The Influences of the Academic Self-concept on Academic Achievement: From a Perspective of Learning Motivation (Draft)

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Abstract

Based on the released data of 5,690 Taiwanese 8th graders participating in TIMSS 1999, an elaborated motivation-resource competition model will be examined through the structural equation modeling technique. According to the model, a student's self-concept in one learning subject exerts a positive effect on his/her achievement in the same subject, but a negative effect on the achievement in another learning subject. The model demonstrates that students with higher academic self-concept tend to invest more time to engage in learning activities in correspondent learning subject; on the other hand, the time spending on study for other learning subjects will decrease relatively.

Keywords: academic self-concept, academic achievement, science learning, mathematics learning

Introduction

There are three perspectives about the relationship between the students' academic achievement and their academic self-concept. The skill development model proposes that academic achievement exerts a positive effect on the self-concept of students (e.g. Pottebaum Keith, & Ehly, 1986). Reversely, those who hold the self-enhancement model claim that the promotion of students' self-concept should be a prerequisite to enhance their academic performance (e.g. Wigfield & Karpathian, 1991). However, the reciprocal model is the most widespread perspective which emphasizes that there is a mutual causality between the academic self-concept and the academic achievement of a student (e.g. Guay, Marsh, & Boivin, 2003; Hansford & Hattie, 1982; Pajares & Schunk, 2001).

To interpret the mechanism of constructing the differentiated self-concepts of various academic areas, Marsh (1986) proposed an internal/external frame of reference model (I/E Model). By using I/E Model, Marsh illustrated how students' math and verbal performances influence on their math and verbal self-concepts. Successively, Marsh and Köller (2003, 2004) proposed the Unification Model to examine the relations, by using a longitudinal survey, among the academic self-concepts and the academic achievements across two different learning subjects as well as within one subject. In order to generalize the Unification Model to interpret the relationships among students' math/science achievements and their self-concepts of math/science learning, Chien, Jen and Chang (in press) argued that Unification Model can be substituted by I/E Model and a motivation-resource competition model (MR model) under the consideration for cross-sectional data. Chien et al. (in press) confirmed that I/E Model can be generalized to Math/Science subject learning. As for the MR model, the results indicated that a student's self-concept in one learning subject (math or science) has a positive effect on his/her achievement in the same subject, but a negative effect on the achievement in another learning subject (science or math) (Fig. 1). Chien at el. (in press) inferred those students with positive academic self-concept tend to invest more time to engage in learning activities in correspondent learning subject; on the other hand, the time spending on study for other learning subjects will decrease relatively. In this study, we will examine the elaborated MR model (Fig. 2) through the data of 5,690 Taiwanese 8th graders participating in TIMSS 1999.

Method

Based on the released database of TIMSS 1999(http://timss.bc.edu/timss1999i/database.html), a secondary analysis approach and structural equation modeling technique were utilized to examine the model mentioned above. Data screening and statistical assumptions testing were processed before model testing.

Six latent variables are involved in the proposed model: "Science Self-Concept" (SSC) and "Math Self-Concept" (MSC) are independent latent variables, "Science Achievement" (SA) and "Math Achievement" (MA) are dependent variables, and "Investment in Science Learning" (SI) and "Investment in Math Learning" (MI) are intermediates. Among these variables, SA and MA are estimated through the plausible values of difference subareas, SSC and MSC are estimated by students' responses on, respectively, four and five related items of the student background questionnaire (SBQ). As for the intervening variables ISL and IML, both are estimated by two related items of the SBQ (Table 1 and Figure 3).

[Take in Table1 about here]

Because the observed indicators include both ordinal and continuous variables, the asymptotic covariance matrix and weighted least-squares method have been used to estimate parameters as well as to process the model fitting (Jöreskog & Sörbom, 1996, 2001). The following criterions for goodness-of-fit indices are taken into account: GFI≧.90, SRMR ≦.08, RMSEA≦.08, NNFI≧.90, CFI≧.90, and CN≧200. Furthermore, the proposed model was validated through cross-validation technique, by which the total sampled subjects were randomly assigned into two groups. The data of first group was used to process the parameter estimation and the second one to process as a validation sample.

Finding and Discussion

The path coefficients of elaborated MR Model estimated through the five sets of plausible values did not show the expected negative effect but a positive correlation between MI and SI. A possible reason is that the two items which we used to measure students' MI and SI can't represent students' total investment of math and science learning. The two items can not imply the active learning activities but only passive ones. Because there is no other item in the students' background questionnaire of TIMSS 1999 can be used to represent the motivation of learning or active leaning, the authors revised the original model as Figure 3. The results indicate that the goodness-of –fit indices met the required criterions in substance (Table 2) and the estimated path coefficients confirm the revised model except for the path from SI to SA (Table 3 and Figure 3).

For both math and science learning areas, students' academic self-concept exerts a positive direct effect on their academic achievement ($\gamma_{MS \rightarrow MA}$=.18, $p<.01$; $\gamma_{SS \rightarrow SA}$=.16, $p<.05$). But the indirect effects between academic self-concept and academic achievement via passive investment demonstrate a positive effect for math learning ($\gamma_{MS \rightarrow MI \rightarrow MA}$=.12, $p<.05$) but no significant effect for science learning. Furthermore, there is a negative effect from the academic self-concept to passive investment in another learning area ($\gamma_{MS \rightarrow SI}$ =-.13, $p<.05$; $\gamma_{SS \rightarrow MI}$. =-.05, $p<.05$).

Although the self-concept on one learning area show a negative effect on the passive investment in another learning area, the indirect negative effects from MS/SS, via SI/MI, to SA/MA are not significant. The direct effect from the self-concept in one learning area still exerts a significant negative effect on another one ($\gamma_{MS \rightarrow SA}$ =-.11, $p<.05$; $\gamma_{SS \rightarrow MA}$. =-.11, $p<.05$). These results indicate that the passive investment in another learning area does not account for the negative effect between the academic self-concept and the achievement of another learning subject. The possible explanation of the results could be that "taking extra lessons/cramming school" and "doing homework" can not reflect the active learning and learning motivation honestly.

Conclusion and Implications

In order to explain the negative effects of the academic self-concepts on Math/Science on the academic achievements in Science/Math, we conducted a follow-up survey of TIMSS 2007. We put some questions of motivation of active learning in that survey. Hope we can confirm our explanation by using these items and the released data of TIMSS 2007. Furthermore, the group comparison for high achievement students and low achievement ones will be presented in the conference.

References

Chien, C.-L., Jen, T.-H., and Chang, S.-T. (in press). Academic self-concept and achievement within and between math and science: An examination on Marsh and Köller's Unification Model. Bulletin of Educational Psychology. (in Chinese)

Guay, F., Marsh, H. W., & Boivin, M. (2003). Academic self-concept and academic achievement: Developmental perspectives on their causal ordering. Journal of Educational Psychology, 95(1), 124-136.

Hansford, B. C., & Hattie, J. A. (1982). The relationship between self and achievement/performance measures. Review of Educational Research, 52, 123-142.

IEA. (2001). TIMSS 1999 international database. Retrieved March, 2007, from http://timss.bc.edu/timss1999i/database.html

Marsh, H. W. (1986). Verbal and math self-concepts: An internal/external frame of reference model. American Educational Research Journal, 23, 129-149.

Marsh, H. W., & Köller, O. (2003). Unification of two theoretical models of relations between academic self-concept and achievement. In H. W. Marsh, R. G. Craven, & D. McInerney (Eds.) International Advances in Self Research (Vol. 1, pp. 17-47). Greenwich, CT: Information Age.

Marsh, H. W., & Köller, O. (2004). Unification of theoretical models of academic self-concept/achievement relations: Reunification of east and west German school systems after the fall of the Berlin Wall. Contemporary Educational Psychology, 29, 264-282.

Marsh, H. W., & Craven, R. G. (2006). Reciprocal effects of self-concept and performance from a multidimensional perspective: Beyond seductive pleasure and unidimensional perspectives. Perspectives on psychological science, 1(2), 133-163.

Pajares, F., Britner, S. L., & Valiante, G. (2000). Relation between achievement goals and self-beliefs of middle school students in writing and science. Contemporary Educational Psychology, 25, 406-422.

Pottebaum, S. M., Keith, T. Z., & Ehly, S. W. (1986). Is there a causal relation between self-concept and academic achievement? Journal of Educational Research, 79(3), 140-144.

Wigfield, A., & Karpathian, M. (1991). Who am I and what can I do? Children's self-concepts and motivation in achievement situations. Educational Psychologist, 26, 233-261.

Appendix

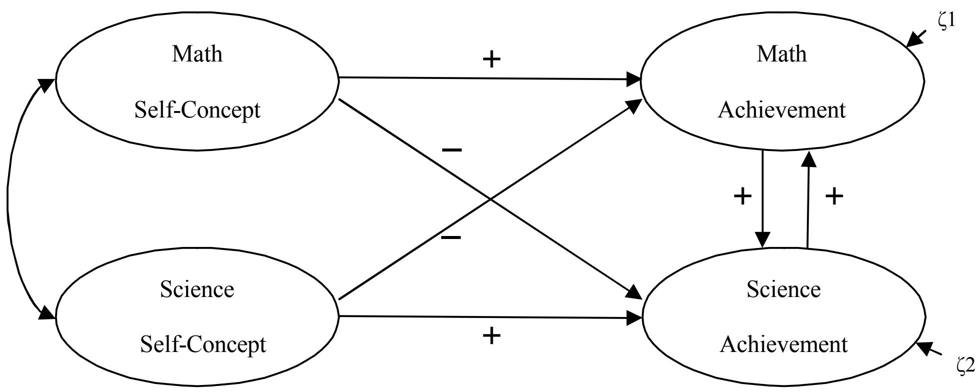

Figure 1: The motivation-resource competition model

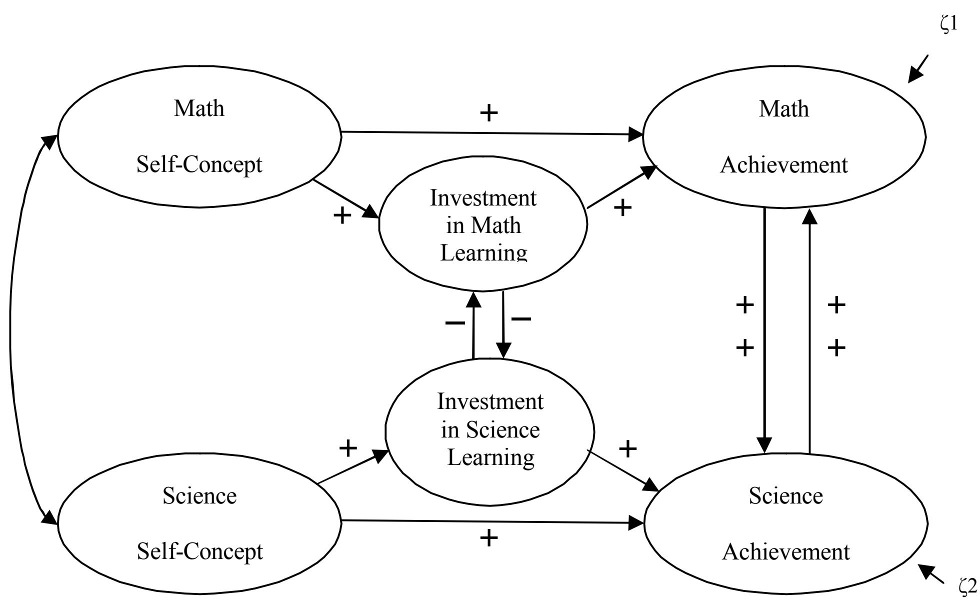

Figure 2: The elaborated motivation-resource competition model

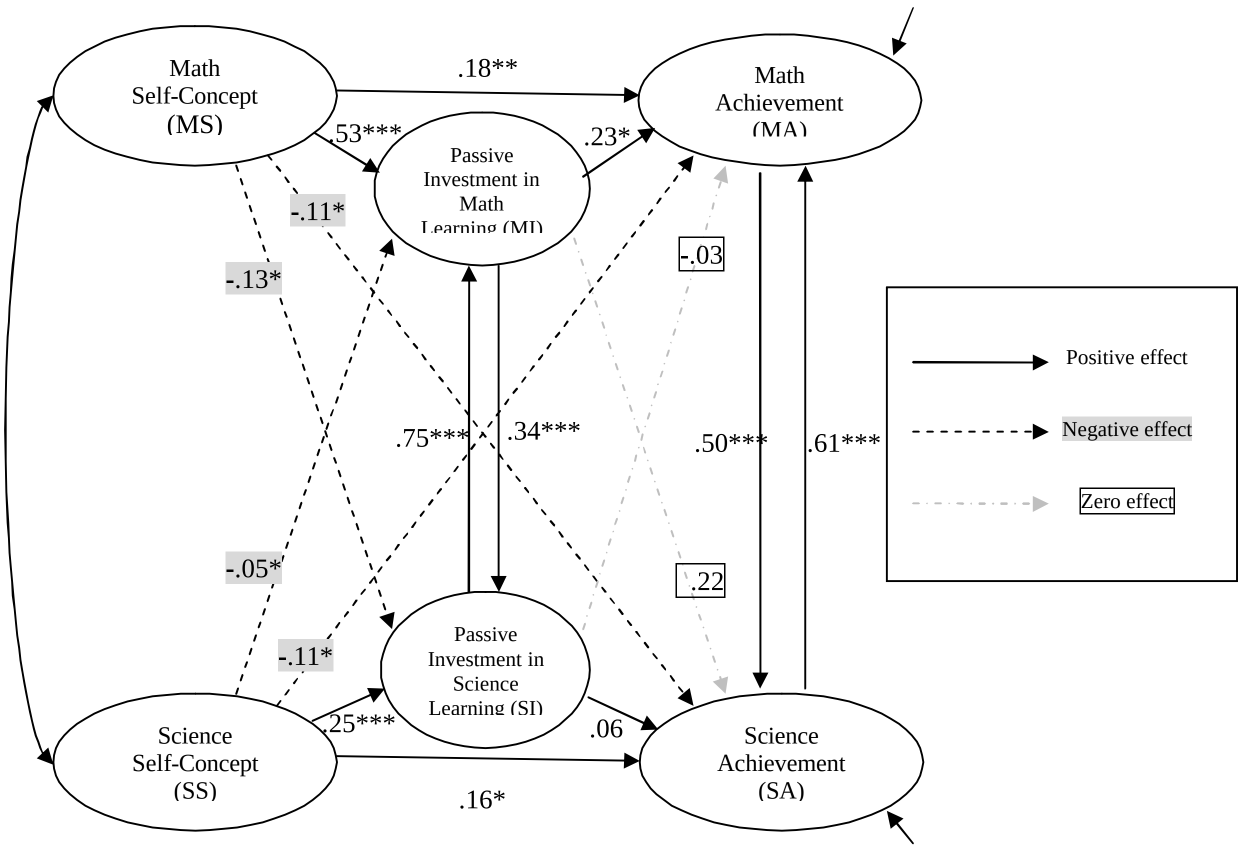

Figure 3: The revised motivation-resource competition model and estimated path coefficients

Table 1: The latent variables and correspondent indicators.

Latent Variable	*Indicators (Items)*	*Type of Variable*
Math Self-Concept (MS)	1. I usually do well in mathematic.	Ordinal
	2. Although I do my best, mathematics is more difficult for me than for many of my classmates.*	Ordinal
	3. Nobody can be good in every subject, and I am just not talented in mathematics.*	Ordinal
	4. Mathematics is not one of my strengths.*	Ordinal
	5. Sometimes, when I do not understand a new topic in mathematics initially, I know that I will never really understand it.*	Ordinal
Science Self-Concept (SS)	1. I usually do well in science.	Ordinal
	2. Although I do my best, science is more difficult for me than for many of my classmates.*	Ordinal
	3. Nobody can be good in every subject, and I am just not talented in science.*	Ordinal
	4. Science is not one of my strengths.*	Ordinal
Investment in Math Learning (MI)	1. During the week, how much time before or after school do you usually spend...(taking <extra lessons/cramming school> in mathematics?)	Ordinal
	2. On a normal school day, how much time do you spend before or after school doing each of these things? (studying mathematics or doing mathematics homework after school)	Ordinal
Investment in Science Learning (SI)	1. During the week, how much time before or after school do you usually spend...(taking <extra lessons/cramming school> in science?)	Ordinal
	2. On a normal school day, how much time do you spend before or after school doing each of these things? (studying science or doing science homework after school)	Ordinal
Math Achievement (MA)	1. Fractions and number sense	Continuous
	2. Measurement	Continuous
	3. Data representation, analysis, and probability	Continuous
	4. Geometry	Continuous
	5. Algebra	Continuous
Science Achievement (SA)	1. Earth science	Continuous
	2. Life science	Continuous
	3. Physics	Continuous
	4. Chemistry	Continuous
	5. Environmental and resource issues	Continuous
	6. Scientific inquiry and the nature of science	Continuous

* The raw data need to be recoded in reverse.

Table 2: The indices for goodness-of-fit of the elaborated MR model estimated by five sets of plausible values

Plausible Values	*df*	*Goodness-of-Fit*						
		χ^2	GFI (>.90)	RMSEA (<.08)	NNFI (>.90)	CFI (>.90)	SRMR (<.08)	CN (>200)
PV1	232	2170.434***	.995	.039	.951	.959	.070	725.387
PV2	232	2499.837***	.988	.042	.942	.952	.095	629.935
PV3	232	2186.482***	.993	.039	.949	.957	.074	720.071
PV4	232	2273.594***	.991	.040	.946	.955	.081	692.52
PV5	232	2292.470***	.997	.040	.947	.955	.077	686.826

***p<.001

Table 3: Parameter estimation for revised MR Model by LISREL 8.70

Path Coefficient	***Path coefficients (standard error) estimated by using different sets of plausible values***					**Aggregative Coefficient**
	PV1	PV2	PV3	PV4	PV5	
$\gamma_{MS \to MI}$	.51(.03)	.54(.03)	.56(.03)	.55(.03)	.51(.03)	**.53(.04)*** **
$\gamma_{MS \to SI}$	-.10(.05)	-.18(.04)	-.15(.05)	-.16(.05)	-.08(.05)	**-.13(.07)***
$\gamma_{MS \to MA}$	.23(.04)	.12(.05)	.17(.05)	.18(.05)	.17(.03)	**. 18(.06)****
$\gamma_{MS \to SA}$	-.14(.02)	-.12(.03)	-.09(.02)	-.13(.02)	-.05(.02)	**-.11(.05)***
$\gamma_{SS \to SI}$	.24(.02)	.26(.02)	.25(.02)	.28(.02)	.25(.02)	**.25(.03)*** **
$\gamma_{SS \to MI}$	-.04(.03)	-.07(.03)	-.05(.03)	-.05(.03)	-.05(.03)	**-.05(.03)***
$\gamma_{SS \to SA}$	.19(.02)	.21(.02)	.14(.02)	.19(.02)	.08(.02)	**.16(.06)***
$\gamma_{SS \to MA}$	-.14(.02)	-.12(.03)	-.09(.02)	-.13(.02)	-.05(.02)	**-.11(.05)***
$\gamma_{MI \to MA}$	.16(.08)	.25(.11)	.29(.09)	.23(.09)	.20(.07)	**.23(.10)***
$\gamma_{MI \to SA}$	.22(.06)	.38(.08)	.09(.06)	.29(.06)	.12(.05)	**.22(.14)**
$\gamma_{MI \to SI}$	.73(.06)	.80(.06)	.76(.07)	.75(.07)	.69(.07)	**.75(.08)*** **
$\gamma_{SI \to SA}$	.04(.05)	-.08(.06)	.17(.04)	.04(.05)	.13(.04)	**.06(.12)**
$\gamma_{SI \to MA}$	.01(.05)	-.05(.08)	-.07(.06)	-.02(.05)	-.05(.05)	**-.03(.07)**
$\gamma_{SI \to MI}$	.36(.05)	.37(.05)	.31(.06)	.32(.06)	.34(.05)	**.34(.06)*** **
$\gamma_{MA \to SA}$	.54(.03)	.45(.03)	.53(.03)	.45(.03)	.54(.03)	**.50(.06)*** **
$\gamma_{SA \to MA}$	.62(.03)	.63(.04)	.57(.03)	.61(.04)	.62(.03)	**.61(.04)*** **

p*<.05; ***p*<.01;* *p*<.001 (one-tail)