and science for students under 15 years of age administered by the Economic Cooperation and Development, and the TIMSS (Trends in International Mathematics and Science Study), an international comparative study of mathematics and science achievement by the International Association for the Evaluation of Educational Achievement.

Upon examination of these international evaluations, however, Korean students demonstrate significant weakness in affective aspects of learning compared to their higher test results. Although Korean students achieved high scores in TIMSS' mathematics, they ranked only in the low-to-middle group concerning academic competency among the nations represented in the test (Park, 2007). Korean students also achieved top-level performance in PISA's mathematics, but they also ranked low in affective aspects of their academic literacy such as academic competency, participation, and anxiety (Nah, 2005).

Researchers have paid close attention to academic self-efficacy as an influential affective factor on mathematics achievement because academic self-efficacy is an indicator of competency in learning (Cha & Kim, 2009). Moreover, test anxiety in mathematics has been studied as an influential affective variable on academic achievement (Kim, 2009) as well as parental academic involvement as both an environmental and psychological factor (Shin & Lee, 2010, Kohl, Leuna & McMahon, 2007). Self-directed learning can also be examined by using cognitive strategy like elaboration (Rush, 2000) and meta-cognitive strategy like self-monitoring (Shin, 2008).

However, much of the previous research on the learner's academic achievement in relation to academic self-efficacy, test anxiety and parental academic involvement focused on a single variable or simply the relevance between them rather than the causal relationship. Therefore, the purpose of this study is to examine the integrative and structural causal relationship among these variables to empirically verify their effects on one another using the Structural Equation Modeling (SEM).

More specific research questions are as follows:

1. In Korean middle school mathematics, do academic self-efficacy, test anxiety, parental academic involvement influence learning strategy?
2. In Korean middle school mathematics, do academic self-efficacy, test anxiety, parental academic involvement and learning strategy influence academic achievement?

II. Theoretical Framework

Academic strategy is a concept that covers information processing activities that influence the learner's learning process (Han, 2004). This research examines learning strategy as cognitive strategy that signifies the promotion of information acquisition, organization, storage and utilization, and meta-cognitive strategy. Self-efficacy which is the variable that affects academic achievement and learning strategy is defined as the judgment of the self's ability to organize and implement the actions he intended to perform (Bandura, 1986). According to Pintrich and De Groot (1990), test anxiety is an intermediary that lowers performance by interfering with concentration of attention. Test anxiety in most research shows that students with low propensity toward anxiety tend to be more proactive and do their best in test while students with high propensity for anxiety tend to lose efficiency greatly due to worrying. Concerning parental academic involvement, Coleman (1988) explained family environment as a concept that covers the parents' economic ability, intellectual level or educational background, and interest and investment of time on the child's education. In this study, however, only parental involvement in the learning activities at home is examined.

Based on the previous study results, this study has set the following hypothesis:

- Hypothesis 1. In Korean middle school mathematics, academic self-efficacy, test anxiety, and parental academic involvement will influence learning strategy.
- Hypothesis 2. In Korean middle school mathematics, academic self-efficacy, test anxiety, parental academic involvement, and learning strategy will influence academic achievement.

III. Research Methods

- Data sources

This study examined the third year (2007) survey data of 6,212 9th graders, 3,229 male (52%) and 2,983 female (48%). from the 3-year Korea Educational Longitudinal Study (2005-2007).

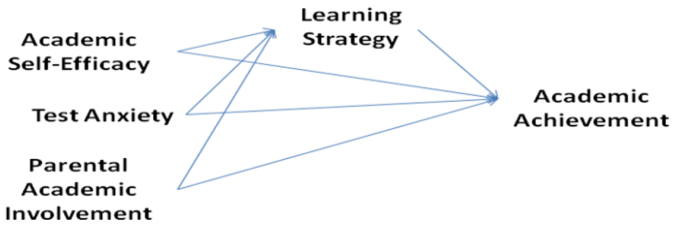
- Measurement instruments

The student's academic achievement was measured by using the assessment scores of the math curriculum in the Korea Educational Longitudinal Study. Academic strategy consists of demonstration, elaboration, organization, and meta-cognition. The Cronbach's α of the internal consistency reliability in each variable was as follows: demonstration (4 questions, Cronbach's α =. 773), elaboration (4 questions, Cronbach's α = .802), organization with 5 questions (Cronbach's α = .832), and meta-cognition with 5 questions (Cronbach's α = .834). Self-efficacy was measured in 5 questions (Cronbach's α = .922), test anxiety questions had 9 questions (Cronbach's α = .918), and parental academic involvement had 8 questions (Cronbach's α = .837).

- Data analysis

To examine causal and structural relationship between the variables, the authors set the statistical model based on the hypothetical research model as shown in Figure 1. To set the model, upon the result of explorative factor analysis, the measurement variables proved to be single-factor measurement variable. Our explorative factor analysis of academic strategy showed its four sub-factors: demonstration, elaboration, organization, and meta-cognition, and to prevent the excessive importance from being attributed to the measurement model, an item parcel was used for academic self-efficacy, test anxiety, and parental academic involvement. Item parceling uses the total or the average value of uni-dimensionally combined one-dimensional measured variables that measure the same factor (Kishton & Widamn, 1994) and can decrease measurement error. Item parceling can also achieve multivariate normal distribution rather than using individual questions (Bandalos, 2002). In order to determine the estimation method for the statistical model, AMOS was used to verify the multivariate normal distribution of the measurement variables of the structural equation model and each model's goodness-of-fit and parameters were estimated by the Maximum Likelihood Estimation procedures.

[Figure 1] Hypothetical Research Model



IV. Results

- Correlation matrix between measurement variables and descriptive statistics

Table 1 shows the mean, the standard variation, and the correlation analysis result for each variable, which confirmed a significant correlation of all variables at the significant level of .05. Since the conditions of the normal distribution is satisfied when the average skewness of the measurement variable in SEM is less than 3 and the average kurtosis is less than 10 (Kline, 2005), the basic hypothesis of the multivariate normal distribution is satisfied in our model.

[Table 1] Matrix of Mean, Standard Deviation, Skewness and Kurtosis of the measurement variables (*n*=6212)

Measurement variables	1	2	3	4	5	6	7	8	9	10	11
1. Academic self-efficacy 1	-										
2. Academic self-efficacy 2	.82*	-									
3. Test anxiety 1	.06*	.04*	-								
4. Test anxiety 2	.05*	.05*	.79*	-							
5. Parental academic involvement 1	.21*	.23*	-.13*	-.13*	-						
6. Parental academic involvement 2	.26*	.29*	-.18*	-.16*	.62*	-					
7. Demonstration	.18*	.20*	.18*	-.17*	.16*	.15*	-				
8. Elaboration	.38*	.40*	-.07*	-.07*	.20*	.22*	.37*	-			
9. Organization	.30*	.32*	-.10*	-.09*	.19*	.22*	.44*	.53*	-		
10. Meta-cognition	.38*	.41*	-.09*	-.07*	.21*	.25*	.44*	.59*	.61*	-	
11. Academic achievement	.37*	.39*	.03*	.04*	.16*	.24*	.03*	.24*	.14*	.25*	-
Mean	2.48	2.50	3.11	3.27	2.69	3.20	2.41	2.63	2.61	2.65	508.84
Standard Deviation	.73	.69	.85	.89	.75	.80	.53	.58	.59	.55	59.51
Skewness	.09	.04	.10	-.04	-.06	-.30	.00	-.26	-.26	-.38	.79
Kurtosis	-.32	-.03	.06	-.17	.18	.27	.96	.57	.61	.88	1.60

*p<.05

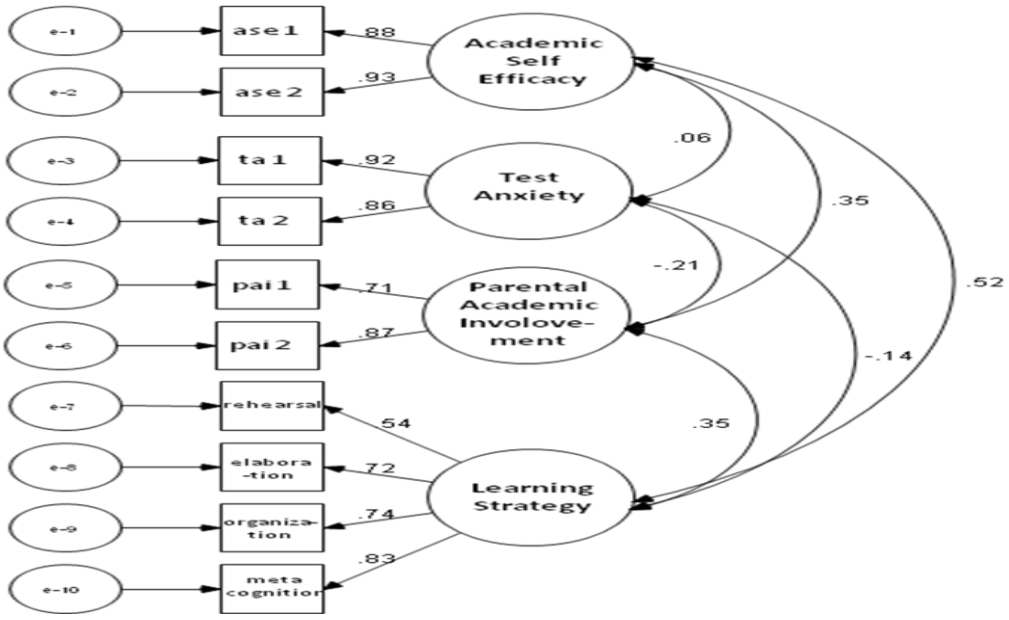
- Verification of the Measurement Model

Based on the verification process via 2-Level possibility of a measurement model (Kline, 2005), its goodness-of-fit was tested by the Maximum Likelihood Estimation and all measurement variables were appropriately measuring the applicable latent variables as indicated in Table 2 and Figure 2.

[Table 2] Results of the Goodness-of-Fit Test on the Measurement Model (*n*=6212)

	CMIN	*p*	*Df*	TLI	CFI	RMSEA (90% C.I.)
Measurement Model	11.022	.000	29	.979	.989	.040 (.036 ~ .044)

[Figure 2] Results of Parameter Estimation of the Measurement Model



- Verification of the Structural Model

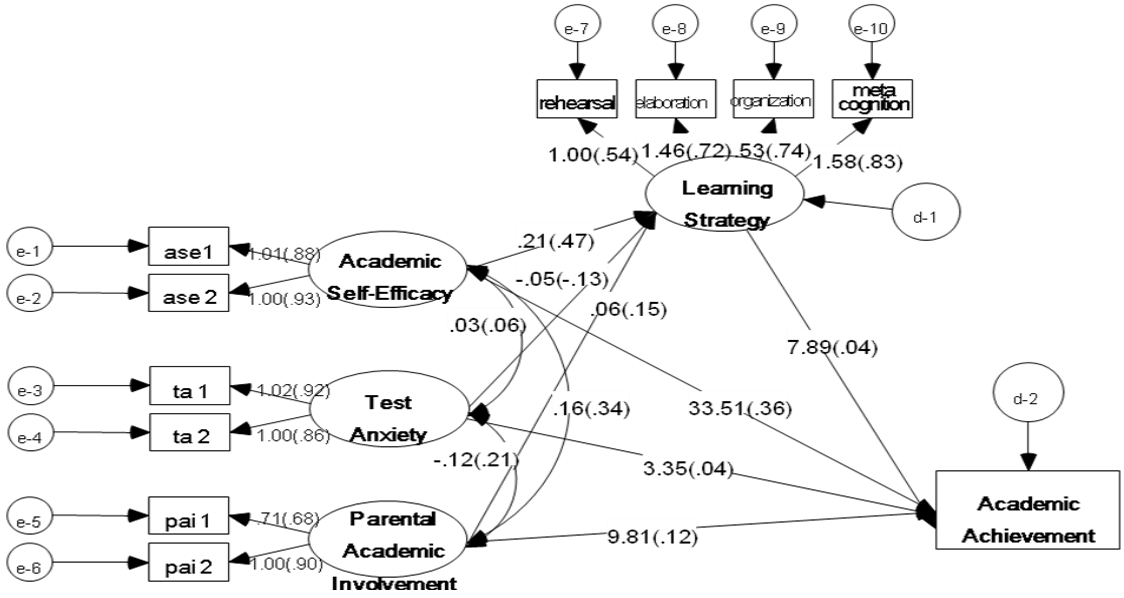
All the goodness-of-fit index of the measurement model were shown to satisfy the standard fit, and since the estimation possibility of the structural model has been theoretically verified, the goodness-of-fit of the research model was tested by the Maximum Likelihood Estimation, proving that it is a statistically proper model as shown in Table 3.

[Table 3] Results of the Goodness-of-fit Test for the Structural Model (*n*=6212)

	CMIN	*p*	*df*	TLI	CFI	RMSEA (90% C.I.)
Structural Model	14.782	.000	35	.969	.983	.046 (.043 ~ .050)

Based on these findings, the results of the effect verification between the measurement variables are as shown in Figure 3. Since the correlations among all variables were statistically significant, the structural model was selected as the final model described in Picture 3.

[Picture 3] Unstandardized (standardized) path coefficients of the structural model



Since academic self-efficacy, test anxiety, and parental academic involvement influences learning strategy, and concurrently, learning strategy was shown to influence academic achievement; it is necessary to examine the significance of the mediating effects between them (Baron & Kenny, 1986). Table 4 shows that learning strategy can be seen as mediating between academic self-efficacy and academic achievement, between test anxiety and academic achievement, and between parental academic involvement and academic achievement in middle school mathematics.

[Table 4] The Breakdown of the Direct/Indirect Effects (*n*=6212)

		Unstandardized coefficient (B)			Standardized coefficient(β)		
		whole	direct	indirect	whole	direct	indirect
learning strategy	← academic self-efficacy	.210	.210	-	.471	.471	-
learning strategy	← test anxiety	-.049	-.049	-	-.133	-.132	-
learning strategy	← parental academic involvement	.061	.061	-	.153	.153	-
academic achievement	← academic self-efficacy	35.168	33.509	1.659	.378	.360	.018
academic achievement	← test anxiety	2.959	3.349	-.390	.038	.043	-.005
academic achievement	← parental academic involvement	10.287	9.809	.478	.124	.119	.005
academic achievement	← learning strategy	7.888	7.888	-	.038	.038	-

V. Discussions and Implications

This research aimed to identify the structural relationship among academic self-efficacy, test anxiety, parental academic involvement, learning strategy and academic achievement in Korean middle school mathematics. Firstly, there were the positive effect of academic self-efficacy and the negative effect of test anxiety on learning strategy, confirming the existing research results that the students who possess high level of academic self-efficacy and low test anxiety employ effective learning strategy (Pintrich & De Groot, 1990). Secondly, upon the examination of the effect of academic self-efficacy, test anxiety, parental academic involvement, and learning strategy on academic achievement, all variables positively influenced academic achievement. One interesting result was that the test anxiety had a negative effect on learning strategy but a positive effect on academic achievement. These results can be explained by the Korean educational culture. Since mathematics is considered as a major subject and private tutoring on mathematic is prevalent in Korea, students can learn the contents of mathematics by memorization. Hence, it is possible that Korean students with high test anxiety can achieve highly on mathematics performance without developing deeper learning strategies, as verified by learning strategy's minor influence on academic achievement. Moreover, parental academic involvement had a positive effect on academic achievement and also indirectly influenced it, suggesting that it is important for parents to have a high expectation of their children's academic competency and provide intellectual and emotional stimuli for their children. Learning strategy also influenced academic achievement; so Korean students should have appropriate learning activities to improve learning strategy. Academic self-efficacy had the greatest effect on learning strategy and academic achievement in this research, suggesting that educational policy and practices should consider effective ways to increase students' academic self-efficacy.

This research is significant in that it has structurally verified the causal relationship between academic self-efficacy, test anxiety, parental academic involvement, learning strategy and academic achievement in Korean middle school mathematics. Unlike previous research, this research has expanded the variables influencing academic achievement to not only the learner variable, but also the causal relationship between the learner variable, the environmental variables and learning strategy. The fact that this study utilized the third-year data from the Korean Education Longitudinal Study can support the generalization of its results.

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