

## **Cross-Cultural Study of Relationship between Mathematics Academic Achievements and Motivation, Attitude and Self-Confidence in Mathematics**

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Utilizing the quantitative analysis methodology of questionnaire, the study explores the differences in the factors of achievement motivation, learning mathematics attitude and learning mathematics self-confidence and also the relationship between mathematics academic achievement and these factors in three areas in China. The following conclusions are drawn:

1. The subjects from different development level areas have significant differences in motivation, attitude and self-confidence in mathematics;
2. The subjects from different areas who possess the same ethnic group have significant differences. But the subjects from same area who possess different nationalities have little difference. It can be concluded that that the differences in these factors can be contributed to regional differences, rather than to ethnic differences;
3. The subjects from undeveloped areas have significant gender differences, and the levels of males are higher than those of female.

*Keywords:* motivation, learning mathematics attitudes, learning mathematics self-confidence, mathematics academic achievement, cross-cultural study

*ZDM Classification:* C4 0

*MSC2000 Classification:* 9 7C20

### INTRODUCTION

Educational psychology study (*cf.* Wu, 2003; Slavin & Robert, 2004) shows that non-cognitive factors comprise of motivation, attitudes and self-confidence which are important variables influencing for students' learning. From the educational perspective, learning motivation is core motivation, is a steady feature and inclination. It is a internal motive force that promotes directly student learning. Learning motivation is an important factor that makes learning activity go on smoothly. In addition, it is a characteristic of

personality (Pi, 2002).

Attitudes, which are formed during the process of learning mathematics, comprise cognition, feeling and behavior inclination. Learning attitude generalizes the attitudes of concrete objects including class, school assignment, teacher learning goods, test and achievement (Gagne, Briggs & Wager, 1992). Self-confidence refers to the judgment and values of students' ability which take place during the learning process activities. It is an important characteristic of personality and includes understanding, emotion and will. (Pi, 2002).

In China, so far, mathematics education studies have some progress on the non-cognitive factors which influence mathematic learning, and there are some important studies on the relationship between these non-cognitive factors and students' academic performance in mathematics (M. Li, 1994a; 1994b; Qiao & Fu , 2003; X. Li & W. Li, 2004). In these studies, the researchers give conclusions that the more motivation, attitudes, self-confidence, the better mathematical academic achievement. The subjects of these studies mostly come from the areas in China where the economy and culture are more developed. But in minority areas, the levels of economy and culture are much lower, and are the conclusions right still?

The *Trends in International Mathematics and Science Study* (TIMSS)<sup>1</sup> has made comparative studies on relationship between mathematics academic achievement and motivation, attitude, self-confidence. The subjects of the study in, 1995 and 1999, were from 38 nations and areas including America, Japan, Hong Kong, Holland and so on (Bao 2003, pp. 111–127 and pp. 166–168). In Asian subjects, the percentage of subjects who learn mathematics well so to have access to better middle school or university is highest. In the subjects from different countries, the higher mathematics academic achievement, the lower activity on mathematical learning (Bao, 2006).

Asian subjects have the highest achievement and lowest activity. The higher self-confidence follows the higher mathematics academic achievement. Although mathematics academic achievement of Asian subjects is much higher, self-confidence of them is much lower than that of the other countries. China is a nation that has 56 ethnic groups and many different development level areas. In China, is the conclusions right still? Why TIMSS does not study different ethnic group students?

So it is important in mathematics education to study the relationships between mathematics academic achievement and motivation, attitudes and self-confidence

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<sup>1</sup> TIMSS is an international comparison in mathematics education. The 1995 study was originally named the "Third International Mathematics and Science Study" and the 1999 was named the "Third International Mathematics and Science Study – Repeat (TIMSS-R)." However, since 2003 it had changed the name to the "Trends in International Mathematics and Science Study." See <http://timss.bc.edu/> for more information.

focusing on cross-cultural factors in China. This study also analyzes the differences in ethnic group and gender. It goes beyond the research work that has been done in China.

## METHODOLGY

This study utilized the quantitative analysis methodology with the purpose to provide basis for study and practice of cross-cultural mathematical education.

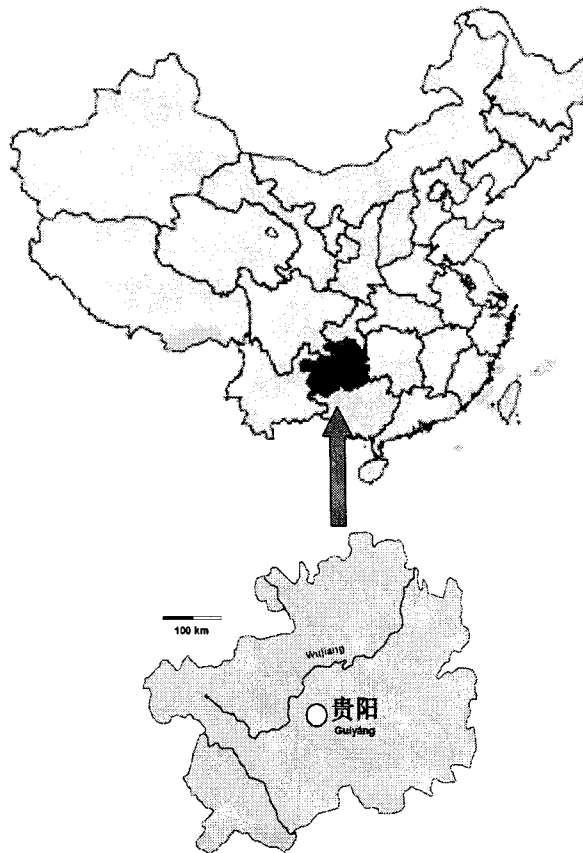


Figure 1. Guizhou Province in China

### Subjects

The subjects come from twelve classes of grade 2 of three junior middle schools from Guiyang City (贵阳; 貴陽: See Figure 1), Luodian County and Sandu County in Guizhou Province (贵州; 貴州), China and each school have four classes. Their

economic backgrounds vary greatly and from different cultural backgrounds of ethnic groups such as Hans (汉; 漢), Buyis (布依), Shuis (水), Miaos (苗) and others. As a political, economical, and cultural center of Guizhou Province, Guiyang has higher degree of social development and better education conditions. While Luodian is an area of poly-ethnic group living closely together and Sandu is an area of Shuis living closely together. Two counties have the same lower degree of social civilization and education.

**Table 1.** Breakdown of subject's ethnic group and gender\*

Area		H		B		S		M		O		Total	
		m	f	m	f	m	f	m	f	m	f	m	f
Guiyang	222	100	114	1	2	0	0	1	1	2	1	104	118
Luodian	234	35	31	54	51	2	2	30	25	3	1	126	108
Sandu	231	3	2	22	16	77	58	23	13	10	9	134	97

\*Note: Han s(H), Buyis(B), Shuis(S), Miaos(M), others(O); male(m), female(f)

## Instrument

### *Motivation Scale*

Achievement motive Scale Preliminary Manual was Constructed by Gjesme & Niggards (1970; see also Schultheiss & Brunstein 2005; Xie & Wang 2003) and this scale has been modified to suit the local situation. Its retest reliability is 0.75 while its structure validity is 0.48 and the scores vary from 30~120. It has ten items and each item is based on a 5 point scale. A sample is as follows. Mathematics is essential for studying physics, chemistry, computer and some other subjects, and social production and daily life keep in close touch with mathematics. How do you look upon the view?

### *Mathematics Attitude Questionnaire*

It is constructed by us according to the values of learning mathematics, feelings and behavior inclination. Its retest value and structure validity obtained is 0.69 and 0.44 respectively and the scores vary from 0~20. It has ten items and each item is based on a 5 point scale. A sample is as follows. After you learn some mathematical knowledge, do you think important content of them again?

### *Mathematics Self-confidence Questionnaire*

It is constructed by us according to the factors that students attribute the failure of learning mathematics to, the factors of learning mathematics behavior and inclination, and the factors of self-esteem, etc. The  $\alpha$  reliability coefficient value obtained is 0.847

and the scores vary from 0 ~ 40. It has ten items and each item is based on a 5 point scale. A sample is as follows. When you face the question you are not sure of in mathematical class, do you speak your own opinion boldly? Mathematics academic achievement is the average score of mid-term and final term tests. The two tests are given regularly in each of the three areas studied. The mid-term test measures algebra, and the final term test measures geometry. They measure basic knowledge, problem solving skill and reasoning skill.

### Program

The subjects' motivation level is divided into three groups: high-scoring group. Middle-scoring group and low-scoring group according to results obtained from the questionnaire. The subjects' attitude score is classified into three groups: active group .general group and the inactive group. Similarly, the mathematics self-confidences is divided three groups: high, medium and low. The mean and standard deviation (*SD*) score for each school is classified as excellent, moderate and backward students according to the ratio of the first 20%, the middle 60%, the final 20% students.

## RESULTS

Table 2 shows that there are significant differences in motivation, attitude and self-confidence in mathematics between Guiyang and Luodian, and similarly these differences apply to Guiyang and Sandu.

Among the three areas, the subjects from Guiyang obtained the highest scores in all. However, there is no significant difference between Luodian and Sandu.

**Table 2.** Comparison of motivation, attitude and self-confidence between areas

Area ( <i>n</i> )	Motivation			attitude			self-confidence		
	$\bar{X} \pm SD$	<i>Z</i>	<i>P</i>	$\bar{X} \pm SD$	<i>Z</i>	<i>P</i>	$\bar{X} \pm SD$	<i>Z</i>	<i>P</i>
Guiyang (222)	95.7±84.2	$Z'_{12}=15.93$	a	17.6±2.14	$Z'_{12}=15.70$	a	34.3±4.66	$Z''_{12}=15.90$	a
Luodian (234)	81.2±10.91	$Z'_{13}=17.61$	a	14.3±2.23	$Z''_{13}=17.61$	a	26.7±5.38	$Z''_{13}=14.92$	a
Sandu (231)	79.6±11.46	$Z'_{23}=9.54$	b	13.9±2.32	$Z''_{23}=1.90$	b	26.2±6.74	$Z''_{23}=0.88$	b

Note: *P*: a ( $P < 0.001$ ); b ( $P > 0.05$ )

Table 3 shows that in three areas, the subjects of Hans have significant differences in motivation, attitude and self-confidence in mathematics: The subjects of Hans from

Guiyang have the highest score. There are significant differences between subjects of Hans in Guiyang and Luodian. However, there are no significant differences between subjects of Buyis(B) and Miaos(M) in Luodian and Sandu.

**Table 3.** Comparison of the same ethnic group in different areas

*	Area	n	Motivation**			Attitude**			Self-confidence**		
			$\bar{x} \pm SD$	Z	P	$\bar{x} \pm SD$	Z	P	$\bar{x} \pm SD$	Z	P
H	Guiyang	214	95.9± 8.38	3.80	a	17.2± 2.18	0.81	a	35.1± 4.81	11.10	a
	Luodian	66	80.7± 10.07			14.4± 2.28			27.1± 5.21		
B	Luodian	105	81.6± 11.24	0.83	b	14.1± 2.20	0.88	b	26.2± 5.12	0.10	b
	Sandu	38	79.8 ± 11.52			13.7± 2.41			26.6 ± 6.81		
M	Luodian	55	82.3 ± 10.92	1.24	b	14.1± 2.21	0.21	b	26.9± 5.52	0.15	b
	Sandu	36	79.4± 10.91			14.2± 2.26			26.7± 6.66		

\*Note: Hans (H), Buyis (B), Miaos (M) - The Shuis subjects are almost from Sandu, and there are only two persons in Luodian and none in Guiyang. So comparison cannot be made.

\*\*Note: P : a ( $P < 0.001$ ); b ( $P > 0.05$ )

Table 4 indicates that in Luodian and Sandu, the subjects of Buyis, Miaos and Hans show no significant difference in motivation, attitude and self-confidence in mathematics.

**Table 4.** Comparison of ethnic group differences in the same area

Area	*	n	Motivation		Attitude		self-confidence	
			$\bar{x} \pm SD$	Z**	$\bar{x} \pm SD$	Z**	$\bar{x} \pm SD$	Z**
Luodian	B	105	81.6 ± 11.24	0.38	14.1± 2.20	0.98	26.2± 5.12	0.78
	M	55	82.3 ± 10.90	0.54	14.1± 2.21	0.85	26.9± 5.52	1.11
	H	66	80.7 ± 10.07	0.83	14.4 ± 2.28	0.73	27.1± 5.21	0.20
Sandu	S	135	78.1 ± 11.27	0.81	13.9 ± 2.30	0.45	26.0 ± 6.75	0.48
	B	38	79.8 ± 11.52	0.63	13.7 ± 2.41	0.71	26.6± 6.81	0.56
	M	36	79.4 ± 10.91	0.15	14.2 ± 2.26	0.92	26.7 ± 6.66	0.06

\*Note: Buyis (B), Hans (H), Miaos (M)

\*\*Note:  $P > 0.05$

Table 5 indicates that, in Guiyang, the subjects show no significant gender differences in motivation, attitude and self-confidence in mathematics.

Table 6 indicates that in Luodian and Sandu, the subjects have significant gender differences in them. In the same area, the different nationalities have significant gender differences in them and the levels of male subjects are higher than those of female.

**Table 5.** Comparison of gender differences in the same ethnic group

*	n	Motivation**			Attitude**			Self-confidence**			
		$\bar{X} \pm SD$	Z	P	$\bar{X} \pm SD$	Z	P	$\bar{X} \pm SD$	Z	P	
H	m	104	96.2 ± 9.46	0.7	b	17.9 ± 2.26	0.94	b	34.9 ± 4.72	1.76	b
	f	118	95.3 ± 7.88			17.3 ± 2.08			33.8 ± 4.58		
B	m	126	86.7 ± 10.39	9.02	a	15.9 ± 2.32	11.90	a	29.2 ± 5.84	7.61	a
	f	108	74.8 ± 9.77			12.4 ± 2.17			23.8 ± 5.01		
M	m	134	82.1 ± 11.66	5.46	a	15.6 ± 2.44	13.33	a	28.8 ± 6.91	7.33	a
	f	97	73.8 ± 11.28			11.6 ± 2.12			22.6 ± 5.89		

\*Note: Hans (H), Buyis (B), Miaos (M)

\*\*Note: P: a (P < 0.001); b (P > 0.05)

**Table 6.** Comparison of gender differences in different ethnic group

Area	n	Motivation			Attitude			Self-confidence				
		$\bar{X} \pm SD$	Z (+)	P	$\bar{X} \pm SD$	Z (+)	P	$\bar{X} \pm SD$	Z (+)	P		
Luodian	B	m	54	87.1 ± 10.42	7.13	a	16.1 ± 2.35	8.94	a	29.6 ± 5.88	5.85	a
		f	51	74.4 ± 7.66			12.2 ± 2.12			23.4 ± 4.98		
	H	m	35	86.4 ± 10.28	4.48	a	15.8 ± 2.27	6.19	a	28.7 ± 5.78	3.36	a
		f	31	75.2 ± 9.99			12.8 ± 2.21			24.2 ± 5.10		
M	m	30	86.1 ± 10.33	4.04	a	15.6 ± 2.28	4.75	a	28.9 ± 5.82	3.22	a	
	f	25	75.1 ± 9.82			12.7 ± 2.24			24.2 ± 4.99			
Sandu	S	m	77	82.3 ± 11.82	4.52	a	15.9 ± 2.49	12.13	a	29.1 ± 7.02	6.55	a
		f	58	73.4 ± 11.12			11.2 ± 2.01			21.9 ± 5.77		
	O	m	13	81.9 ± 11.40	1.72(t)	d	15.4 ± 2.36	3.59(t)	d	28.6 ± 6.79	2.09(t)	b
		f	11	73.9 ± 11.34			df=22			11.8 ± 2.20		
	B	m	22	81.9 ± 11.54	1.91(t)	d	15.2 ± 2.36	4.39(t)	c	28.5 ± 6.82	2.51(t)	c
		f	16	74.6 ± 11.36			df=36			11.8 ± 2.20		
	M	m	23	82.0 ± 11.60	1.89(t)	d	15.1 ± 2.39	3.98(t)	a	28.3 ± 6.88	2.19(t)	d
		f	13	74.4 ± 11.62			df=34			11.9 ± 2.18		

\*Note: Hans (H), Buyis (B), Miaos (M)

P: a (P < 0.001), c (P < 0.01), d (P < 0.05) — The probability of t is limit of single-side.

Table 7 shows that there is significant correlation between mathematics academic achievement and motivation, attitude and self-confidence in mathematics. The subjects with higher score of motivation, more positive attitude and stronger self-confidence is inclined to get higher mathematics academic achievement, and the difference is also significant.

**Table 7.** Cor relation analysis

		motivation	attitudes	self-confidence
Guiyang	$x^2$	15.21	14.71	14.65
	$P$	<0.01	<0.01	<0.01
	$r$	0.721	0.646	0.677
	$P$	<0.01	<0.01	<0.01
Luodian	$x^2$	17.74	15.62	18.39
	$P$	<0.01	<0.01	<0.01
	$r$	0.645	0.716	0.683
	$P$	<0.01	<0.01	<0.01
Sandu	$x^2$	18.91	19.32	18.46
	$P$	<0.01	<0.01	<0.01
	$r$	0.711	0.727	0.694
	$P$	<0.01	<0.01	<0.01

\* Note: The free degree of  $x^2$  test ( $df = 4$ )

## CONCLUSION AND DISCUSSION

### Area differences in motivation, attitude and self-confidence in mathematics

This study shows that in comparing motivation, attitude and self-confidence in mathematics, the subjects from Guiyang obtained significantly higher mean scores as compared to the subjects from Luodian and Sandu. However, the mean scores show no significant difference between Luodian and Sandu. There are various reasons and factors that might have contributed to these differences. We believe that students' motivation, attitude and self-confidence in mathematics, which are non-cognitive factors, are mainly influenced by the environment and education factors. Guiyang is regarded as the central focal point for political, economical and cultural center for Guizhou province.

Comparatively, it is much more developed than other areas and this significantly contributes to the difference in standard of living, better school conditions, higher standards acquired for teachers qualifications, fierce social competition and higher entry requirements for school admission. We believe that these factors significantly contributed to the higher attainment in the motivation, attitude and self-confidence in mathematics. In contrast, Luodian and Sandu are relatively economically underdeveloped compared to Guiyang, and these economic factors contributed to the students low scores in motivation, attitude and self-confidence in mathematics. In short, the economy and education conditions in Luodian and Sandu significantly influenced the requisition of students low self-expectation, low self-esteem and low self-confidence which we believe contributed



to their lower mathematics academic achievement.

### **National differences in the above-mentioned regional differences**

We investigated the subjects from different areas with the same ethnic group about difference levels of achievement motivation, learning mathematics attitude and learning mathematics self-confidence. We have also investigated the subjects from same area with different ethnic group about difference levels of them. From the results, the subjects from the same area in Luodian & Sandu with different ethnic group have no significant differences in achievement motivation, learning mathematics attitude and learning mathematics of self-confidence. But the Hans subjects from Guiyang and Luodian that have differences in social development level have significant differences in achievement motivation, learning mathematics attitude and learning mathematics self-confidence. So it is area differences that cause the differences in the achievement motivation, learning mathematics attitude and learning mathematics self-confidence, instead of ethnic group difference. This accords with the results which we obtained with cross-culture methods (Luchuanghan & Wangbingyi 1991).

Some research indicated that the differences on cognitive and non-cognitive factors are not caused by ethnic group difference, but by development level differences of society and culture (Lu & Wang 1991). So educating and developing motivation, attitude and self-confidence in mathematics, must be restricted by economy, cultural and social development level. And school heads and teachers have a significant role to play for positive changes to occur in motivation, attitude and self-confidence in mathematics. In fact, the connection between mathematics academic achievement and motivation, attitude and self-confidence are mutual and not stand-alone, and these factors play an important role in mathematics learning which directly influence the learning processes and academic achievement. Also teachers should consciously provide abundant opportunities for students even with a slight chance of success to achieve higher academic achievement.

### **Gender differences in motivation, attitude and self-confidence in mathematics**

This study indicates gender differences in motivation, attitude and self-confidence is significant in all areas except Guiyang and this difference is also significant in the same area. We believe that motivation, attitude and self-confidence, which are non-cognitive factors, are mainly influenced by the environment and education. In Guiyang, relatively high economy and culture development level and open-minded, men and women have equal about education to success. However, in Luodian and Sandu, there are lower economic status and the non-equal social traditional cultural rights between men and women that are deeply rooted in family, society, even school and teacher. And in some

way the bias that men are superior to women impede the development and expectation of women that directly influenced their motivation attitude and self-confidence in mathematics. So the gender differences don't arise from national differences, but are determined by local social economic status, cultural perspective and education development level which can't be changed over night. School education can play an important role that can narrow the gender differences by paying greater emphasis on females pursuant of education.

The study is a cross-cultural research on different nationalities and different development level areas in China. The conclusions are as follows:

1. The subjects from different development level areas have significant differences in motivation, attitude and self-confidence in mathematics;
2. The subjects from different areas who possess the same nationality have significant differences. But the subjects from same area who possess different nationalities have little difference. It can be concluded that that the differences in these factors can be contributed to regional differences, rather than to ethnic differences;
3. The subjects from undeveloped areas have significant gender differences, and the levels of males are higher than those of female.

The background, the question and the method of the study are different from those of TIMSS, so the study is another one. But some conclusions of the study conform to the corresponding findings of TIMSS (Bao 2003). They all indicate that there is a close relationship between academic achievement and motivation, attitude and self-confidence in mathematics. The attitude levels of males are higher than those of female. Some conclusions of the study do not conform to those of TIMSS. In TIMSS, there is little gender difference, but in the study, the gender difference is significant. In all these studies, motivation, attitude and self-confidence are several important factors that influence mathematics academic achievement. Therefore, we should further go on our research on cross-national and cross-regional comparison in cross-cultural mathematics education (Lu & Wang 1991), so that we can put forward effective science measures to further promote research and development of mathematics education in theory and practice.

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