

Science Learning in Chinese Secondary Schools

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Abstract: This study explores and analyzes factors that are related to the science achievement of Chinese secondary school students. The variables include: job requirements, knowledge usefulness, influences of others, teaching methods, family conditions, perceived difficulty of subject area, and mathematics. This study also provides some data to supplement TIMSS.

Keywords: multicultural, science education, student beliefs, motivation

Background

The Third International Mathematics and Science Study (TIMSS) is the largest and most ambitious of any cross-national study undertaken. Unfortunately, TIMSS does not include information on Chinese students. This gap becomes even more pronounced when we consider that the largest group of students worldwide live in China. Chinese science education differs markedly from other Western science programs due to China's size, political system, and culture. The value of a cross-national study rests in its ability to inform American science educators about the successes of Chinese science programs.

Indeed, features of the Chinese science educational experience could serve as elements in a model for global science education improvement. For example, one model for exploration might be to incorporate a Chinese syllabus, an American textbook, the systematic Chinese lecture formats, Chinese students' work ethic, and American students' initiative and creativity. (Su, 1994).

Methodology

Subjects

A total of 2,303 secondary school students were selected by using cluster-sampling in two medium sized cities in eastern China, which included grades 7, 8, 10, and 11. The sample includes 1,238 males and 1,059 females. A total of 930 8th grade Chinese students were compared to their same grade counterparts participating in TIMSS.

Instrument

A questionnaire was developed by the authors. Most items were selected from *Students' Backgrounds and Attitudes towards the Science* in TIMSS. A total of 47 items were included in the questionnaire: 26 items were on general science and school study; 6 items were on time spent out-of school; 4 items were on achievement; and 6 items were about their science classes. The last 5 questions asked about student family background using multiple choice items. The reliability of the 26 items of this questionnaire was $\alpha = .846$.

Procedures

Data analysis included (1) descriptive methods were used to calculate the central trends of variables; (2) multiple linear regression revealed how variables influenced student science achievement and attitudes; (3) a two-way MANOVA was used to compare student science outcomes by grade and gender; (4) correlation analysis investigated relationships between variables and items; and (5) data of 8th grade Chinese students were compared with results in TIMSS.

Results of the Study

Grade differences

The results revealed that 7th and 8th graders' attitudes toward science were more positive than those of 10th and 11th graders. However, there was no significant difference by grade in *homework hours* and *teaching methods*.

Gender Differences

In most science related subjects, male students' attitudes toward science were more positive than female students' attitudes. This was especially true in subjects like physics, chemistry, and mathematics. However, there were no significant differences in *teaching methods*, *family condition*, and *TV watching time* between genders. Females even had better achievement than that of males in biology.

Particular Correlation

Opposite to the results of TIMSS, Chinese students' science achievement and attitudes were weakly correlated with the number of books in their homes ($r=.12$, $r=.12$), their parents' educational levels ($r=.08$, $r=.02$); and had no significant correlation with their owning a dictionary ($r=.02$, $r=.04$), desk ($r=.02$, $r=.03$), computer ($r=.03$, $r=.05$), or all three educational aids ($r=.02$, $r=.05$) in homes. Mathematics achievement was strongly correlated with physics ($r=.65$), chemistry ($r=.55$), and biology ($r=.40$). Another meaningful finding was that Chinese students' perceptions of encouragement of scientists' great successes were significantly correlated with their science achievement ($r=.20$) and attitudes ($r=.36$).

Science Study, Attitudes, and Achievement

Multiple linear regression was used to analyze the influence of ten factors on student science outcomes: achievement (A), attitudes (I), mathematics (M), difficulty (D), family condition (F), job (J), others' opinions (O), usefulness (U), teaching method (T), test frequency (Q), and homework hours (H). Five factors (I, M, D, F, & J) were found to influence student science achievement significantly ($R^2=.277$, $F=170.44^*$, $P_{SL5}<.05$). Six factors (D, A, U, J, O, & H) were found to influence student science attitudes significantly ($R^2=.610$, $F=579.49^*$, $P_{SL5}<.05$). Neither teaching method nor test frequency significantly influence students' achievement and attitudes.

Comparisons between China and other countries

Of the items used in this study, 25 were the same or similar to questions used in TIMSS. The data from 8th grade Chinese students were compared with that of 8th grade students from five countries that participated in TIMSS.

Table 1. Data from the TIMSS study compared with Chinese students

	Time spent after-school (hours/day)		Education aids in home (%)			The highest education level of parents (%)		Self-perception study science well (%)
	Science study	TV watch	Dictionary	Desk / Table	Computer	University	Post-secondary	
Australia	0.5	2.4	88	97	73	28	37	77
Canada	0.6	2.3	97	89	61	37	39	86
Germany	0.6	1.9	98	93	71	11	32	-
Japan	0.6	2.6	-	-	-	-	-	45
USA	0.6	2.6	97	90	59	33	54	86
<i>China</i>	<i>1.8</i>	<i>0.6</i>	<i>96</i>	<i>95</i>	<i>15</i>	<i>15</i>	<i>19</i>	<i>38</i>

Conclusions

The sample of Chinese students had a positive attitude toward science. However, there was an erosion in this attitude as students moved to higher-grade levels. Furthermore, there were gender differences, males had more positive attitudes toward science than females. This gender difference was more pronounced in physics and chemistry than in biology. Attitude toward science, knowledge of mathematics, difficulty level in learning, background of family, and need for science in future jobs were factors were closely related with students' science achievement. Compared with students from other nations, Chinese 8th graders spent more hours studying outside of school, less time watching TV, and fewer of their parents had completed university schooling.

Educational Importance

This study supplements TIMSS and provides further evidence of a decline in the interest of students in science as they move through the K-12 pipeline. Likewise, these data show the persistence of gender differences in attitude toward science and level of perceived achievement in science.

References

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