Journal of the Korean Society of Mathematical Education Series D:
Research in Mathematical Education
Vol. 13, No. 4, December 2009, 267–296

韓國數學敎育學會誌 시리즈 D:
<數學敎育硏究>
제 13 권 제 4 호 2009 년 12 월, 267–296

Comparative Study on Chinese Junior Middle School Students' Mathematics Belief Systems in Chaoxian and Han Nationalities

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(Received May 30, 2009. Accepted December 3, 2009)

We used the quantitative method to compare with Chinese junior middle school students' mathematics belief systems in Chaoxian and Han nationalities, and their correlations within its own group. By comparison, the results revealed that all students in Han and Chaoxian nationalities hold multiple beliefs, and their belief systems are not stable. In addition, there were some differences and similarities between their belief systems in two nationalities, and significant correlations were founded.

Keywords: students' belief systems about mathematics, Han nationality, Chaoxian nationality,
MESC Classification: C20, D10
MSC2010 Classification: 97C20, 97D10

INTRODUCTION

With the development of cognitive psychology, students' belief systems increasingly become concerned by researchers. The students' belief systems about mathematics are

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made up of one's views about the nature of mathematics, mathematics teaching, and mathematics learning (Ernest, 1989), as well as beliefs about self and learning contexts (Jin, Dai, Guo & Jia, in press). These beliefs are interrelated to each other, and influenced by each other (Thompson, 1992).

Ernest (1989) described beliefs of mathematics education as:

1. Beliefs about mathematics are the individual views about nature of mathematics as a discipline;
2. Beliefs about mathematics learning are the individual views of the process of learning mathematics, behaviors and mental activities, and what constitute appropriate and prototypical learning activities;
3. Beliefs about mathematics teaching are the individual views about the type and range of teaching roles, actions and classroom activities associated with the teaching of mathematics.

Beliefs about self in mathematics involve self-efficacy, goal orientation, task values, and attributions (Op't Eynde, De Corte & Verschaffel, 2006). Beliefs about learning contexts refer to the views about the classroom context, family context and social context (Mcleod, 1992).

Students' beliefs about mathematics, mathematics teaching and learning can determine how they choose a way to approach a problem, for which techniques will be used or avoided, how long and how hard they will work on it, and so on (Op't Eynde & De Corte, 2003). Students' ways of tackling mathematics problems are constrained by what they see as mathematics problems and what they see as reasonable ways of going about solving such problems (Wong *et al.*, 2002). So they also can influence solving problems and achievement of mathematics (Liu & Chen, 2004; Schommer-Aikins, Duell & Hutter, 2005; House, 2006; P. Chen, 2003; S. Chen, 2005; Wong, Marton, Wong & Lam, 2002). Students' mathematics-related belief systems can influence their subjective initiative, and lead them to choose the appropriate cognitive strategies to solve mathematics problems.

Although there have been so many important findings about students' mathematics belief systems so far, and the general agreement among researchers that students' beliefs have an important influence on mathematical learning and problem solving, research on this topic has not yet resulted in a comprehensive model of students' mathematics-related belief. As a matter of fact, most of the studies are relatively isolated from each other beliefs. And there are few or no researches about comparative study in different nationalities.

We used the quantitative method to investigate students' mathematics-related beliefs systems in Chaoxian and Han nationalities, and to find the differences and similarities between them. The results are expected to promote the development of beliefs research.

THEORETICAL FRAMEWORK

Ernest (1991) describes five social groups in the area of ideologies of mathematics education; industrial trainers, technological pragmatists, old humanists, progressive educators, and public educators. Each group has its own educational ideology; view of mathematics, theory of society, theory of ability, mathematical aims, and theory of learning/teaching mathematics, theory of resources, theory of assessment in mathematics, and theory of social diversity. He summarized ideologies of five social groups (see Table 0).

Table 0. Ideologies of five social groups about mathematics education

Social group	Mathematics	Mathematics learning	Mathematics teaching
Industrial trainers	Set of truths and rules	Hard work, effort, practice, rote	Authoritarian transmission, drill, no 'frills'
Technological pragmatists	Unquestioned body of useful knowledge	Skill acquisition, practical experience	Skill instructor motivate through work-relevance
Old humanists	Body of structured pure knowledge	Understanding and application	Explain, motivate pass on structure
Progressive educators	Personalized mathematics	Activity, play, exploration	Facilitate personal exploration, prevent failure
Public educators	Social constructivism	Questioning, decision making, negotiation	Discussion, conflict questioning of content and pedagogy

Students' beliefs about self in mathematics involve self-efficacy, goal orientation, task values, and attributions to beliefs about mathematics (Op't Eynde, De Corte & Verschffel, 2006). Self-efficacy is defined as personal judgment of one's capability to organize and execute courses of action to attain designated goals, and he/she seeks to assess its level, generality, and strength across activities and contexts (Bandura, 1997). Two distinct types of goal orientation have been of interest to researchers in psychology; intrinsic goal and extrinsic goal. The intrinsic goals of students are motivated primarily by a desire for knowledge acquisition and self-improvement (Slavin, 2009). The extrinsic goals of students are motivated primarily by a desire to gain recognition from others and to earn good grades (Slavin, 2009). Task value refers to the students' understanding and views about the task value for themselves. Attribution theory deals primarily with explanations for success and failure in achievement situations: ability, effort, and task difficulty. Ability and effort attributions are internal to the individual; task difficulty attribution is external (Slavin, 2009).

Students' beliefs about their learning contexts refer to beliefs about the role and the functioning of the students in their own classrooms, about the role and the functioning of their parents, and the socio-views about mathematics. There are two kinds of beliefs about the role and the functioning of students in mathematics classroom context. One is traditional mathematics classroom context beliefs, and the other is the new classroom context beliefs. The traditional mathematics classroom context beliefs are that the teachers play the main role in classroom activities. The new mathematics classroom context beliefs are that the students are in the centre of the classroom and the teachers occupy the guiding position.

As for beliefs about the role and the functioning of their parents, there are two kinds of beliefs (positive beliefs and negative beliefs) about family context. Students with positive beliefs about family context recognize parents' role is offering help to their mathematics learning. Students with negative beliefs about family context are unwilling to be understood by their parents, so they do not let their parents help them to learn mathematics.

The socio-views about mathematics mainly contain two aspects; beliefs about gender stereotypes and beliefs about mathematics superiority.

Based on the Ernest's theory, we identified and compared students' beliefs about mathematics, mathematics learning and teaching. Based on the theory about self-efficacy, goal orientation, task value, attribution and learning contexts, we identified the students' beliefs about self in mathematics learning and mathematics learning contexts.

RESEARCH METHOD

Participants

430 Chinese junior middle school students (grades 7–9) from 6 cities in Liaoning and Jilin Provinces participated in the study. The number of validated questionnaires was 413 (Han: 237, Chaoxian: 176).

Instruments

We developed a 180-items questionnaire to investigate students' belief systems about mathematics (see Appendix). The questionnaire consisted of five scales of beliefs about mathematics, mathematical teaching, mathematical learning, self in mathematics, and environment of learning. The scale on beliefs about mathematics was developed to survey students' beliefs about nature, epistemology, and the values of mathematics, including 26 items. The scale on beliefs about mathematical learning was developed to survey beliefs about views of students' ability and their learning methods, including 34 items. The scale on beliefs about teaching mathematics was developed to investigate their beliefs about purposes, methods, resources, and assessment of teaching mathematics, including 47 items. The scale on beliefs about self in mathematics was developed to investigate their beliefs about self, internal and external causes, including 31items. The scale on beliefs about learning contexts was developed to investigate their beliefs about progressive and traditional contexts.

Following the exploratory analysis, the internal consistency estimates of reliability (Cronbach's alpha coefficient) were computed for the scales representing the five factors. The scale on students' beliefs about mathematics teaching had a very high alpha (0.800), as did the scale on beliefs about mathematics (0.791), mathematics learning (0.742), self (0.723), and mathematics learning contexts (0.758). The alphas suggest that the five-factor model is a reasonable representation of the data and that an adjusted version of the questionnaire can provide us with an instrument to reliably measure students' mathematics related beliefs system.

Data Analyses

In order to facilitate quantitative analyses, numerical values of 1, 2, 3, 4 and 5 were respectively assigned to the responses of strongly disagree, disagree, undecided, agree, and strong agree. The analytical and statistical procedures of the data were carried out using a computer statistical software package SPSS 16.0.

To establish students' beliefs about mathematics, mathematical learning and teaching, we first used Ernest's five ideologies of mathematics to classify these three beliefs, and according to the average score, we identified which beliefs he or she may hold. That is to say, we believe that students hold one belief when its average score is higher than 3.

The higher the average score were, the stronger beliefs they held. Then, a synthetic method of cluster analysis is presented to evaluate and classify students holding beliefs, and determine the central beliefs or peripheral beliefs that students may hold; the classificatory criteria should be distance between 15–20 middle positions.

To establish students' beliefs about self in mathematics and learning contexts, we used average scores as judgment standards. When average score is higher than 3, we believe that students hold this belief. Between 3 and 3.5, they hold belief on average; likewise, between 3.5 and 4.5, on high level; above 4.5, on extremely high level.

Finally, independent samples of t-test are conducted to evaluate whether there are differences between Chaoxian and Han nationalities students' beliefs, with significant level at 0.05 (2-tailed). We adopt Pearson's correlation analysis to test correlative relationship between Chaoxian and Han nationalities students' holding mathematical belief systems, based on judgment standards of $p < 0.05$.

RESULTS

Comparison of Students' Belief Systems about Mathematics

Beliefs about Mathematics

Table 1. Comparison of students' beliefs about Mathematics in Chaoxian and Han nationalities

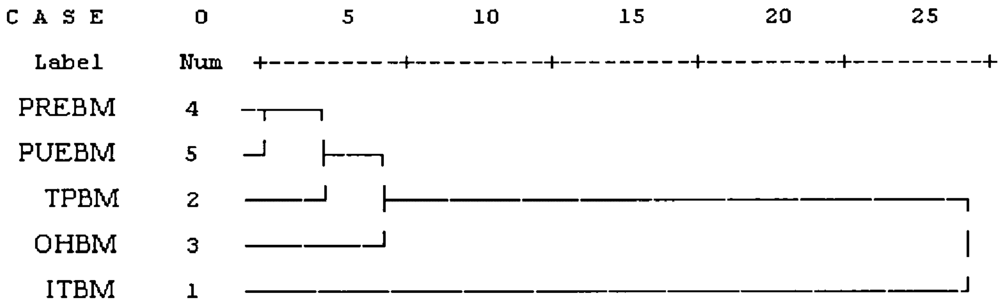
Social group	Nationality (Number)	Mean	Standard deviation	*P*-value
Industrial trainers	Han (237)	2.5601	0.70510	0.000
	Chaoxian (176)	2.8949	0.65816	
Technological pragmatists	Han (237)	3.1741	0.64689	0.012
	Chaoxian (176)	3.3381	0.66283	
Old humanists	Han (237)	3.5584	0.60560	0.028
	Chaoxian (176)	3.4233	0.62738	
Progressive educators	Han (237)	3.3685	0.48073	0.002
	Chaoxian (176)	3.5294	0.55285	
Public educators	Han (237)	3.2658	0.57624	0.461
	Chaoxian (176)	3.2244	0.54509	

Table 1 shows that the average scores of beliefs about mathematics of students (both in Han nationality and in Chaoxian nationality) of technological pragmatists, old humanists, progressive educators, and public educators, are higher than 3. The data indicates students' beliefs (both in Han nationality and in Chaoxian nationality) about mathematics may be those of technological pragmatists, old humanists, progressive educators and public educators.

Figures 1 and 2 demonstrate that beliefs (about mathematics) of technological pragmatists, old humanists, progressive educators, and public educators fall into a category (*i. e.* one of two big branches of the tree diagram), but those of industrial trainers are the other. Therefore, both Han and Chaoxian students hold beliefs of technological pragmatists, old humanists, progressive educators, and public educators, these are peripheral beliefs, and there is no central belief.

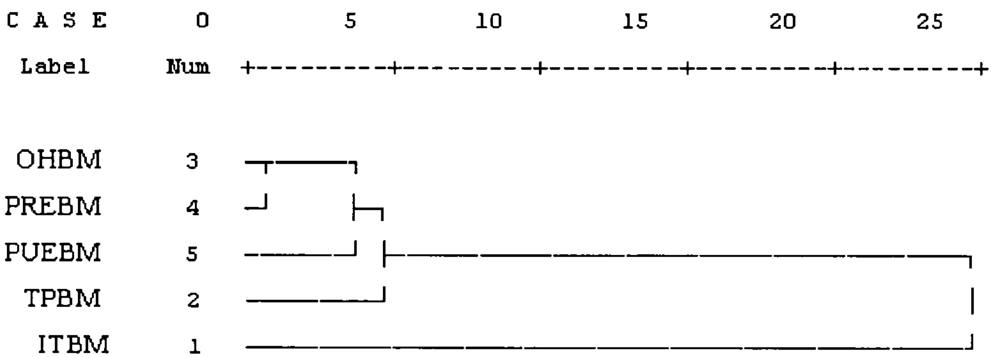
Through t-test, we could see that beliefs about mathematics of technological pragmatists, old humanists, and progressive educators, are significantly different. Compared with Han students, Chaoxian students hold stronger beliefs (about mathematics) of technological pragmatists and progressive educators, weaker those of old humanists.

In all, students in Han and Chaoxian nationalities hold beliefs about mathematics of technological pragmatists, old humanists, progressive educators, and public educators, which are peripheral beliefs, and there is no central belief. But compared with students in Han nationality, students in Chaoxian nationality hold stronger beliefs about mathematics of technological pragmatists and progressive educators lower than those of old humanists.



Notes: ITBM — industrial trainer beliefs about mathematics
TPBM — technological pragmatists beliefs about mathematics
OHBM — old humanists beliefs about mathematics
PREBM — progressive educators beliefs about mathematics
PUEBM — public educators beliefs about mathematics

Figure 1. Dendrogram of cluster analysis of students' beliefs about mathematics in Han nationality



Notes: ITBM — industrial trainer beliefs about mathematics
TPBM — technological pragmatists beliefs about mathematics
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Figure 2. Dendrogram of cluster analysis of students' beliefs about mathematics in Chaoxian nationality

Beliefs about Mathematical Learning

Table 2. Comparison of students' Beliefs about Mathematical learning in Han and Chaoxian nationalities

Social group	Nationality (Number)	Mean	Standard deviation	*P*-value
Industrial trainers	Han (237)	3.1266	0.58080	0.007
	Chaoxian (176)	2.9773	0.51027	
Technological pragmatists	Han (237)	3.5480	0.66782	0.024
	Chaoxian (176)	3.4020	0.61816	
Old humanists	Han (237)	3.3094	0.56197	0.378
	Chaoxian (176)	3.2576	0.62661	
Progressive educators	Han (237)	3.4219	0.61054	0.018
	Chaoxian (176)	3.2727	0.65498	
Public educators	Han (237)	3.4219	0.62389	0.198
	Chaoxian (176)	3.3456	0.55407	

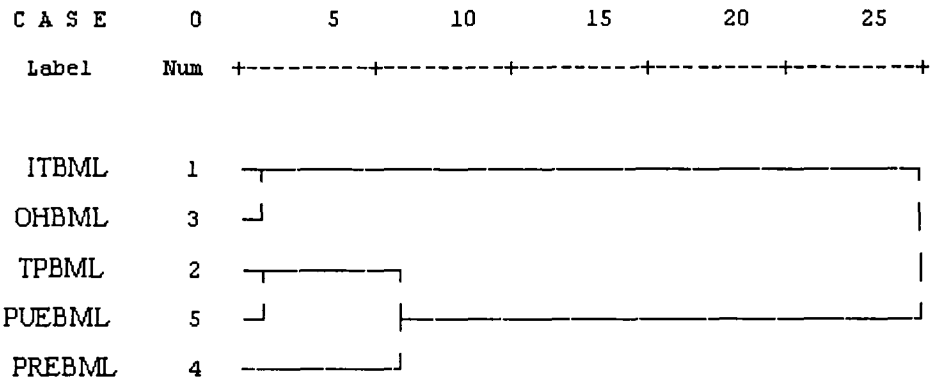
Table 2 shows that, in Han nationality, the average scores of beliefs about mathematical learning of students of industrial trainer, technological pragmatists, old humanists, progressive educators, and public educators are higher than 3. The data demonstrate that Han students' beliefs of mathematical learning are similar to beliefs about mathematical learning of industrial trainer, technological pragmatists, old humanists, progressive educators, and public educators.

Figure 3 demonstrates that, in Han nationality, beliefs about mathematical learning of industrial trainer and old humanists fall into a category, beliefs about mathematical learning of technological pragmatists, progressive educators, and public educators fall into the other. Therefore, students' beliefs about mathematical learning in Han nationality are beliefs of industrial trainer, technological pragmatists, old humanists, progressive educators, and public educators, which are peripheral beliefs.

Table 2 also shows that, in Chaoxian nationality, the average scores of beliefs about mathematical learning of students of technological pragmatists, old humanists, progressive educators, and public educators are higher than 3. The data demonstrate that Chaoxian students may hold beliefs about mathematical learning of technological pragmatists, old humanists, progressive educators, and public educators.

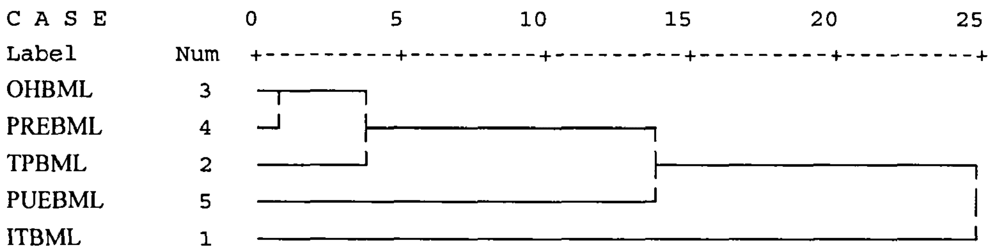
Figure 4 shows that, in Chaoxian nationality, beliefs about mathematical learning of industrial trainer fall into a category, those about mathematical learning of old humanists and progressive educators, technological pragmatists, and public educators are the other. So, students' beliefs about mathematical learning in Chaoxian nationality are beliefs of technological pragmatists, old humanists, progressive educators, and public educators, which are peripheral beliefs, and there is no central belief.

Through t-test, we could see that beliefs about mathematical learning of industrial trainer, technological pragmatists, and progressive educators, are significantly different. Compared with Chaoxian students, Han students hold stronger beliefs about mathematics of technological pragmatists, industrial trainer and progressive educators.



Notes: ITBML — industrial trainer beliefs about mathematics learning
TPBML — technological pragmatists beliefs about mathematics learning
OHBML — old humanists beliefs about mathematics learning
PREBML — progressive educators beliefs about mathematics learning
PUEBML — public educators beliefs about mathematics learning

Figure 3. Dendrogram of cluster analysis of students' beliefs about mathematical learning in Han nationality



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PREBML — progressive educators beliefs about mathematics learning
PUEBML — public educators beliefs about mathematics learning

Figure 4. Dendrogram of cluster analysis of students' beliefs about mathematical learning in Chaoxian nationality

In all, students in Han and Chaoxian nationalities hold beliefs about mathematical learning of technological pragmatists, old humanists, progressive educators, and public educators, Han students have those of industrial trainer too, which are peripheral beliefs, and there is no central belief. But students' beliefs about mathematical learning in Han and Chaoxian nationalities are significantly different on the other side. Students in Han nationalities hold stronger beliefs about mathematical learning of technological pragmatists, and progressive educators than students in Chaoxian nationality.

Beliefs about Mathematical Teaching

Table 3. Comparison of students' beliefs about mathematical teaching in Han and Chaoxian nationalities

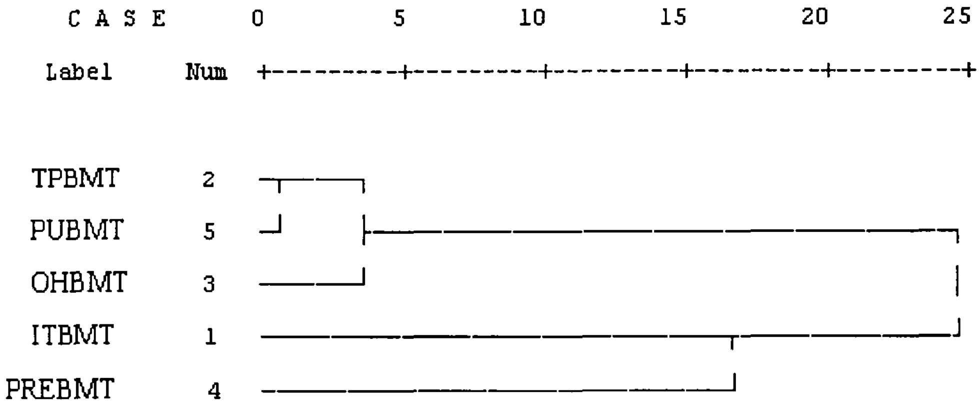
Social group	Nationality (Number)	Mean	Standard deviation	*P*-value
Industrial trainers	Han (237)	2.7291	0.70653	0.015
	Chaoxian (176)	2.8801	0.55446	
Technological pragmatists	Han (237)	3.3324	0.56201	0.122
	Chaoxian (176)	3.2481	0.52637	
Old humanists	Han (237)	3.2295	0.56536	0.080
	Chaoxian (176)	3.1335	0.52857	
Progressive educators	Han (237)	2.7008	0.48790	0.000
	Chaoxian (176)	3.1101	0.50784	
Public educators	Han (237)	3.4308	0.65795	0.000
	Chaoxian (176)	3.1790	0.53480	

Table 3 shows that, in Han nationality, the average scores of students' beliefs about mathematical teaching of technological pragmatists, old humanists, and public educators are higher than 3. The data indicated that Han students may hold beliefs about mathematical teaching of technological pragmatists, old humanists, and public educators.

Figure 5 demonstrates that, in Han nationality, students' beliefs about mathematical teaching of techno-logical pragmatists, old humanists, and public educators fall into a category, but beliefs about mathematical teaching of industrial trainer and progressive educators are the other. Therefore, students' beliefs about mathematical teaching in Han nationality hold beliefs of technological pragmatists, old humanists, and public educators, which are peripheral beliefs, and there is no central belief.

Table 3 also shows that, in Chaoxian nationality, the average scores of beliefs about mathematical teaching of students of technological pragmatists, old humanists, progressive educators, and public educators are higher than 3. The data indicates that students in

Chaoxian nationality may hold beliefs about mathematical teaching of technological pragmatists, old humanists, progressive educators, and public educators.



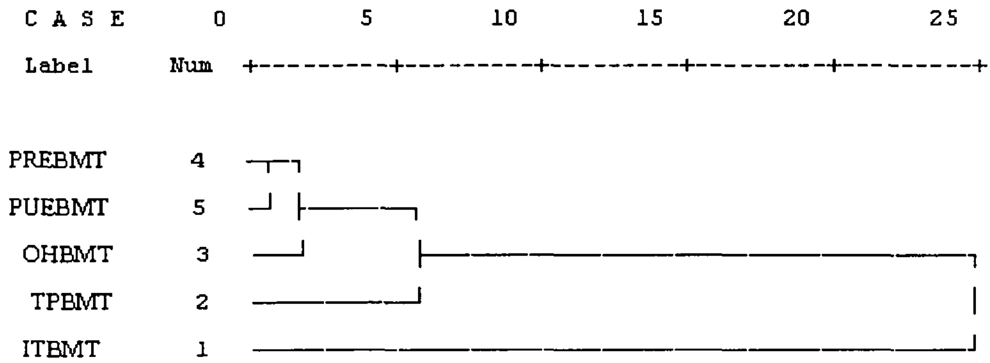
Notes: ITBMT — industrial trainer beliefs about mathematics teaching
TPBMT — technological pragmatists beliefs about mathematics teaching
OHBMT — old humanists beliefs about mathematics teaching
PREBMT — progressive educators beliefs about mathematics teaching
PUEBMT — public educators beliefs about mathematics teaching

Figure 5. Dendrogram of cluster analysis of students' beliefs about mathematical teaching in Han nationality

Figure 6 demonstrates that besides belief about mathematical teaching of industrial trainer, beliefs about mathematical teaching of technological pragmatists, old humanists, progressive educators, and public educators fall into a category. So, students' beliefs about mathematical teaching in Chaoxian nationality hold peripheral beliefs of technological pragmatists, old humanists, progressive educators, and public educators, and there is no central belief.

Through t-test, we could see that beliefs about mathematical teaching of progressive educators and public educators are significantly different. Students in Chaoxian nationality hold stronger belief about mathematical teaching of progressive education than in Han nationality. Students in Han nationality hold stronger belief about mathematical teaching of public educators.

In all, students in Han nationality hold beliefs about mathematical teaching of technological pragmatists, old humanists, and public educators. Students in Chaoxian nationality hold beliefs about mathematical teaching of technological pragmatists, old humanists, progressive educators, and public educators. They all have no central beliefs. But, students' beliefs about mathematical teaching in Han and Chaoxian nationalities are significantly different. Compared with students in Chaoxian nationality, students in Han nationality hold stronger beliefs about mathematical teaching of public educators.



Notes: ITBMT — industrial trainer beliefs about mathematics teaching
TPBMT — technological pragmatists beliefs about mathematics teaching
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PREBMT — progressive educators beliefs about mathematics teaching
PUEBMT — public educators beliefs about mathematics teaching

Figure 6. Dendrogram of cluster analysis of students' beliefs about mathematical teaching in Chaoxian nationality

Beliefs about self in mathematics

Table 4 shows that the average scores of Han students' beliefs about mathematical self-confidence, intrinsic goal and failure to effort in internal attribution lie between 3 and 3.5, and the average score of students' beliefs about mathematics success to effort in internal attribution lies between 3.5 and 4.5.

The data showed that students in Han nationality have beliefs about mathematical self-confidence. Their mathematical learning goals are intrinsic. To a certain extent, they think their failures in mathematics are attributable to their efforts. They have stronger success to effort attribution in mathematics.

Table 4 also indicates that, in Chaoxian nationality, the average scores of students' beliefs about self-confidence, intrinsic goal, success to effort and failure to effort in internal attribution in mathematics lie between 3 and 3.5. The data shows that students in Chaoxian nationality have belief about self-confident in mathematics. Their mathematical learning goals are intrinsic. To some extent, they think their successes and failures in mathematics are attributable to their efforts.

Table 4. Comparison of students' beliefs about self in mathematics in Han and Chaoxian nationalities

			Nationality (Number)	Mean	Standard deviation	P-value
Self-confidence			Han (237)	3.1533	0.65378	0.020
			Chaoxian (176)	3.3040	0.64679	
Attribution	Internal attribution	Intrinsic goal	Han (237)	3.3734	0.73975	0.001
			Chaoxian (176)	3.1506	0.61248	
		Success to effort	Han (237)	3.6055	0.95749	0.012
			Chaoxian (176)	3.3636	0.97754	
		Success to ability	Han (237)	2.9979	1.00896	0.078
			Chaoxian (176)	2.8295	0.88281	
		Failure to effort	Han (237)	3.1519	1.06670	0.966
			Chaoxian (176)	3.1562	0.94401	
		Failure to ability	Han (237)	2.6266	1.13627	0.855
			Chaoxian (176)	2.6080	0.93182	
	External attribution	Extrinsic goal	Han (237)	2.9596	0.77368	0.574
			Chaoxian (176)	2.9205	0.63809	
		Success to task	Han (237)	2.7046	1.12902	0.318
			Chaoxian (176)	2.8068	0.94395	
		Failure to task	Han (237)	2.6435	1.09723	0.318
			Chaoxian (176)	2.7472	0.96362	

Through t-test, students' beliefs about mathematical self-confidence, intrinsic goals, and success to effort attributions, are significantly different in Han and Chaoxian nationalities. In other words, students in Han nationality have higher beliefs about intrinsic goals and success to effort attributions, and lower self-confidence in mathematics, than those in Chaoxian nationality.

In brief, all the students in Han and Chaoxian nationalities have beliefs about self-confidence in mathematics to a certain extent, definite intrinsic goals, success to effort, and failure to effort attributions. But for their self-confidence, intrinsic goals, and success to effort attributions, there are significant differences. Students in Han nationality have higher beliefs about intrinsic goals and success to effort attributions, and lower self-confidence in mathematics, than those in Chaoxian nationality.

Beliefs about learning contexts

Table 5. Comparison of students' beliefs about learning contexts in Han and Chaoxian nationalities

Contexts	Nationality (Number)	Mean	Standard deviation	*P*-value
Progressive	Han (237)	3.2867	0.56043	0.000
	Chaoxian (176)	3.1078	0.46231	
Traditional	Han (237)	2.9574	0.52669	0.480
	Chaoxian (176)	2.9264	0.36428	

Table 5 shows that the average scores of students' beliefs about progressive learning contexts lie between 3.0 and 3.5 in both Han and Chaoxian nationalities. It indicated that students in both Han Chaoxian nationalities have beliefs about progressive learning contexts to a certain extent.

Through t-test, we could see that students' beliefs about progressive learning contexts are significantly different in Han and Chaoxian nationalities.

In short, students have beliefs about progressive learning contexts in Han and Chaoxian nationalities. Compared with students in Chaoxian nationality, students in Han nationality have stronger beliefs about progressive learning contexts.

Comparison of correlations of students' belief systems about mathematics

Correlations of students' belief systems about mathematics in Han nationality

By above knowable, students in Han nationality hold peripheral beliefs about mathematics of technological pragmatists, old humanists, progressive educators, and public educators, and there are no central beliefs; they hold peripheral beliefs about mathematical learning of industrial trainers, technological pragmatists, old humanists, progressive educators, and public educators; they hold peripheral beliefs about mathematical teaching of technological pragmatists, old humanists, and public educators, and also no central beliefs; they have beliefs about self-confidence; their mathematical learning goals are intrinsic, they think their failures in mathematics are attributable to efforts, they have stronger success to effort attribution; they have belief about progressive learning contexts to a certain extent.

Table 6 shows that in Han nationality students' beliefs about mathematics of old humanists, progressive educators, and public educators, have a positive correlations with beliefs about mathematical learning of technological pragmatists, old humanists, progressive educators, and public educators; beliefs about mathematical teaching of technological pragmatists, old humanists, and public educators; beliefs about intrinsic goals and progressive learning contexts.

Table 6. Correlations between students' beliefs about mathematics, mathematical learning, mathematical teaching, self in mathematics and mathematical learning contexts in Han nationality

	TPBML	OHBML	PREBML	PUEBML	TPBMT	OHBMT	PUEBMT	Self-Confidence	Intrinsic goal	Success to effort	Failure to effort	Progress
TPBM	0.292**	0.154*	0.121	0.16*	0.161*	0.259**	0.043	0.147*	0.139*	0.000	0.049	0.104
OHBM	0.377**	0.342**	0.348**	0.275**	0.324**	0.242**	0.312**	0.207**	0.292**	0.221**	0.019	0.245**
PREBM	0.317**	0.180**	0.262**	0.268**	0.308**	0.210**	0.295**	0.236**	0.174**	-0.012	0.017	0.215**
PUEBM	0.373**	0.267**	0.236**	0.357**	0.322**	0.283**	0.264**	0.122	0.233**	0.064	0.094	0.204**

* $p < 0.05$, ** $p < 0.01$

Beliefs about mathematics of old humanists have a positive correlation with self-confidence and beliefs about success to effort. Beliefs about progressive learning contexts have a positive correlation with self-confidence. Beliefs about mathematics of progressive educators have a positive correlation with beliefs about self-confidence. Beliefs about mathematics of technological pragmatists have a positive correlation with beliefs about mathematical learning of technological pragmatists, old humanists, and public educators; beliefs about mathematical teaching of technological pragmatists and old humanists; self-confidence and intrinsic goals. Beliefs about mathematics of technological pragmatists have no correlation with beliefs about mathematical learning of progressive educators, beliefs about mathematical teaching of public educators, beliefs about success to effort, failure to effort, and progressive environment of learning. Beliefs about mathematics of progressive educators were not related to beliefs about success to effort and failure to effort. Beliefs about mathematics of public educators were not related to beliefs about success to effort, failure to effort, and self-confidence. Beliefs about mathematics of old humanists have no correlation with beliefs about failure to effort.

Table 7 indicates that, in Han nationality, students' beliefs about mathematical learning of technological pragmatists, old humanists, progressive educators, and public educators, are positively correlated with beliefs about mathematical teaching of technological pragmatists, old humanists, and public educators; beliefs about self-confidence, intrinsic goals, success to effort, and progressive learning contexts.

Table 7. Correlations between students' beliefs about mathematical learning, mathematical teaching, self in mathematics, and learning contexts in Han nationality

	TPBMT	OHBMT	PUBMT	Self-confidence	Intrinsic goal	Success to effort	Failure to effort	Progress
TPBML	0.425**	0.463**	0.456**	0.247**	0.386**	0.250**	0.134*	0.455**
OHBML	0.305**	0.242**	0.179**	0.354**	0.215**	0.167*	0.002	0.225**
PREBML	0.432**	0.339**	0.310**	0.283**	0.330**	0.241**	0.185**	0.334**
PUEBML	0.442**	0.413**	0.370**	0.198**	0.293**	0.250**	0.095	0.279**

* $p < 0.05$, ** $p < 0.01$

Beliefs about mathematical learning of technological pragmatists and progressive educators have positive correlations with beliefs about failure to effort. But, beliefs about mathematical learning of old humanists and public educators have no correlations with beliefs about failure to effort.

Table 8. Correlations between students' beliefs about mathematical teaching, self in mathematics, and learning contexts in Han nationality

	Self-confidence	Intrinsic goal	Success to effort	Failure to effort	Progress
TPBMT	0.201**	0.231**	0.274**	0.029	0.449**
OHBMT	0.244**	0.250**	0.269**	0.108	0.410**
PUBMT	0.197**	0.302**	0.360**	0.084	0.617**

* $p < 0.05$, ** $p < 0.01$

Table 8 shows that, in Han nationality, beliefs about mathematical teaching of technological pragmatists, old humanists, and public educators, are positively correlated with beliefs about self-confidence, intrinsic goals, success to effort, and progressive learning contexts. These are not correlated with beliefs about failure to effort.

Table 9. Correlations between students' beliefs about self in mathematics and learning contexts in Han nationality

Contexts	Self-confidence	Intrinsic goal	Success to effort	Failure to effort
Progressive	0.253**	0.435**	0.414**	0.163*

* $p < 0.05$, ** $p < 0.01$

Table 9 shows that, in Han nationality, students' beliefs about progressive learning contexts have positive correlation with beliefs about self-confidence, intrinsic goals, success to effort, and failure to effort.

In short, in Han nationality, students' belief systems about mathematics have complex positive correlative relationships.

Correlations of students' belief systems about mathematics in Chaoxian nationality

By above analysis, students in Chaoxian nationality hold peripheral beliefs about mathematics, mathematical learning, and mathematical teaching of technological pragmatists, old humanists, progressive educators, and public educators, with no central beliefs; to a certain extent they are self-confident, their learning goals are intrinsic, they think their beliefs about successes and failures are attributable to efforts; they have beliefs about progressive learning contexts to a certain extent.

Table 10. Correlations between students' beliefs about mathematics, mathematical learning, mathematical teaching, self in mathematics, and mathematical learning contexts in Chaoxian nationality

	TPBML	OHBML	PREBML	PUEBML	TPBMT	OHBMT	PUEBMT	Self-Confidence	Intrinsic goal	Success to effort	Failure to effort	Progress
TPBM	0.276**	0.218**	0.228**	0.163*	0.310**	0.261**	0.261**	0.190*	0.113	0.311**	0.129	0.116
OHBM	0.478**	0.487**	0.505**	0.291**	0.460**	0.348**	0.373**	0.308**	0.325**	0.405**	0.295**	0.088
PREBM	0.362**	0.362**	0.382**	0.476**	0.494**	0.329**	0.358**	0.312**	0.294**	0.335**	0.252**	0.155*
PUEBM	0.394**	0.352**	0.418**	0.322**	0.465**	0.407**	0.404**	0.428**	0.125	0.451**	0.301**	0.170*

* $p < 0.05$, ** $p < 0.01$

Table 10 shows that, in Chaoxian nationality, students' beliefs about mathematics of technological pragmatists, old humanists, progressive educators, and public educators, are positive correlation with beliefs about mathematical learning and mathematical teaching of technological pragmatists, old humanists, progressive educators, and public educators; beliefs about intrinsic goals and progressive learning contexts in mathematics. Beliefs about mathematics of old humanists have positive correlation with beliefs about self-confidence and success to effort. Beliefs about mathematics of progressive educators have positive correlation with beliefs about self-confidence, success to effort, and failure to effort. Beliefs about mathematics of public educators have positive correlation with beliefs about success to effort and failure to effort. But, Beliefs about mathematics of technological pragmatists have no correlation with beliefs about self-confidence, success to effort, and failure to effort. Beliefs about mathematics of public educators have no correlation with beliefs about self-confidence. Beliefs about mathematics of old humanists are not correlation with beliefs about failure to effort.

Table 11. Correlations between students' beliefs about mathematical learning, and mathematical teaching, self in mathematics, learning contexts in Chaoxian nationality

	TPBMT	OHBML	PREBML	PUEBML	Self-confidence	Intrinsic goal	Success to effort	Failure to effort	Progressive contexts
TPBML	0.336**	0.531**	0.356**	0.344**	0.253**	0.389**	0.252**	0.055	0.226**
OHBML	0.404**	0.489**	0.393**	0.349**	0.133	0.362**	0.327**	0.104	0.258**
PREBML	0.385**	0.534**	0.373**	0.375**	0.197**	0.321**	0.238**	0.063	0.173*
PUEBML	0.461**	0.296**	0.291**	0.178*	0.151*	0.140	0.147	0.010	0.263**

* $p < 0.05$, ** $p < 0.01$

Table 11 indicates that, in Chaoxian nationality, students' beliefs about mathematical learning of technological pragmatists, old humanists, progressive educators, and public educators, are positive correlation with beliefs about mathematical teaching of technological pragmatists, old humanists, progressive educators, and public educators, and with beliefs about progressive learning contexts. Beliefs about mathematical learning of old humanists have positive correlation with beliefs about self-confidence. Beliefs about mathematical learning of technological pragmatists, old humanists, and progressive educators, have positive correlation with beliefs about intrinsic goals and success to effort. Beliefs about mathematical learning of technological pragmatists, progressive educators, and public educators have positive correlation with beliefs about self-confidence. Beliefs about mathematical learning of public educators are not correlated with beliefs about intrinsic goals, success to effort, and failure to effort. Beliefs about mathematical learning of technological pragmatists, old humanists, and progressive educators, aren't correlation with beliefs about failure to effort. Beliefs about mathematical learning of old humanists have no correlation with beliefs about self-confidence.

Table 12 indicates that, in Chaoxian nationality, students' beliefs about mathematical teaching of progressive educators, and public educators, are positive correlation with beliefs about self-confidence, intrinsic goals, success to effort, failure to effort, and progressive learning contexts.

Table 12. Correlations between students' beliefs about mathematical teaching, self in mathematics, and learning contexts in Chaoxian nationality

	Self-confidence	Intrinsic goal	Success to effort	Failure to effort	Progressive contexts
TPBMT	0.251**	0.337**	0.304**	0.111	0.517**
OHBMT	0.015	0.435**	0.089	0.076	0.256**
PREBMT	0.170*	0.313**	0.234**	0.153*	0.259**
PUEBMT	0.193*	0.521**	0.358**	0.128	0.392**

* $p < 0.05$, ** $p < 0.01$

Beliefs about mathematical teaching of technological pragmatists are positive correlation with beliefs about self-confidence, intrinsic goals, success to effort, and progressive learning contexts, with no correlation with belief about failure to effort. Beliefs about mathematical teaching of old humanists are positive correlation with beliefs about intrinsic goals and progressive learning contexts, with no correlation with beliefs about success to effort and failure to effort.

Table 13. Correlations between students' beliefs about self in mathematics and learning contexts in Chaoxian nationality

Contexts	Self-confidence	Intrinsic goal	Success to effort	Failure to effort
Progressive	0.357**	0.342**	0.398**	0.152*

* $p < 0.05$, ** $p < 0.01$

Table13 shows that in Chaoxian nationality students' beliefs about progressive learning contexts have positive correlation with beliefs about self-confidence, intrinsic goals, success to effort, and failure to effort.

In short, in Chaoxian nationality students' belief systems about mathematics have complex positive correlative relationships.

CONCLUSIONS

The study mainly compared with junior middle school students' mathematics belief systems and their correlation between Han and Chaoxian nationalities in China. The conclusions are as follow:

1. Han and Chaoxian nationalities students' belief systems about mathematics are instability.

According to the study, students' mathematics belief system is consist of mathematics beliefs, mathematics learning beliefs and mathematics teaching beliefs, it only have peripheral beliefs but no core beliefs, this indicates that the students' mathematics belief systems in Han and Chaoxian nationalities are instable. This may be caused by dynamicity. So the mathematics beliefs, mathematics learning beliefs and mathematics teaching beliefs in Han and Chaoxian nationalities are easy to change as time passing. That is to say, the peripheral beliefs may be gone or may turn to be the core beliefs.

2. The students' belief systems about mathematics in Han and Chaoxian nationalities are compound.

Han and Chaoxian nationalities students simultaneously have diverse beliefs of mathematics, mathematics learning and mathematics teaching which possibly contradict each other. So, students' belief systems about mathematics in Han and Chaoxian nationalities are compound, which being in agreement with the view of Green (1971). When studying the relationships among beliefs, Green clearly stated that beliefs are developed in cluster and affect each other. Each group of beliefs can not be affected by beliefs of other groups, in stead they may be affected by other beliefs in the same group.

3. There are ethnic differences in the students' mathematics belief systems in Han and Chaoxian nationalities.

There are differences in students' mathematics belief systems in Han and Chaoxian nationalities. Compared with Han students, Chaoxian students have stronger mathematics beliefs of technological pragmatists and progressive educators, and stronger self-confidence in mathematics. In contrast, compared with the students in Chaoxian nationality, students in Han nationality have stronger mathematics beliefs of old humanists, stronger mathematics learning beliefs of technological pragmatists and progressive educators, stronger beliefs about mathematical teaching of public educators, higher beliefs about intrinsic goals and success to effort attributions, and stronger beliefs about mathematics learning contexts of progressive.

4. Almost of beliefs among the students' mathematics belief systems are positive correlated with each other in its own nationality group.

For example, in Han nationality, students' beliefs about mathematics of old humanists, progressive educators and public educators, have a positive correlations with beliefs about mathematical learning of technological pragmatists, old humanists, progressive educators, and public educators; beliefs about mathematical teaching of technological pragmatists, old humanists, and public educators; beliefs about intrinsic goals and progressive learning contexts.

In Chaoxian nationality, students' beliefs about mathematics of technological pragmatists, old humanists, progressive educators, and public educators are positive correlation with beliefs about mathematical learning and mathematical teaching of technological pragmatists, old humanists, progressive educators, and public educators; beliefs about intrinsic goals and progressive learning contexts in mathematics.

The positive correlations mean that one belief is strong, the others are also strong.

DISCUSSIONS

1. The formations of scientific belief systems about mathematics

To accelerate students, the formations of scientific belief systems about mathematics are needed with appropriate teaching.

The instability of the students' belief systems about mathematics brings to the teaching positive and negative effects. With the appropriate teaching approach, the teacher can improve the students' irrational beliefs. However, some scientific beliefs the students have held could be abandoned at the same time. Furthermore, there are positive relations among mathematics belief systems that the students have held, which provide the teacher suitable opportunity to improve the students' beliefs. For example, if teachers want to improve the students' self-confidence level, they can achieve it through improving students' intrinsic goals. Based on the attribution theory, attributing the failure to efforts will help the students attain encouragement for the subsequent motivation and be led to positive learning behaviors.

2. The terrace of teaching exchange for different nationalities

Schools should provide the terrace of teaching exchange for different nationalities. In accordance with the differences between students' beliefs systems in Han and Chaoxian nationalities about mathematics belief systems, schools should increase more cooperation and exchange between various ethnic groups. For each nationality have its own cultural characteristics and strong points. Exchange of activities such as teaching observation should be carried out in different schools, which is helpful to improve the teaching standards, teachers' skills, the optimization of teaching resources, and the teaching philosophy. Each nationality students also can be achieved full development. There are more advanced teaching resources and teaching philosophy in those economically developed areas of Han and Minority nationalities. An effective way to improve the teachers' professional qualities and to learn advanced teaching philosophy and educational thought is providing opportunity for cooperation and exchanging between developed areas and underdeveloped areas as much as possible.

3. Further research.

We found that there are some differences between junior middle school students' belief systems about mathematics in Han and Chaoxian nationality. It is worth while to note that, teachers play an important role in the process of formatting students' beliefs for whether there are differences between teachers' belief systems about mathematics in Han and Chaoxian nationalities. In addition to that, whether there are differences between students' belief systems about mathematics in Han and other minority nationalities. All of these questions deserve further investigation.

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APPENDIX

QUESTIONNAIRE ABOUT MATHEMATICS SYSTEMS

Beliefs about mathematics

1. Different people have different understanding of mathematics.
2. Mathematics is a kind of subjective knowledge.
3. The true or false of mathematics knowledge only can be judged by authority or experts.
4. The mathematics domain is far beyond the question about ethnicity, culture, gender and society.
5. Mathematics is a body of truths, which needs to be complete.
6. Mathematics knowledge consists of two parts: one is pure knowledge, the other is application knowledge.
7. Mathematics is hierarchical: the higher level it is, the stricter the logic is, and the more abstract the content is.
8. Mathematics can be used freely, and it is above questions.
9. Mathematics is a language.
10. The values of mathematics are embodied in industrial production and wealth creation.
11. Mathematics is a tool.
12. In mathematics, if it is not right, it must be wrong.
13. The true or false of mathematics knowledge only can be judged by logical reasoning and prove.
14. Mathematics is a central element of culture.
15. Mathematics is "the queen of the sciences."
16. Mathematics has intrinsic values, which are strictness, logicality, abstractness, briefness, and constitution.
17. Mathematics knowledge has a hierarchy structure, from the shallower to the deeper.
18. The value of mathematics is that it can promote a development of human being.
19. Mathematics stems from guessing, exploring, reasoning, negotiating and verifying.
20. Mathematics is formed in society, and it has social value.
21. Mathematics is bounded by culture.
22. There is no clear boundary between mathematics and other subjects.
23. The producing and judging of mathematics depend on communicating and negotiating.
24. Mathematics is closely related to history, culture and daily life.
25. The human beings' development has nothing to do with mathematics.
26. Mathematics is not related to society and culture.

Beliefs about mathematics learning

1. Student slips easily into play and sloth unless checked and disciplined by nature.
2. Competition can encourage students to develop themselves better.
3. Mathematics ability of a student is different in nature, and the level of the ability is decided by social class.
4. Mathematics can be learned well by exercises and memory.
5. Students' development depends on autonomic learning, and it is influenced by culture and society.
6. A student is born with nothing, and he needs to be filled up with facts and skills through school education.
7. Mathematics ability is inherited, but this potential requires to be realized by teaching.
8. The acquirement of mathematics knowledge and skills depends on practical experience.
9. Although students are born with different essence or character, postnatal education can cultivate students' spiritual outlook, moral level and aesthetics.
10. Understanding should be emphasized during student's mathematics learning.
11. Mathematics ability is inherited, and it decided by the intelligence level.
12. Students are born with the ability of Mathematics, and its development depends on accumulation of experiences.
13. The ability of Mathematics is acquired by learning, and the social context plays an important role through the process.
14. When you learn mathematics, you should communicate and negotiate with others.
15. Students should use the method of active exploration to learn mathematics.
16. Students should raise their learning autonomies and positives through the activities of survey, discovery, play, discussion, exploration, and cooperation.
17. A student is born with good personality.
18. There is no relationship between student's mathematics ability and his social class.
19. It is important to remember the mathematics formulas and steps for learning mathematics.
20. The key of acquiring mathematics knowledge and skills is accumulating the learning experiences.
21. Teaching can develop students' mathematics potential.
22. Practice is the basic way to get mathematics knowledge and skills.
23. School education can develop students' abilities to perceive the arts and moral trait, but it can't change their natural mathematics ability.
24. School education can change students' personalities and qualities.
25. Students should understand the mathematics concepts and formulas.

26. Students should be grown up in the environment which helps them giving full play to their potential, and keeps them from the failure.
27. Accumulating experience is very important for developing mathematics ability.
28. Society, culture and effort work together to promote the student's development.
29. Learning mathematics needs gift.
30. While learning mathematics, you should develop the critical thought.
31. Laborious study is indispensable for mathematics learning.
32. The way of discussion and cooperation can make students acquire the answer without thinking.
33. When learning mathematics, students must operate by themselves.
34. Practical experience is very important for students.

Beliefs about mathematics teaching

1. Mathematics teaching should cultivate students' habit of following the rules.
2. Teachers teach us to get the computing power.
3. Mathematics teaching should be joyless.
4. I believe that the teachers' teaching and our learning should be taken as the method of mathematics teaching.
5. What matters is the teachers' professional quality for mathematics teaching than the instructional resource.
6. The attractive factors of materials, games, puzzles or television contents can detract the students' attention from their studies.
7. I think the way of examination is enough to test the result of students' leaning.
8. Mathematics teaching is to make the students possess the knowledge and skills for career.
9. Mathematics teaching should make students acquire the knowledge of computers and information technology.
10. Teachers should teach students how to use mathematics knowledge.
11. Instructional resources play an important role in mathematics teaching.
12. The instructional resources that teachers choose should service the accumulation of experiences for students.
13. Teachers should provide the enough opportunity for practice.
14. The assessment of mathematics learning should involve not only examination but also certification of skills
15. The aim of school education is to culture future mathematicians.
16. The goal of mathematics teaching is to transmit pure mathematics knowledge.
17. Teachers should guide students to understand the relationships among mathematics

concepts.
18. Teachers should use several kinds of questions and activities to help students understanding mathematics.
19. Teaching resources should help students understanding mathematics knowledge.
20. Mathematics teaching resources should involve models and visual aids.
21. The assessment of mathematics teaching should reflect the acquirement of application skills of students.
22. Examination is the best way to test students' learning.
23. Calculators can obstruct students' development of numeracy.
24. The purpose of mathematics teaching is to enable the students to perceive the beauty in mathematics.
25. Students should be allocated to several classes according to their mathematics ability.
26. The assessment of mathematics learning should involve not only examination but also research subject.
27. Examination is a good way to identify excellent mathematician.
28. The assessment of mathematics learning should pay attention to the process of mathematics learning.
29. Mathematics teaching should stimulate students' integrated development.
30. Mathematics teaching should cultivate students' positive attitudes, self-respect and self-confidence.
31. Mathematics teaching should not let students be frustrated.
32. During the mathematics teaching, teachers should often encourage students.
33. Teaching resources should help students connect their acquired knowledge with the new one.
34. Which resources should be used is decided by students.
35. Students' mistakes can not be explicitly indicated, when assessing their learning.
36. Unified examination is not a good way of assessing students learning.
37. Teachers should cultivate students' ability of solving social problem.
38. Mathematics teaching is to help students get the critical thinking.
39. In class, teachers should provide more opportunities of discussion between teachers and students, and students and students.
40. Teachers should often use the method of Group Cooperative Learning to teaching.
41. The materials about social problems should be regarded as the teaching resources, such as newspapers, official statistics and so on.
42. Resources for teaching should involve several kinds of materials, in order to adapt several kinds of teaching methods.
43. Teachers should provide the opportunities of discussing mathematics problems for us.
44. When teachers assessing students' learning, they should record students' learning

daily, such as mathematics performances in Class, homework and so on.

45. I think transmission is the most effective way for mathematics knowledge teaching.
46. Teachers choose the teaching methods that are good for students to accumulate practical experiences.
47. When assessing students' learning mathematics, teachers should reduce competition.

Beliefs about self in mathematics

1. I am sure I can learn mathematics well.
2. I learn mathematics for acquired integrated development.
3. If one works hard, he/she can learn mathematics well.
4. If one is not clever enough, he/she can not learn mathematics well.
5. I learn mathematics to show my wisdom.
6. I learn mathematics by effort, because it is important for college entrance exam (senior middle school entrance exam).
7. I want to be a mathematician, so I work hard to learn mathematics.
8. If one has the gift in mathematics, he/she can learn mathematics well.
9. One failed in examination, because the test is difficult.
10. I am confidence to get high marks in mathematics examination.
11. I learn mathematics well for making my parents be happy.
12. I am sure that I can take up advanced studies in mathematics.
13. Because of mathematics being very easy, he/she learn it well.
14. One can not learn mathematics well, because he doesn't work hard.
15. I want to learn mathematics well, and my classmates all admire ones who can get high marks in mathematics exams.
16. I can't learn the college mathematics course.
17. I learn mathematics well for getting a good job in future.
18. I am interested in mathematics, so I want to learn mathematics well.
19. I learn mathematics by effort to win the teacher's admiration.
20. I think it is very hard for me to learn mathematics.
21. I learn mathematics well for getting in good college or senior middle school.
22. One got a high marks in the mathematics exam, because the problems were very easy.
23. Mathematics is not fit for me.
24. I learn mathematics to get a job related with it.
25. One doesn't learn mathematics well, because it's difficult for him/her to learn.
26. I want to learn mathematics well, because it's very beautiful.
27. One got a high marks in the mathematics exam, because he/she worked hard.
28. One got a high marks in the mathematics exam, because he/she has good ability to

learn.
29. I learn mathematics to improve my ability.
30. One failed in the mathematics exam, because he/she has no ability to learn.
31. One can not learn mathematics well, if he/she doesn't work ward.

Beliefs about learning context

1. In math class, the activity is that teachers are lecturing and we are listening.
2. Only teachers can identify whether the answer is right or wrong.
3. In math class, teachers should take group learning as a teaching method.
4. Teachers should provide the opportunities of discussing with each other for us.
5. I can not learn mathematics without help from others.
6. I think girls can do better than boys in math.
7. People think that the person who can learn mathematics well is very clever.
8. It is not enough to learn mathematics well only for finding a good job.
9. Parents should urge us to complete my homework.
10. Teachers should use the form of class-based teaching.
11. My classmates are competitors for me in math class.
12. Classroom atmosphere should be lively.
13. Teachers should encourage us to find the answers by ourselves.
14. In math class, there should be more opportunities of communication among studen
15. It is hard to believe a female could be a genius in mathematics.
16. Parents should not have high hopes for my mathematics achievement.
17. Parents should give me confidence that I can learn mathematics well.
18. Parents shouldn't pay attention to my mathematics learning.
19. The context of the classroom should be quiet.
20. My classmates' marks are higher than mine, which means I failed.
21. Students should be encouraged to question teachers' views.
22. Teachers are my promoter in mathematics learning.
23. Girls don't have fewer gifts than boys.
24. Compared with girls, boys have more gifts of mathematics.
25. If one can learn mathematics well, he can learn other subjects well, too.
26. If I failed in mathematics exam, parents should encourage me.
27. We can't state without teacher's permit in class.
28. Individualized learning pattern is the best.
29. Teachers should encourage us to state on our own.
30. Teachers are my guide in learning mathematics.
31. Girls can do just as well as boys in math.

32. I believe that most of the mathematics puzzles are solved by boys.
33. He, who has learned mathematics, physics and chemistry well, has a part everywhere.
34. When I was lost in mathematics examinations occasionally, my parents should still believe I can learn mathematics well.
35. When we debate about the answer to the question, teachers should tell us the correct one.
36. We should say statement freely in class.
37. Classmates are my cooperators.
38. Girls have the gifts to learn mathematics.
39. Women who enjoy studying math are a little strange.
40. The one, who wins the National Olympic Contests of mathematics, should get admission to graduate school.
41. When I meet difficulties in mathematics learning, parents should help me.
42. Teachers should guide us to think problems independently.