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Junior Middle School Students' Perceptions of Mathematics Classroom Learning Environments and Their Approaches to Learning Mathematics in China

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Abstract

This study investigated Chinese junior middle school students' perceptions of mathematics classroom learning environments and approaches to learning mathematics, among 1,640 students from 62 junior middle school classrooms in eight provinces in China. A Chinese-language version of the Constructivist Learning Environment Survey (CLES) and Approach to Learning Mathematics (ALM) were used in this study and were proved reliable and valid in the Chinese context. Factor analysis, CFA, descriptive statistics, Independent-Samples T Test, and Bivariate Correlation were used to analyze data from the questionnaire survey. The results of this study indicate that Chinese students failed to perceive their classroom learning environment as relatively positive, and tended to use deep learning approach and surface motive in mathematics learning. In addition, significant urban-rural differences were identified in both perceptions of classroom learning environment, and approaches to learning. The findings reveal that deep approaches were positively associated with Chinese students' perceptions of mathematics classroom learning environments (Personal Relevance, Uncertainty, Shared Control, and Student Negotiation).

Key words: Mathematics classroom learning environments; Approaches to learning mathematics; Junior middle school; Chinese students

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INTRODUCTION

Students spend up to 20,000 hours in classrooms throughout their student lives (Fraser, 2001), and classrooms largely reflect teachers' teaching processes and students' learning approaches. In recent decades, an increasing number of researchers have concentrated on the psychological environment of classrooms (e.g., Walberg, 1968; Fraser, 2001; Aldridge et al., 2000). However, most previous studies have focused on Western classrooms (Fraser, 2012), with only a few studies having investigated mathematics classroom learning environments in mainland China.

In the past two decades, international comparative studies of mathematics achievement, such as TIMSS 2011 and PISA 2009 (Mullis, Martin, Foy, & Arora, 2012; OECD, 2010), have shown outstanding mathematics performance among students from such East Asian education systems as those in China, Hong Kong and Singapore, when compared with their Western counterparts. Accordingly, Chinese mathematics teaching and learning have attracted researchers' attentions. At the same time, some researchers have indicated that Asian students tend to use rote-learning approaches and surface strategies in their learning (Murphy, 1987), and the prevalence of teacher- and knowledge-centered classrooms in Eastern countries has been the focus of criticism (Biggs, 1998). In essence, Chinese students and teachers have their own classroom learning and teaching approaches; it is therefore necessary to investigate Chinese mathematics classroom learning environments and approaches to learning mathematics, to deepen researchers' understanding of Chinese mathematics education.

Previous studies have proved there are significant associations between classroom learning environments and students' approaches to learning (Dart, 1999; Yuen-Yee & Watkins, 1994). Thus, there is a need to explore the relationship between mathematics classroom learning environments and learning approaches in a mainland

China context, to provide a possible perspective on Chinese students' learning approach preferences.

With the recent implementation of curriculum reforms in China, classroom learning environments have changed greatly (Ding, Zhang, & Yunpeng, 2013). For example, China's New Scheme (experiment) for senior high school curricula proposes that schools and teachers should create appropriate classroom learning environments to improve students' self-learning abilities, cooperative abilities, and communication skills (Ministry of Education, 2003), which has deeply affected current mathematics classrooms. In addition, past studies have indicated that current curriculum reforms have changed Chinese students' approaches to learning mathematics (Yao, 2011); thus, there is a need to explore the current situations of Chinese mathematics classroom learning environments, and students' approaches to learning mathematics, against the background of curriculum reform.

Based on the discussion above, the current study focuses on two research questions:

RQ1: What are the characteristics of junior middle school students' perceptions of mathematics classroom learning environments in China?

RQ2: What are the associations between junior middle school students' perceptions of mathematics classroom learning environments and their approaches to learning mathematics in China?

1. LITERATURE REVIEW

1.1 Classroom Learning Environment

Previous studies in this field have emphasized on the elements of classroom learning environments, rather than providing an overall definition (Fan & Dong, 2005). Fraser (1998) regarded the learning environment as 'the social, psychological, and pedagogical contexts in which learning occurs and which affect student achievement and attitudes' (p.3), and viewed it in terms of students' shared perceptions of the classroom. Based on previous studies and the research questions of this study, the mathematics classroom learning environment is defined as students' perceptions of and feelings about the mathematics classroom, based on their mathematics classroom learning experiences.

Walberg (1968) argued that the classroom learning environment contains both a structural dimension and an emotional dimension, and proposed the Learning Environment Inventory (Lei, Walberg & Anderson, 1968), which has become the foundation of contemporary classroom learning environment instruments. Moos and Trikett (1973) created the Classroom Environment Scale (CES), which classifies human environments into three dimensions: relationship; personal development; and system maintenance and change (Moos, 1974). Most subsequent classroom learning environment research instruments have tended to use Moos' scheme as their research foundation; Building on Moos scheme and constructivist epistemology, Taylor, Fraser and Fisher's (1997) proposed Constructivist Learning Environment Survey (CLES) which defined classroom learning environment with five dimensions (Personal relevance, Uncertainty, Critical voice, Shared control, Student negotiation). This structure takes constructivist teaching theory into consideration, which can scientifically reflect the contemporary classroom learning environment against the background of curriculum reform.

1.2 Approaches to Learning Mathematics

Many researchers have focused on student approaches to learning, the most famous of them being Biggs (1993), who defined them as how students deal with learning tasks. Biggs (1987) and Marton (1983) divided approaches to learning into two different categories, deep and surface approaches, to distinguish between meaningful learning and rote learning. A deep approach means students tend to understand learning materials and try to find the connections between new knowledge and previous ideas, which is related to internal motivation and learning interests (Biggs, 1989; Marton & Saljo, 1984; Chin & Brown, 2000). In contrast, in surface approaches, students try to reproduce learning materials by repeatedly memorizing isolated parts by rote learning (Biggs, 1989; Marton & Saljo, 1984). This learning approach is associated with extrinsic motivation (Chin & Brown, 2000).

1.3 The Associations Between Students' Perceptions of Mathematics Classroom Learning Environments and Their Approaches to Learning Mathematics

Previous research has indicated that learning approaches are influenced by many factors, including such personal characteristics as learning objectives and motivations, and such external factors as teaching methods, classroom, learning freedom, and external evaluation (Dart et al., 1999). Several researchers have proposed that the classroom learning environment has a significant effect on students' learning approaches (Doyle, 1977; Fraser, 1989; Dart et al., 1999); for example, students tend to choose deep approaches when the classroom learning environment satisfies their needs (Yuen-Yee & Watkins, 1994; Wong, 1998). Dart et al. (1999) investigated Australian junior high school students' perceptions of classroom environments and learning methods, and found that deep approaches were significantly related to classroom learning environments with active participation and investigation. In addition, there was an important association between school environments and learning approaches. Ramsden, Martin and Bowden (1989) identified that the deep approach was positively correlated with teacher support, coherent structure, and moderate stress on achievement in school.

1.4 Research Gaps

The literature review shows there have been many studies off the associations between classroom learning environments and approaches to learning mathematics (Dart et al., 1999; Ramsden, Martin, & Bowden, 1989; Wong, 1998), the results of which make contributions to this research field. However, several research gaps also can be identified. First, most previous studies have focused on Western students; the associations between mathematics classroom learning environments and approaches to learning mathematics in Eastern countries (especially mainland China) have seldom been researched. Second, as curriculum reforms have recently been implemented in mainland China, new ideas in education have deeply affected current Chinese classroom learning environments and students' learning approaches (Ding, Zhang, & Yunpeng, 2013; Qian & Wang, 2014). Thus, most extant studies in this field are limited in their ability to reflect the new characteristics and situations of classroom learning environments, and students' approaches to learning in China.

2. RESEARCH METHODOLOGY

2.1 Participants

In this study, 62 mathematics classrooms in junior middle schools from eight provinces (Chongqing, Guangdong, Hunan, Liaoning, Shanxi, Sichuan, Tianjin, Yunnan) were sampled, taking into consideration such factors as school location, academic performance, class size, and teacher experience. There were 1,640 students who took part in this study; their basic information is presented in Table1.

Table 1
Basic Information of Participates in This Study

Subgroup	Frequency	Percentages(%)
Gender		
Boys	821	50.1
Girls	809	49.3
Grade		
Grade 7	991	60.4
Grade 8	649	39.6
Region		
Urban	1053	64.2
Rural	587	35.8

Note. 10 students did not indicate their gender in the survey.

2.2 Instruments

2.2.1 Classroom Learning Environment Questionnaire

There are numerous instruments for measuring students' perceptions of the classroom learning environment. The Learning Environment Inventory (LEI) (Walberg & Anderson, 1968), for example, is a classical instrument that has been used in previous studies; however, the original version is outdated and difficult to adapt to modern classroom learning environments. Fraser, Anderson and Walberg (1982) modified the LEI to create the My Class Inventory (MCI), an easy-to-understand questionnaire, developed to measure the classroom learning environment in primary schools; however, this study focuses on junior middle schools. Taylor, Fraser and Fisher (1997) designed the Constructivist Learning Environment Survey (CLES), which has been widely used to assess students' perceptions of classroom learning environments, and has been proven valid and reliable in previous studies (Nix et al., 2005; Peiro and Fraser, 2009). This instrument focuses on constructivist classroom learning environment, which can scientifically reflect modern classroom against background of Chinese curriculum reform. Thus, this study adopted Taylor's CLES questionnaire.

The CLES questionnaire has been modified to suit the Chinese learning context and mathematics classrooms. The questionnaire has been translated into simplified Chinese, based on extant Mandarin versions of the CLES (Aldridge, Fraser, Taylor, & Chung-Chih, 2000) and suggestions from experienced junior middle teachers. A back translation has also been done to reduce errors and potential misunderstandings.

The modified version of the CLES questionnaire adopts a five-point frequency response scale (Never, Seldom, Sometimes, Often, and Always). Five factors (personal relevance, uncertainty, critical voice, shared control, student negotiation) were identified by factor analysis (the description of the modified CLES is presented in Table 2). This questionnaire has been proven to have sound reliability, with a relatively high Cronbach coefficient (approximately 0.90), and confirmatory factor analysis has validated its structure (for detailed information, see the Findings section).

2.2.2 Approaches to Learning Mathematics Questionnaire

Biggs (1987) proposed two important classical questionnaires, the Learning Process Questionnaire (LPQ) and the Study Process Questionnaire (SPQ), to measure students' approaches to learning. Based on Biggs' questionnaires, Kember et al. (2004) designed the Revised Learning Process Questionnaire (R-LPQ-2F), which has been proven reliable and valid in previous studies (Weller et al., 2013). After that, Lee, Johanson and Tsai (2007) proposed the Approaches to Learning Science (ALS) questionnaire, a Mandarin version learning approach questionnaire based on R-LPQ-2F, to measure students' learning approaches in Science. The final version of the ALS includes four factors (i.e., Deep Motive, Deep Strategy, Surface Motive, and Surface Strategy). Lee et al. (2007) confirmed the structure of the ALS through confirmatory factor analysis (CFA) and proved its reliability and validity.

This study adopted the Approaches to Learning Mathematics (ALM), which is based on a Mandarin version of the ALS, to measure Chinese junior middle students' approaches to learning mathematics. The ALM includes ALS items modified to focus on mathematics learning; for example, "science classroom" was replaced by "mathematics classroom." In addition, the final version of the ALM was reviewed by other researchers in this field and experienced junior middle school teachers to ensure its validity.

The final version of ALM includes 15 items and adopts a five-point response scale (Strongly Disagree, Disagree, Neither Agree nor Disagree, Agree, Strongly Agree) to measure students' degree of agreement with the statements. Factor analysis was used to explore the structure of the final ALM. Four factors (Deep Motive, Deep Strategy, Surface Motive, Surface Strategy) were identified, which is the same as in the original ALS (the description of the ALM is presented in Table 3). The Cronbach α coefficient of the final ALM is 0.76, which shows it has relatively good internal consistency reliability; confirmatory factor analysis identified in final ALM's sound model fit and further validated its structure.

Table 2
Description and Sample Item for Each Scale in the Modified CLES (Taylor et al., 1997)

Scale	Description	Sample item
Personal relevance	Extent to which students perceive the connectedness of classroom mathematics to their out-of-school experiences.	I learn about the world outside of school in mathematics classroom.
Uncertainty of mathematics	Extent to which opportunities are provided for students to experience mathematics knowledge as arising from theory-dependent inquiry involving human experience and socially determined.	I learn that mathematics has changed over time.
Critical voice	Extent to which a social climate has been established in which students feel that it is beneficial to question the teacher's plans, and teaching methods.	It's OK for me to question the way I'm being taught in mathematics classroom.
Shared control	Extent to which students being invited to share with the teacher control of the learning environment.	I help the teacher to decide which activities I do in mathematics classroom.
Student negotiation	Extent to which opportunities exist for students to explain to others their ideas and reflect on the viability of other students' ideas in classrooms.	I talk with other students about how to solve problems in mathematics classroom.

Table 3
Description and Sample Item for Each Scale in the Modified ALM (Lee et al., 2007)

Scale	Description	Sample item
Deep motive	Student holds deep motive (e.g., intrinsic interest) on learning mathematics	I find that at times studying mathematics makes me feel happy.
Deep strategy	Student uses deep strategy (e.g., understand meaning) to learn mathematics	I try to find the associations between the contents of what I have learned in mathematics subjects.
Surface motive	Student holds surface motive (e.g., fear of failure) on learning mathematics	I worry that my performance in math class may not satisfy my teacher's expectations.
Surface strategy	Student uses surface strategy (e.g., narrow target) to learning mathematics	I see no point in learning mathematics materials that are not likely to be on the examinations.

2.3 Data Analysis

The data from CLES and ALM was subjected by four different steps. First, factor analysis and CFA were conducted to validate the modified CLES and ALM questionnaires. After that, descriptive analysis was used to generate descriptive statistics, such as means and standard deviations, to help researchers reveal the general situations in the students' perceptions of classroom learning environments, and their approaches to learning mathematics. Next, an independent sample *T*-test was conducted to identify the differences between urban and rural areas. Finally, bivariate correlation was used to analyze the associations between students' perceptions of mathematics classroom learning environments, and their approaches to learning mathematics. The data analysis methods are presented in Table 4.

Table 4
Data Analysis Methods Used in This Study

Aims of data analysis	Analysis methods
Validation of CLES and ALM questionnaires	Factor analysis /CFA
General situations	Descriptive statistics
Differences between urban and rural students	Independent-samples *T* Test
Associations between scales of CLES and ALM	Bivariate correlation

3. FINDINGS

3.1 Validation of Questionnaires

The modified CLES and ALM questionnaires were validated by factor analysis and CFA. The participants (n=1640) were divided (by random selection) into two subsets for factor analysis (n=789) and CFA (n=851).

3.1.1 Validation of the Modified Version of CLES Questionnaire

Principal components factor analysis with varimax rotation was conducted for the modified CLES questionnaire. The KMO measure of sampling adequacy was 0.93, and Bartlett's test of sphericity was significant (chi-square =6024.45, p < 0.001), indicating the factor analysis was approachable for the data (n=789). Five factors of the original CLES questionnaire were identified.

The factor analysis results are presented in Table 5, and indicate that each item of the modified CLES questionnaire weighs greater than 0.4 on one factor, and less than 0.4 on other factors. Approximately 55.76% of the total variance can be explained by the five factors. The internal consistency of the final questionnaire version was measured. The Cronbach coefficient of scales (n=789) ranged from 0.61 to 0.86 (as shown at the bottom of Table 5), and the total coefficient was approximately 0.90, indicating the modified Chinese-version CLES questionnaire had good reliability.

CFA (n=851) was used to confirm the structure of the final CLES version. The fitness indices of the five -factor CLES (x^2/df=3.235<5, RMSEA=0.51, NFI=0.893, GFI=0.928, NNFI=0.912, CFI=0.924) indicate a sound model fit and validate the structure of the Chinese-version CLES questionnaire.

3.1.2 Validation of the Modified ALM Questionnaire

For factor analysis (n=789), the KMO measure of sampling adequacy was 0.840, and Bartlett's test of sphericity was significant (chi square =3690.26, p < 0.001), indicating the data (n=789) was approachable for factor analysis. Four factors of the original ALS questionnaire were identified.

The factor analysis results are presented in Table 6, and indicate that each item of the modified CLES questionnaire weighed greater than 0.4 on the specific factor, and less than 0.4 on other factors. The four factors cumulatively explain 60.34% of total variance.

The Cronbach coefficients of the four factors (n=789) were acceptable, ranging from around 0.60 to 0.83. The total coefficient was approximately 0.76. The results indicate the Chinese-version ALM questionnaire had sound internal consistency reliability.

For CFA (n=851), the fitness indices of the four-factor ALM (χ^2/df=3.504<5, RMSEA=0.54, NFI=0.925, GFI=0.953, NNFI=0.931, CFI=0.945) indicate a sound model fit and validate the structure of the Chinese-version ALM questionnaire.

3.2 General Situations of Mathematics Classroom Learning Environments and Approaches to Learning Mathematics

Descriptive statistics (item mean score and standard deviation of each scale in the modified CLES and ALM) were used to describe the general situations of mathematics classroom learning environments, and Chinese students' approaches to leaning mathematics. As shown in Table 7, it is evident that students in this survey did not have relatively positive perceptions of their classroom learning environment, especially in the scale of Critical Voice (item mean score=2.11) and Shared Control (item mean score=2.56). Specifically, students perceived they seldom had opportunities to question their teachers' teaching methods and choose their preferred classroom activities. Comparably, there were higher item mean scores in scales of Personal Relevance, Uncertainty of Mathematics, and Student Negotiation (all close to 3), meaning the participants perceived mathematics classrooms sometimes (but not often) provided them with opportunities to: a) connect mathematics knowledge with real life experience; b) experience mathematics as a developing theory, and, c) communicate with other students.

Moreover, Table 7 also shows that item mean scores in the ALM scales (except the Surface Strategy scale) were relatively high (all close to 3.45), which suggests that students tended to use Deep Strategy and hold both Deep and Surface Motivation in mathematics learning. In contrast, students relatively disagreed with the items in the Surface Strategy scale (item mean score was only 2.7), meaning participants were less likely to choose Surface Strategy as their main learning method.

Table 5
Factor Loadings and Internal Consistency Reliability (Cronbach) for the Modified CLES

Item	Factors loading				
	Shared control (SC)	Personal relevance (PR)	Student negotiation (SN)	Critical voice (CV)	Uncertainty of mathematics (UM)
C1	0.75				
C2	0.71				
C3	0.68				
C4	0.68				
C5	0.68				
C6	0.65				
C7		0.76			
C8		0.68			
C9		0.62			
C10		0.62			
C11		0.57			
C12			0.67		
C13			0.67		
C14			0.63		
C15			0.59		
C16				0.79	
C17				0.78	
C18				0.55	
C19				0.46	
C20					0.68
C21					0.62
C22					0.62
C23					0.54
Cronbach	0.77	0.61	0.67	0.86	0.76

Table 6
Factor Loadings and Internal Consistency Reliability (Cronbach a) for the Modified ALM

Item	Factors loading			
	Deep motive (DM)	Deep strategy (DS)	Surface motive (SM)	Surface strategy (SS)
A1	0.77			
A2	0.76			
A3	0.76			
A4	0.72			
A5		0.77		
A6		0.74		
A7		0.69		
A8		0.64		
A9		0.53		
A10			0.83	
A11			0.82	
A12			0.68	
A13				0.76
A14				0.74
A15				0.69
Cronbach	0.83	0.78	0.70	0.60

Table 7
Item Mean and Standard Deviation for Each CLES and ALM Scale

	Scale	No. of items	Item mean	Standard deviation
CLES	Personal relevance (PR)	5	3.15	0.80
	Uncertainty of mathematics (UM)	4	3.15	0.81
	Critical voice (CV)	4	2.11	0.81
	Shared control (SC)	6	2.55	0.94
	Student negotiation (SN)	4	3.00	0.88
ALM	Deep motive (DM)	4	3.39	0.93
	Deep strategy (DS)	5	3.50	0.79
	Surface motive (SM)	3	3.49	0.96
	Surface strategy (SS)	3	2.70	0.89

3.3 Urban and Rural Differences in Perceptions of Mathematics Learning Environment and Approaches to Learning Mathematics

An independent samples *T*-test was conducted to assess the differences between urban and rural students' perceptions of their mathematics classroom learning environment and learning approaches. The mean, standard deviation, and *T*-test values are presented in Table 8. There were significant differences between rural and urban students' perceptions of the five scales of classroom learning environment, suggesting participants in cities tended to perceive their classroom learning environment relatively more positively than did rural students. In addition, significant differences between urban and rural participants can be observed in the item mean scores for Deep Motive, Deep Strategy, and Surface Strategy. These findings indicated that urban participants were more likely to use a deep approach in mathematics learning than were rural students. At the same time, urban participants used more Surface Strategies than did their rural counterparts.

Table 8
Mean, Standard Deviation, *T* -Test Value for Scales of CLES and ALM

Scale		Urban(n=1053)		Rural(n=587)		t
		Item mean	Standard deviation	Item mean	Standard deviation	
CLES	Personal relevance (PR)	3.28	0.81	2.92	0.73	9.071***
	Uncertainty of mathematics (UM)	3.28	0.81	2.92	0.77	8.868***
	Critical voice (CV)	2.20	0.87	1.93	0.66	6.937***
	Shared control (SC)	2.76	0.95	2.16	0.79	13.655***
	Student negotiation (SN)	3.12	0.89	2.79	0.84	7.341***
ALM	Deep motive (DM)	3.48	0.94	3.23	0.90	5.225***
	Deep strategy (DS)	3.60	0.79	3.30	0.77	7.458***
	Surface motive (SM)	3.48	0.95	3.52	0.98	-0.794
	Surface strategy (SS)	2.78	0.96	2.56	0.84	4.943***

Note. * p<0.05; ** p<0.01; *** p<0.001

3.4 Association Between Students' Perceptions of Mathematics Classroom Learning Environment and Approaches to Learning Mathematics

Bivariate correlation was used to estimate the associations between each scale of the CLES and each scale of the ALM. The Pearson correlation coefficients are presented in Table 9. The CLES scales (except Critical Voice) were positively and statistically significantly correlated with Deep Motive and Deep Strategy. There was a positive correlation between Surface Motive and Uncertainty of Mathematics, and Surface Strategy was positively correlated with Uncertainty of Mathematics, Critical Voice and Shared Control. At the same time, there were (not very significant) negative correlations observed between Surface Motive and Critical Voice/Shared Control.

Table 9
Bivariate Correlation for the Association Between the Scales of Mathematics Classroom Environment and Scales of Approach to Learning Mathematics

	Personal relevance (PR)	Uncertainty of mathematics (UM)	Critical voice (CV)	Shared control (SC)	Student negotiation(SN)
Deep motive (DM)	0.525***	0.289***	0.044	0.415***	0.473***
Deep strategy (DS)	0.541***	0.382***	0.044	0.406***	0.474***
Surface motive (SM)	0.013	0.102***	-0.030	-0.040	0.006
Surface strategy (SS)	-0.021	0.076**	0.240***	0.117***	0.034

Note. * $p<0.05$; ** $p<0.01$; *** $p<0.001$.

DISCUSSION

This study investigated junior middle students' perceptions of mathematics classroom learning environments and approaches to learning mathematics in China using modified CLES and ALM questionnaires. In general, the survey results indicate that Chinese students do not hold relatively positive attitudes towards their mathematics classroom learning environment, with item mean scores lower than 3.2. Yang (2015) investigated rural high school students' perceptions of classroom learning environments in western China, and found similar results. In addition, the low mean scores in Critical Voice (around 2.11) and Shared Control (about 2.54) show that Chinese students have little opportunity to question their teachers' teaching methods or take part in classroom design; numerous previous studies have identified similar results. For instance, Aldridge and Fraser (2000) investigated classroom learning environments in Taiwan and Australia, and found students in Taiwan gave more respect to their teachers than Australia students did, and that Taiwanese teachers hold professional status in classroom. In addition, Huang et al. (1998) indicated that Taiwanese teachers play a dominant role in science classrooms. This common phenomenon is mainly because of China's Confucian heritage, which has a significant influence on students' and teachers' behaviors in Chinese society (Lee, 1996; Smith, 1997). Specifically, one of the main ideas of Confucius is to keep social harmony (Tong, 1970); thus, Chinese students are encouraged to respect and follow their teachers' ideas, instead of breaking classroom rules or questioning their teachers' teaching.

In addition, this study identified that students in mainland China had relatively high item mean scores in Deep Motive (around 3.39), Deep Strategy (around 3.50) and Surface Motive (about 3.49). Lee et al. (2007), using ALS to investigate Taiwanese high school students' science learning approaches, found similar results in Deep Strategy (item mean was 3.41), Surface Motive (item mean was 3.41) and Surface Strategy (item mean was 2.76). Several reasons can be identified to explain the high Surface Motive held by Chinese students. In China, good academic performance is closely related to future success in one's career and family (Biggs, 1998). In addition, China's long-standing "examination culture" also contributes to this phenomenon. Previous research has indicated many Chinese teachers regard "[getting] good marks in the national university entrance examination" as their teaching aims (Gao, 1996, p.8); thus, many Chinese students learn mathematics simply to pass examinations and gain access to higher education (Cai & Nie, 2007; Zheng, 2006).

Another important finding of this study is the significant rural-urban differences in each CLES and ALM scale (except Surface Motive). Previous studies have indicated that Chinese students in rural schools fail to perceive their mathematics learning environments in a positive light (Yang, 2015), for several reasons, the most important being that rural schools typically have poorer teaching conditions and lower teacher quality. According to Education statistics for the year 2011, in China, 62.83% of rural teachers have a Bachelor's degree, compared to 81.98% of urban teachers, a gap of 19.15%. In addition, rural teachers and parents tend to hold more traditional conceptions of teaching and education (Ma et al., 2006; Yang, 2015), which may influence their teaching classroom practices. Thus, rural students perceive they have fewer opportunities to communicate with teachers and connect their mathematics knowledge with other aspects of their life (Yang, 2015).

This study has identified that students in cities are more likely to use deep learning approaches than are rural students. One possible reason for this is that rural students have poorer academic backgrounds than their urban counterparts (Ma et al., 2006), which may make it difficult for them to understand the meaning of learning materials and hold positive attitudes towards mathematics. Moreover, as mentioned above, poorer teacher quality and teaching conditions in rural schools may also contribute to this difference.

Another special finding is that urban students had higher Surface Strategy scores than rural students did, meaning urban students concentrated more on examination-related mathematics knowledge than their rural peers. Again, there are several possible reasons for this phenomenon. Compared with parents in rural areas, urban parents have higher expectations of their children's academic performance (Huang & Xue-Yuan, 2007). Moreover, there is more competitions in high school entrance examination in cities, which translates to greater pressure from parents and society on urban students to use Surface Strategy to scores well on mathematics tests.

Furthermore, previous studies have identified significant correlations between the classroom learning environment and deep approaches to learning (Dart et al., 1999). In this study, four CLES scales (all except Critical Voice) were significantly related to deep approaches to learning mathematics. In addition, there was a negative correlation between Personal Relevance and Surface Strategy; students were less likely to use Surface Strategy when they perceive mathematics to be more relevant to their out-of-school experiences. If students find a relationship between mathematics and other aspects of life, they tend to establish connections between new knowledge and experience (Deep Strategy) instead of using rote learning (Surface Strategy).

CONCLUSION AND IMPLICATIONS

This study used modified CLES and ALS questionnaires to evaluate junior middle school students' perceptions of mathematics classroom learning environments and approaches to learning mathematics in China. The major findings of this study are that Chinese students failed to perceive their classroom learning environment positively, and tended to use deep learning approaches and Surface Motive in their mathematics learning. In addition, significant differences between urban and rural areas were identified in terms of perceptions of both classroom learning environments and learning approaches. Compared with urban students, rural students perceived their mathematics classroom learning environment more negatively, and were less likely to use deep approaches in their mathematics learning. In addition, this study also found positive correlations between classroom learning environments and deep approaches to learning, and slightly negative correlations between some classroom learning environment scales (Surface Motive and Surface Strategy) and surface approaches.

This study modified the CLES and ALS questionnaires based on the Chinese context, and confirmed the cross-cultural validity and reliability of the two questionnaires. In addition, the findings of this study reveal Chinese students' classroom learning experience and preferred learning approaches, which can provide valuable information about Chinese mathematics education from a student perspective. The positive correlations found between classroom learning environments and deep approaches to learning mean the former may promote the latter and lead to meaningful learning. The findings suggest that, if Chinese teachers provide more opportunities for students to: a) express their ideas; b) connect mathematics with life; c) experience the uncertainty of mathematics; and, d) take part in the design of classroom activities, students are more likely to develop appropriate approaches to learning mathematics.

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