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# Outsiders' Views on Chinese Mathematics Education: A Case Study on the United States Teachers' Teaching Experience in China

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*This case study investigated the U.S. teachers' views on Chinese mathematics education based on their teaching experience in China. The use of multiple data collection strategies was applied to serve as a form of data collection triangulation. The results of the study provided suggestions on how U.S. and Chinese mathematics education can learn from one another from the U.S. teachers' views, which provides some insightful implications for enhancing both U.S. and Chinese mathematics education.*

***Key words*:** mathematics instruction, lesson planning, cultural immersion, experiential learning technology integration, Bloom's Taxonomy cognitive domain

## Introduction

In recent decades, in addition to the growth in its economy and technology, China has instituted reforms in education aimed toward global perspectives in various areas at different levels. For example, mathematics education in China has reformed by developing new curricula and allowing a variety of new textbooks with different perspectives to be used in school mathematics (An, 2000). Numerous studies indicate that Chinese teachers, when compared with U.S. teachers, had also a deeper understanding of mathematics and mathematics teaching; thus they were able to teach mathematics effectively. However, these studies were generally limited to a descriptive level (Wang & Lin, 2005). Although some studies on Chinese teachers' mathematical knowledge (Ma, 1999) and pedagogical content knowledge (An, 2004; An, Kulm, & Wu, 2004) and Chinese students' computational and problem solving skills (Cai, 2000) revealed further understanding of Chinese mathematics education, most of these are studies from insiders' views.

To understand how Chinese teachers have developed such profound knowledge in teaching mathematics and how Chinese students have built fluency in learning mathematics, not only a substantial international study from scholars' views is needed to explore the characteristics of mathematics teaching and learning, but also a study from listening to outsiders' views is needed, especially listening to views of classroom teachers who are from another culture and have immersion experiences, to provide a different perspective on Chinese teaching and learning mathematics. Although immersion experience in another cultural setting is by no means the equivalent of teaching in a culture, it can provide some initial insight into such a predicament.

## Theoretical Framework

### Cross-Cultural Studies

During the last two decades, researchers have identified cultural tradition as a factor that could considerably contribute different strategies in mathematics teaching and learning between different countries. A wide range of studies on mathematics education between Hungary and England (Andrews 1997, 1999; Hatch, 1994, 1999; Harries, 1997), Japan and the United States (Jacobs, Makoto, Stigler, & Fernandez, 1997; Whitman & Lai, 1990), France and Britain (Jennings & Dunne, 1996), China, Hong Kong and Britain (Leung, 1995) and elsewhere have revealed repeatedly the important role of cultural influence on differences in mathematics education.

Other cross-cultural studies on comparing the U.S. and East Asian students' mathematical achievement have indicated that East Asian students consistently outperform American students in almost every area of mathematical knowledge (Geary, Fan, & Bow-Thomas, 1992; Stevenson, Chen, & Lee, 1993; Stevenson & Stigler, 1992; Zhou & Peverly, 2004; Zhou, Peverly, Boehm, & Lin, 2000). Several factors have been hypothesized and explored for explaining this ''learning gap,'' including different systems of numerals (Fuson & Kwon, 1991; Miller, Smith, Zhu, & Zhang, 1995; Miller & Stigler, 1987), culture differences (e.g., parents' expectations, students' motivation, beliefs, and effort), school organization (e.g., time spent on learning mathematics in school), classroom practice (Wang, 2002; Yang & Cobb, 1995), and the content and organization of mathematics curricula (Geary, Siegler, & Fan, 1993; Lee, Ichikawa, & Stevenson, 1987; Stevenson & Stigler, 1992; Stigler, Lee, & Stevenson, 1987; Stigler & Perry, 1988; Sutter, 2000). Studies showed that different cultural traditions could remarkably impact mathematics teaching (An, Kulm, & Wu, 2004; Ma, 1999; Stigler & Hiebert, 1999). The outcomes of this body of research have had a far reaching impact in mathematics education. However, without carefully exploring the cultural influence from different perspectives, and without first-hand experience in other cultural systems, it is not enough to provide a full understanding and to promote learning from different educational systems (An, 2004; Wang & Lin, 2005).

### Teachers' Views from Cultural Immersion in Experiential Learning

Listening to classroom teachers' voices on issues in education helps researchers examine important issues from a different perspective. The systematic study of teachers' conceptions of mathematics and their views of mathematics teaching has been of continuing interest to researchers for many years; as Thompson (1992) notes, they "play a significant role in shaping teachers' characteristic patterns of instructional behavior" (Thompson, 1992, pp. 130–131). Although numerous studies confirm that cross-national studies in mathematics education provide opportunities for increasing mathematics educators' awareness of alternatives in teaching and learning and promoting their reflections on their own teaching practices (An, 2004; Stigler & Hiebert, 1999; Stigler & Perry, 1988), few research probes views from classroom teachers who are placed in a different cultural setting and the impact of their experience on teaching.

This study is grounded in experiential learning by Kolb and Fry (1975). They created a famous model out of four stages: concrete experience, observation and reflection, the formation of abstract concepts, and testing in new situations. They represented these in the famous experiential learning circle in Figure 1 (Smith, 2001). According to Kolb's learning circle, experiential learning represents a learning process where the learner experiences, reflects, abstracts, and tests: concrete experiences lead to critical reflections that then assimilate into abstract conceptions to be tested and experimented with in a new situation (Kolb, 1976). Other studies also confirmed that experiential learning is about learning from primary experience (Jarvis, 1995) and it occurs as direct participation (Houle, 1980).

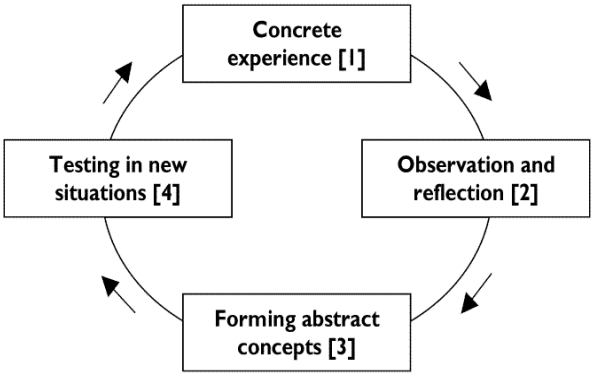


*Figure 1.* **Kolb's learning cycle**

Various studies integrated experiential learning in teaching learning in multicultural education (Spalding, Garcia, & Savage, 2003; Spalding, Wang, Lin, & Butcher, 2005). The benefits of pre-service teacher learning from cultural immersion experience in cross-cultural settings have been well documented (e.g., Stachowski & Mahan, 1998; Wiest, 1998; Willison, 1994). However, more studies are needed on classroom teacher learning from cultural immersion experience. This study is seeking to investigate U.S. classroom teachers' first-hand experiential learning from teaching integrated mathematics, science, and English instruction in China.

According to Bowden and Marton's view of learning (1998), learning is about broadening one's ways of experiencing some aspect of the world (Bruce, Buckingham, Hynd, McMahon, Roggenkamp, & Stoodley, 2004). The pertinent aspect of the world in this study is cultural immersion experience in China. This study attempts to illuminate an understanding of roles of teacher learning in a different cultural setting, focusing particularly on the classroom teachers' views from their first-hand experiential learning and the impact of their experiential learning on their teaching in the U.S. upon coming back from China.

Confucius' idea, "Don't worry about being misunderstood but about understanding others" provides a very important insight for this study: the investigation of Chinese mathematics teaching from U.S. teachers' perspectives may help Chinese mathematics education better understand its problems in mathematics education practice and it may also provide insights into U.S. mathematics education. In addition, it will contribute to a better understanding of how different cultural traditions influence

mathematics teaching and learning from international perspectives.

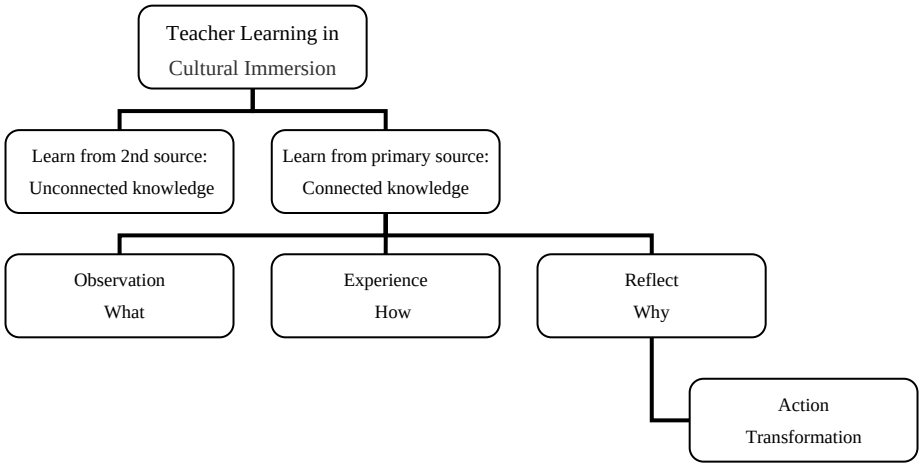


*Figure 2.* **Teacher learning in cultural immersion**

Figure 2 shows a conceptual framework for this study. It addresses the importance of primary learning experience that shapes teachers' knowledge in a connected way. It also indicates the three stages of the first-hand experience in teacher learning in a cultural immersion setting: observation helps U.S. classroom teachers see "what" is happening in real classroom teaching in China; experience of teaching in Chinese classrooms assists the U.S. teachers to understand "how" instruction works in Chinese mathematics teaching; reflection facilitates the U.S. teachers' thinking "why" it works in Chinese teaching, which then advance the U.S. teachers' knowledge and encourage them to take action on applying their learning in their own classrooms in the U.S., thereby fostering the transformation into new learning.

The research questions to be examined in this study were: (a) What are the U.S. teachers' views on Chinese mathematics education before their cultural immersion experience? (b) What are the strengths and weaknesses of Chinese mathematics education according to the U.S. teachers' views after their first-hand teaching experience in China? (c) According to the U.S. teachers' views, in what areas can U.S. mathematics education benefit from Chinese mathematics education, and vice versa? (d) What are the impacts of the U.S. teachers' cultural immersion experience on their classroom teaching in the U.S.?

## Methodology

### Subjects

Four U.S. elementary and middle school classroom teachers from Southern California participated in this study. The U.S. teachers' demographic information is found in Table 1.

*Table 1*

**Four U.S. Teachers' Demographic Information**

| Teacher | Degree | Gender | Ethnicity | Grade Level | Subject Area | Teaching Exp. |
|---|---|---|---|---|---|---|
| Mrs. N | Master | F | W | 2 | All | 24 yr |
| Mrs. D | Master | F | W | 5 | All | 16 yr |
| Mr. G | Master | M | W | 7 | M&S | 10 yr |
| Mr. E | Bachelors | M | AA | 8 | M&S | 13 yr |

*Note.* W = White; AA = African American; All = Multiple Subjects; M&S = Math and Science

**Procedure**

Before the China trip in summer 2007, all the U.S. teachers responded to a pre-questionnaire focused on effective teaching and global perspectives in mathematics education. Each of the four teachers prepared 15 integrated lessons on mathematics, science, and English for their teaching task in China. After the trip, the U.S. teachers responded to a post-questionnaire focused on reflecting on their learning from the trip. The teachers were followed up on their teaching upon their return to the U.S. For two weeks in China, the U.S. teacher participated in the following activities in three cities in China:

- Engaged in the "Open Class" activity – a unique form of professional development in China, and provided a model lesson to a class of Chinese children while being observed by 200 Chinese colleagues in a large northern metropolis in China"?
- Provided a weeklong integrated mathematics, science, and English instruction to grades 3-6th Chinese children at two elementary schools in a large southeast metropolis (the two schools differed in their level of performance). Groups of Chinese teachers observed the US teachers' instruction every day at the same time.
- Participated in lesson studies – daily discussion and reflection on their lessons to Chinese children with Chinese colleagues during the week of teaching.
- Observed Chinese lessons.
- Presented their assessment projects at the National Math Conference in another large northern metropolis.
- Visited schools differing in academic achievement, geographical area, and socio-economic demographics.

**Instrument and Data Collection**

This study applied the use of multiple data collection strategies to serve as a form of data collection triangulation. All the U.S. teachers were given pre- and post questionnaires before and after their teaching in China. The pre-questionnaire included eight questions regarding effective teaching and global perspectives in mathematics education. The post-questionnaire consisted of five questions on strengths and weaknesses of Chinese mathematics education, suggestions for improvement, areas that Chinese teachers can learn from US mathematics education and vice versa. In addition, the U.S. teachers made field notes and wrote daily reflections on their experience in China. Their classroom teaching in China was observed and videotaped. Their mathematics instruction was also observed twice in their own classrooms in the U.S. after the trip. Interviews were conducted as interactions, discussion, and conversations before, during, and after the trip. Data collection from multiple sources is summarized in Table 2.

*Table 2*

**Sources of Data Collection**

| Instrument | Participants | No. of Participants | Date | Research Question |
|---|---|---|---|---|
| Pre-questionnaire | US Teachers | 4 | May 2007 | 1 |
| Post-questionnaire | US Teachers | 4 | July 2007 | 2, 3 |
| Survey | Chinese Students | 44 ($3^{rd}$ & $4^{th}$ graders) | June | Another Repot |
| Lessons in China | US Teacher | 4 (16 lessons) | June | Another Repot |
| Reflection | US Teachers | 4 | July | 2, 3 |
| Reflection | Chinese Teachers | 8 | July | Another Report |
| Teaching observation | US Teachers | 3 (14 Lesson) | Fall 2007 & Spring 2008 | 4 |
| Interview | US Teachers | 4 | Before, during, and after the trip | 1, 2, 3, 4 |

## Data Analysis

The study used a qualitative method to analyze data from the case study. Data analysis aimed to develop a representation of the U.S. teachers' views from cultural immersion, which was grounded in seeking impacts of the experiential learning process. To achieve this, Meta-Matrix and Causal Models (Miles & Huberman, 1994) were adapted to group the views of the participants in a logical order, simultaneously contrast differences and cluster similarities, and indicate the relationships between the categories in order to analyze the U.S. teachers' responses in the questionnaires, reflections, and interviews, so as to provide evidence for the case study. Yin (1989) indicated case study research as a flexible form of inquiry that can be carried out through use of observations and interviews.

Both transcribing (Stigler, Gonzales, Kawanaka, Knoll, & Serrano, 1999) and moment-by-moment (Powell, Francisco, & Maher, 2003) methods were used for analyzing the 14 video lessons from classroom observation – eight from before the trip and six from after the trip. The unit analysis of their teaching was a focus on a balanced way of teaching mathematics according to the guiding principles in the *Mathematics Framework for California Public Schools* (2006).

Chinese students' surveys were analyzed and the mean scores of their answers were calculated. The reflections from Chinese teachers were coded, categorized, and compared for data analysis. The data from Chinese teachers and students will be provided in another report.

## Results

The results of this study indicate the changes in the U.S. teachers' views on Chinese mathematics education before and after teaching experience in China (See Tables 1-7). In addition, the results demonstrate the U.S. teachers' views on strengths of Chinese mathematics education in curriculum, teaching, learning, lesson preparation, technology, teacher preparation and professional development, and cultural factors from their firsthand experience. The U.S. teachers also noted that Chinese mathematics education has areas needing improvement and that both systems could learn from each other.

### Before the Trip: U.S. Teachers' Views of Chinese Mathematics Education in Pre-Survey

Table 3 summarizes the responses of the U.S. teachers in the pre-survey prior to the trip.

*Table 3*
**U.S. Teachers' Views in Pre-Survey**

| | |
|---|---|
| Impression of Chinese mathematics education | 1. Chinese students are very respectful and know that they are expected to learn.<br>2. Chinese students are more advanced in math than our students here in the states.<br>3. Excellent procedural fluency.<br>4. Chinese students will be better behaved. No discipline problems. |
| Do you think the Chinese method can be transcribed into U.S. classrooms? | 1. Not sure what the Chinese method of teaching math is at this time.<br>2. Hope to learn and apply Chinese method in our own classrooms after this trip.<br>3. Chinese methodology can be adapted and taught in US classrooms.<br>4. Don't believe the US is willing to change the way we have been doing things. |
| Expect to gain from the trip | 1. A better understanding of the Chinese educational system.<br>2. Find out the truth about math instruction in China.<br>3. Learn some strategies and new methods and share with others.<br>4. Know what we do differently.<br>5. Know Chinese students.<br>6. Know the cultural role in teaching<br>7. This experience is an opportunity to become better teachers |

*Impression of Chinese Mathematics Education*

Prior to the trip, the U.S. teachers perceived a lack of understanding of teaching and learning mathematics in China. As Teacher N said, "I don't really have any impressions of mathematics instruction at this time. Overall, I believe that the Chinese students are very respectful and know that they are expected to learn all that they can." Teacher G also mentioned his impression that mathematics is a strong subject in Eastern cultures, especially China, and is considered better than in American educational institutions.

According the U.S. teachers' responses, their impressions about China were mainly from secondary sources. As Teacher D stated, "I am under the impression that students in China will be more advanced in math than my students here in the States. I don't know why I think this-probably a cultural bias, but also based on our Asian students in the states and their test scores." Teacher E regarded Chinese students as "excellent in procedural fluency" and "no discipline problems" in the classroom. "This is what I have been told at various conferences and district meetings," said Teacher E.

*Chinese Methods of Teaching and Learning*

To answer the question, "Do you think the Chinese method of teaching and learning math can be transcribed into U.S. Classrooms? How?" responses varied as a result of teachers' prior experiences with international perspectives. Two U.S. teachers did not have any ideas on it. As Teacher N recognized, "I am not aware of what the Chinese method of teaching and learning math is at this time,'' but she expressed a desire to learn: "I would like to hope that I will be able to take with me all that I learn while in China and incorporate their strategies into my classroom in the fall." For teachers who knew some Chinese methods of teaching and learning, they had different views. Teacher G believed that it can be adapted and taught, using Chinese methodology. Teacher E

argued that "No, I don't think so. I do not believe the US is willing to change the way we have been doing things. I think the textbook publishers and the government believe what they have come up with is the best."

*Learning from the Trip*

All the U.S. teachers expected to gain new ideas and knowledge in teaching mathematics from this trip. In addition, the teachers hope to be able to apply the new knowledge and share with their colleagues all that they learned from the visit. They believed that this experience would be very profound to help them be better teachers. It is interesting to note that Teacher D would like "to know what we do differently:"

> If what we do and how we teach in the states is fundamentally different, or if the difference is in lesson delivery. I would like to become a better teacher to help my students learn more. Anything I can do to this end would be a bonus.

Furthermore, she was anxious to get to know her Chinese students.

> Aside from cultural differences, I believe that children are children wherever they live in the world. I want to find out if the way I teach can be transferred to Chinese children. I am curious as to how my Chinese students will respond to the way I teach. I wonder if the way I teach my students is a result of the culture I was raised in.

To teacher E, he would like to have a better understanding of the Chinese educational system that was echoed by other participants. Particularly, he was hoping "to find out the truth about mathematics instruction in China" and learn some strategies that he can take back to the U.S. and share with others.

## After the Trip: U.S. Teachers' Views on Strengths of Chinese Mathematics Education

All the U.S. teachers in China participated in many discussions with Chinese colleagues about Chinese mathematics education and had the opportunity to teach Chinese students and observe lessons in China. They acknowledged a great deal of their learning from the trip. For example, Teacher G described his learning: "After traveling to China and absorbing all the culture a person can handle in two weeks, I have come back to the U.S. with new ideas and impressions that have changed my vision, both here and abroad after visiting four cities in China."

Table 4 summarizes the U.S. teachers' views on strengths of Chinese mathematics education from their observations in China after their trip to China.

*Table 4*

**Strengths of Chinese Mathematics Education**

| Areas | Strengths |
|---|---|
| Curriculum | 1.One "expert" area of the curriculum |
| | 2.Standardization of expectations and curriculum |
| | 3.Deep teachers' knowledge of curriculum |

| | |
|---|---|
| Teaching | 1.High level of expertise among the Chinese teachers<br>2.Well taught and organized lessons<br>3.Amount of time spent ensuring students' mastery of skills and procedures<br>4.Teaching a single subject at the elementary level<br>5.Teachers teach only two classes a day<br>6.Good classroom management<br>7.Good nurturing environments (art work and posters) |
| Learning | 1.Students have a higher desire to learn<br>2.Students are very proficient with skills and procedures |
| Lesson preparation | 1.A considerable amount of time spent on organizing and planning lessons<br>2.Detailed daily lesson plan like a case study |
| Technology | 1.Teachers are well prepared to use technology<br>2.Teachers use technology to present concepts<br>3.Each class has a teacher station with the latest in technology |
| Teacher preparation | 1.Highly qualified math teachers<br>2.Highly trained math teachers |
| Cultural factors | 1.A privileged position in society for teachers<br>2.High expectations of students, from both parents & teachers<br>3.High degree of parental involvement<br>4.The National Exam system and the One Child Policy makes it necessary for parents to prioritize their children's education |

*One "Expert" Area of the Chinese Curriculum*

Some strengths the U.S. teachers noticed were directly related to the curriculum. They found that a teacher in China is responsible for one "expert" area of the curriculum. Chinese teachers who teach mathematics only teach mathematics, which means at the elementary level, Chinese teachers teach a single subject, as opposed to teaching multiple subjects. Therefore, the level of expertise among the Chinese math teachers is very high. Teacher D compared it with her experience in the U.S.:

> I am required to teach all areas of the curriculum and all standards to my fifth graders. While I see myself as a master teacher, I would never consider myself an expert in all curricular areas. This structure in the educational system allows a teacher to become extremely well-versed in his or her curriculum, planning, and implementation of lessons.

In addition, the U.S. teachers found that Chinese teachers teach only two classes a day. They believed that "these two elements make it possible for Chinese teachers to master their content and to give the math curriculum 100% of their focus."

*Standardization*

The U.S. teachers identified standardization as one of the characteristics of Chinese mathematics education. The first is a standardization of expectations. The students are expected to perform at a certain level, and this level is accepted and supported by both teachers and parents. The second is a standardization of curriculum. Teacher D explained this using her experience: while teaching her Chinese students to find percent of a number, their teacher told her, "The students don't know how to divide with a decimal in the divisor. That is not taught until next year." This standardization is understood and followed by the teachers in the schools she was able to teach at within China.

*Proficient with Skills and Procedures*

The U.S. teachers, glimpsing their Chinese student performance in classes and their work, marveled at the very proficient skills and procedures of their Chinese students. As Teacher N explained, "While observing these lessons, I couldn't help but to notice how quickly the students were to respond to various questions asked by the teacher." Similarly, Teacher E noticed Chinese students' proficiency in mathematics, but admired the roles of Chinese teachers and parents in fostering this proficiency: "Many students knew how to add, subtract, multiply, and divide whole numbers, fractions, and decimals. Teachers and parents spent time ensuring that students mastered these skills and procedures, which was evident."

*Lesson Preparation and Teaching*

All the U.S. teachers recognized that the time spent on organizing and planning lessons is one of the important strengths of Chinese mathematics education. They were amazed that Chinese mathematics teachers spent a considerable amount of time everyday writing out detailed lesson plans. "This leads to a lesson that is well thought out and organized," Teacher E commented. Teacher N further noticed valuable instructional techniques:

> I found the instructional techniques their teachers incorporated into their lessons to be very interesting and valuable for their students. From what I observed and what was translated to me, I could understand that the teachers first began with finding out about the students' prior knowledge then built upon that. Students were challenged to think and experiment with manipulatives in order to solve the equation presented.

*Technology Integration*

All the U.S. teachers admired the high technology integration in mathematics classrooms in China. In every classroom they saw, technology was present. For example, Teacher E observed that each class had a teacher station, comprising a computer, projector, and document camera. He commented, "I personally believe we are in a technological age and many students enter classrooms with a lot of experience with technology; therefore, technology should be used to enhance lessons that teachers teach." Teacher N echoed the same observation.

> The one factor I noticed in both cities was their strong use of technology in presenting mathematical concepts to their students. Whether it was incorporating pictures of themselves or of formations, the skill was presented in a way that would make any student or teacher become excited about learning. With the use of technology, especially the Elmo, teachers seemed to be very prepared to teach the content skill for each lesson.

Teacher D compared the use of technology in China with her classroom in the U.S.

> Every classroom I entered in China had the latest in technology. The teacher had access to a computer with a linked projector and screen that was easily visible for all students in the classroom. This was considered standard equipment in every school! All new curricula that I have seen here in my district have a technology component; however, it is inaccessible to me and my students because I simply do not have the required equipment in my classroom.

*Cultural Factors*

The U.S. teachers witnessed and learned that the Chinese seem to instill cultural appreciation for educators. They observed a privileged position in society for teachers as well as high expectations of students, from both parents and teachers. The U.S. teachers contributed the reason of the high degree of parental involvement to the National Exam system and the One Child Policy. As Teacher E explained,

> From some of the conversations that I had with Chinese college students, it seems that the National Exam and the One Child Policy made it necessary for parents to help their children with homework, teach them concepts that were not taught in school, and send them to alternate educational settings (such as math Olympics or tutoring).

## After the Trip: U.S. Teachers' View on Improving Areas in Chinese Mathematics Education

While the U.S. teachers came to recognize the apparent strengths of Chinese mathematics education, they noticed some weaknesses in Chinese mathematics education. They observed two main areas of weakness in Chinese mathematics education: Teaching and assessment. The teaching area included a sparing use of manipulatives and real-life projects, lack of active participation strategies, lack of teaching thematically, lack of working with small groups of students, inflexible arrangement of desks, and a lack of differentiated instructional groups. The assessment area was a lack of multiple forms of assessments (see Table 5).

Nevertheless, while Table 5 summarizes and describes the U.S. teachers' views on areas of weakness in Chinese mathematics education from their observation and experience during their trip in China.

*Table 5*

**Weaknesses in Chinese Mathematics Education**

| Areas | Needing improvement |
|---|---|
| Teaching | 1.Lack of use of active participation strategies<br>2. Lack of working with small groups of students -- The lessons observed were very teacher directed.<br>3.Lack of differentiated instructional groups |
| Integration in teaching | 1.Lack of integrating literature into math lessons<br>2.Lack of integrating various manipulatives into the lesson<br>3.Lack of Realia and the use of activities and real-life projects |
| Structure of the classroom environment | 1.Number of students per class: Classrooms are overcrowded<br>2.Lack of space to provide additional support within the classroom<br>3. Structure of all classes is not varied. All had their desks in rows |
| Assessment | 1.National Exam determines the academic and professional future of students<br>2.Multiple forms of assessment should be used aside from the National Exam |

The US teachers provided helpful suggestions on improving Chinese mathematics education in seven aspects corresponding the weakness areas: Across the curriculum, integration of literature & other subjects, use of manipulative and real life projects, cooperative groups, active participation, smaller class sizes, multiple assessments, and change in the arrangement of the desks (see Figure 3).

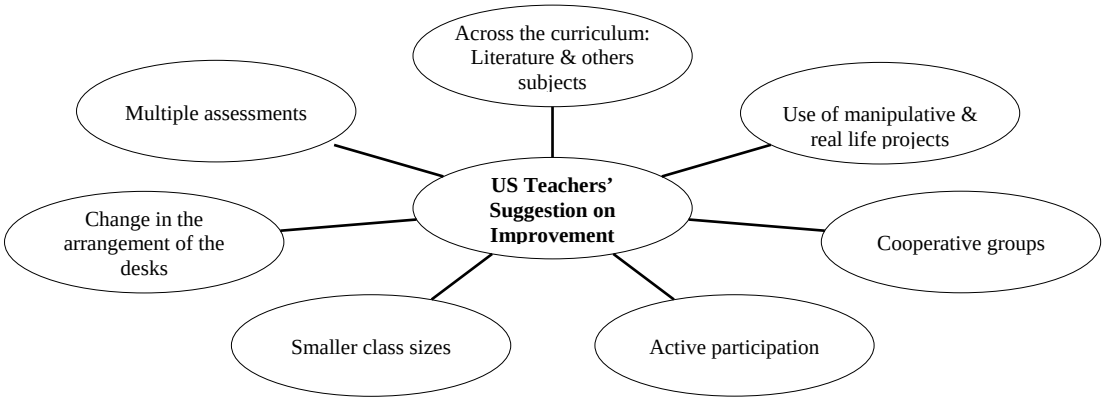


*Figure 3.* **U.S. teachers' suggestion on improving Chinese math education**

*Assessment*

The U.S. teachers found that one major weakness that cannot be controlled by the individual teacher, but it greatly affects how and what a teacher teaches, is the National Exam in China. "This exam determines the fate of students as they complete high school. A test is just a snapshot of what a student knows and it does not give a complete picture of the student," remarked Teacher E. Similarly, Teacher G described his view, "I did not see any assessments beyond hearing about the test that all students take at the end of High School to determine qualification for Colleges, both here and abroad." Teacher E echoed most teachers' reactions to the National Exam in China, "One test cannot be representative of a student's thirteen years in school."

The U.S. teachers suggested multiple forms of assessment to be used to determine the number of students accepted into college and to determine a student's academic future. As Teacher G recommended, "I would also focus on providing alternative forms of assessment besides the High School End Exam since in USA we have ACT as well as the SAT."

*Manipulatives and Real-Life Projects*

The U.S. teachers indentified the use of activities and real-life projects as another area that is lacking in the Chinese mathematics classes. "Many Chinese teachers did not see a reason to do activities that connected the mathematics to real-life and they thought it was easier to just give students the information required and teach them the process," remarked Teacher E. He believed, "Using activities that connect to real-life adds to the level of motivation among students. Students tend to be more engaged in the lesson when they are able to see how it relates to real life."

The U.S. teachers recommended looking at utilizing more manipulatives and developing a print-rich environment to support and facilitate learning. For example, Tea-

cher N spoke of the need for Manipulatives: "Using the computer and various forms of technology is important in learning math; however, students need to be able to have multiple opportunities to investigate math concepts with their hands." The U.S. teachers indicated that the idea of bringing manipulatives into the classroom setting to strengthen a concept is invaluable. Students remember lessons when they are actively involved.

*Curriculum Integration*

The U.S. teachers recognized that Chinese teachers are very well versed in their own subject area, but subjects are not integrated. They were concerned with lack of integrating literature into math lessons and lack of integrating various subjects into the lesson.

The U.S. teachers addressed the importance of curriculum integration: students enjoy learning across the curriculum and by incorporating various concepts together and unifying them into a specific subject, different from math, as being always exciting to the students. "It is important to understand that math is everywhere and a part of our everyday life," Teacher N commented.

*Active Participation Strategies*

The U.S. teachers observed the failure to use active participation strategies in Chinese mathematics classrooms. Teacher E connected his own practice regarding this issue：

> In our district, active participation involves the participation of every student at the same time. In China (and in many U.S. classes, also) teachers would ask a question and call on one student to answer. In my district, teachers would ask a question and have all students overtly respond at the same time. This would ensure that more than one student is learning the content.

The U.S. teachers recommended promoting more active participation to allow all students to engage in learning simultaneously. Teacher E expressed the following: "I would recommend the use of overt active participation strategies in each lesson. This will ensure that all students are learning at the same time." From his teaching experience, the use of real-life activities and projects to motivate students would help "some" students actively participate in individual lessons.

*Cooperative Learning Group*

All the U.S. teachers thought that the lessons they observed were very teacher directed. There was little opportunity for student input during the lesson. Teacher G observed that Chinese teachers seemed to focus more time on instruction and guided practice in their lessons and less time allowing students to collaborate. However, he recognized this could have been due to the time allotted to observing the lessons.

The U.S. teachers suggested providing more interaction amongst students (cooperative groups versus straight rows) while learning. Teacher D compared it with her teaching again and recommended using checks for understanding as a base for assigning students in a small group.

> Working with small groups of students to re-teach or provide enrichment is something

> very typically done by teachers in classrooms at the school where I teach. When I teach a lesson, I am constantly checking for understanding so I will know who to work with in a small group before he or she does independent practice.

*Number of Students per Class*

Another area of concern to the U.S. teachers is the number of students per class. Some Chinese teachers indicated that they may have up to 60 students per class. Teacher E echoed most teachers' concerns on larger class sizes leading to a lack of differentiated instructional:

> When you consider the total number of students they have in a day, it only amounts to 120, as opposed to a middle school or high school teacher in our district, who would have a total of 185 students in a day. However, to have 50 to 60 students per class makes it very difficult to identify the individual needs of students and to differentiate their instruction. In China, classroom management did not seem to be an issue, but if it is, then obviously the class size will make the situation worse.

Since the U.S. teachers did not observe the use of differentiated instructional groups in Chinese classrooms, Teacher N wanted to know more about "how they vary the lesson for students having difficulty grasping the concepts."

The suggestion from the U.S. teachers on class size issue is smaller class sizes and possibly increasing the number of classes teachers teach. Teacher E explained this suggestion, "If a teacher currently has 120 students with a maximum of 60 students per class, maybe it would be better to give that teacher a maximum of 40 students per class by adding one class to their day." Similarly, Teacher G related how smaller size class would reduce grading and increase teaching time: "With excessive numbers in the classroom, there is a need to improve class size and reduce the planning time in return. With fewer students there is less grading and more time for instruction."

*Structure of the Classroom Environment*

The U.S. teachers recognized a weakness that could be a by-product of the large class sizes, as the structure of the classroom environment (i.e. the desks). All classes the U.S. teachers taught in China had their desks in rows, which "made it difficult to monitor the class efficiently." Teacher E described the difficulty of the desks in rows in Chinese classrooms:

> As I taught, I had trouble moving around the class and reaching the corners of the room in a reasonable amount of time. Also, as I stated above, classroom management did not seem to be an issue in the classes that we taught and observed, but if it is an issue then the arrangement of the desks will compound the situation.

Teacher G believed there is a need to have the student engaged in cooperative groups, but he had the same observation as Teacher E, "The desks always seemed to be in straight rows, which is not the typical seating arrangement for cooperative learning groups." He spoke of the need for having the student engage in cooperative groups. Teacher N was concerned of lack of space to provide additional support to students within the classroom, such as a learning center or station.

The U.S. teachers recommended changes in the arrangement of the desks within a

classroom to help teachers efficiently monitor their students. Teacher N recommended having additional space or stations in a classroom to support students with learning difficulties.

> Students who have difficulty learning various concepts and need additional support would benefit from working in a small cluster where they could receive additional help. If the classrooms could have an additional "work table," students could receive one-on-one assistance by a paraprofessional or aide. The lack of space within the classroom does not provide room for students to physically demonstrate math problems (and with the weather, going outside is not always an option).

## Learning from Each Other: U.S. and Chinese Mathematics Education

### *Areas that U.S. Mathematics Education Can Learn from China*

To provide their views on how U.S. mathematics education can learn from Chinese mathematics education, the U.S. teachers reflected on their experience of teaching in China in terms of their own teaching experience in the U.S. The results from Table 6 summarize the U.S, teachers' views on six main aspects that U.S mathematics education can learn from Chinese mathematics teaching:

*Table 6*

**Areas that U.S. Math Education Can Learn from Chinese Math Education**

| Area | Learning from Chinese math education |
|---|---|
| Teaching | 1. Increase the level of difficulty of the content they teach<br>2. Teach math at a level that is high on Bloom's Taxonomy<br>3. Focus more time on perfecting their lesson delivery |
| Learning | 1. Higher expectations at an early level<br>2. Work hard to help students become advanced in proficiency<br>3. Better preparing students for the next grade level |
| Lesson preparation | 1.Pay more attention to lesson plans, as Chinese teachers do, to write complete lesson plans |
| Technology | 1. More integration of technology into curriculum<br>2. Use technology as an integral part of the lesson |
| Teacher preparation | 1. U.S. teachers can learn from the work ethic of Chinese educators<br>2. More professional development participation |
| Teacher benefits | 1. Parity in teacher pay scale between China and the US. |

While all the U.S. teachers recognized areas of U.S. learning from China, their responses varied as a result of their experiences with teaching. The following describes their different views related to their teaching:

*Higher expectations at an early level.* Teacher N, a second grade teacher, addressed her view of U.S. learning on higher expectations at an early level: "I learned that the Chinese students begin learning their math facts at a very early age. I was greatly impressed to find that their math textbook BEGAN with multiplication in the first

semester of second grade. In order for students to understand multiplication, they must have a strong foundation of their addition facts." She connected her teaching:

> In our district, students are held accountable for learning their math facts. However, I believe that the first graders should have their facts to 20 mastered at the end of their third trimester and not wait until they are in second grade to have this accomplished. Multiplication is introduced during the third trimester of second grade with an emphasis placed on memorizing the following facts: 0's, 1's, 2's, 5's, and 10's. I work really hard on helping my students become advanced proficient in their addition facts prior to the third trimester as it is my intent for them to know their division facts before they leave in June.

*Integration of technology into the math curriculum*. Teacher D believed that the U.S. should learn integrating technology in the math curriculum. She said,

> I was very impressed by the seamless integration of technology in the math curriculum. In both of the demonstration lessons I observed, technology was an integral part of the lesson. The technology was in both the anticipatory set as well as the input. This was VERY motivating and exciting for the students. It was obvious that much time and effort had gone into the lesson preparation. The students had a very clear visual picture of the concept the teacher was teaching. I must admit that I was envious of the technology and equipment evident in all the classrooms I visited!

*The work ethic of Chinese educators*. Teacher G mentioned three areas of learning related to the work ethic: mandated professional development, lesson planning, and pay scale:

> The assumption of participation in professional development is a way different approach that should be mandated for all teachers. I also believe Chinese teachers focus more time on perfecting their lesson delivery where American teacher rarely reflect upon a poor lesson or think how they could get more students to learn, similar to the no child left beyond mentality, but more realistic.
>
> The U.S. teachers can also learn from the pay scale of the Chinese teachers, while some teachers here think they are underpaid, though the reality is we are paid high relative to other cultures, yet still far below the normal salary in industry or technology fields. We can also look at China as a model for preparing students for the next grade level, as here in America we rarely retain for fear the parents might rebel against the district. In China the retention policy seems cut and dry: either you are prepared and move on or you do not move on due to lack of preparedness.

*Lesson plans and the level of difficulty of the content they teach.* Teacher E believed that U.S. teachers should pay more attention to their lesson plans, as Chinese teachers do. In addition, he would like to increase the level of difficulty of the content they teach.

> Chinese teachers write complete lesson plans every day. In the U.S., many teachers write complete lesson plans when they are required, which could mean three times a year or less. Many U.S. teachers don't spend enough time planning well thought-out lessons. Unfortunately, the fact that elementary teachers teach more hours than Chinese teachers and more subjects compounds this problem. U.S. teachers do not have enough time each day to write out complete lesson plans, but I believe the issue is important enough for teachers to get together and discuss solutions to this problem. Also, U.S. teachers could learn to increase the

> level of difficulty of the content they teach. Many U.S. teachers do not teach math at a level that is high on Bloom's Taxonomy. Chinese teachers, in preparation for the National exam, require their students to learn at a high level on Bloom's Taxonomy.

*Areas that Chinese Mathematics Education Can Learn from U.S.*

The U.S. teachers provided suggestions in four areas that Chinese mathematics education can learn from U.S. mathematics education (see Table 7). However, since the U.S. teachers related to their teaching experience in the U.S., each discussed the learning in a unique perspective.

*Table 7*

**Areas that Chinese Math Education Can Learn from U.S. Math Education**

| | Learning from U.S. math education |
|---|---|
| Teaching | 1 Teaching thematically (integrating concepts across the curriculum) is valuable to all students<br>2. Meet the individual needs of the students<br>3. Interact with every student in teaching (It may be difficult with 50 students in China)<br>4. Usage of wipe board (or interactive dry erase boards for instant feedback)<br>5. Frequent use of active participation to check for understanding during a lesson |
| Lesson Preparation | Use horizontal lesson planning with the use of task analysis |
| Technology | 1. Learn the usage of 'scantrons' and develop easier methods of assessing their large population of students<br>2. Promote online usage of technology, like TI calculators that allow students to graph, to promote the paperless climate. |
| Assessment | 1. Find alternative models of assessment |

*Teacher N's view.* Teaching thematically is a main approach suggested by Teacher N.

> I found it interesting how the Chinese departmentalize their teaching in elementary school. I know that their math teachers are highly qualified and trained, however as I mentioned earlier, I believe teaching thematically (integrating concepts across the curriculum) is valuable to all students. Teachers in our school district know that we can cover many concepts by integrating skills throughout the various core subjects. In doing this, we have the ability to teach "math" all day long, by bringing the skills into science, language arts, history, art and even physical education. By limiting the teachers to their specific subject, I wonder if the students are seeing and learning about the interrelationship math has in our daily life.

*Teacher D's view.* Meeting the individual needs of the students is a focus in Teacher D's teaching:

> In my class I think that if a Chinese teacher came to my class and observed me teaching, I would want her to see and understand that I teach lessons that are prescribed to meet the individual needs of the students in my class. I spend a lot of time researching what my students know and what they do not know. Students in my class are able to "compact out" of areas in which they demonstrate mastery. When I teach I am focused on what my students are thinking and doing during the lesson. I EXPECT every student to interact with me when I am teaching. I feel that I am able to do this because it is important to me

and also because I have 30 students in my class, not 50-as is typical in China.

*Teacher G's view.* Teacher G would like to share some new techniques or materials:

> They can learn the usage of 'scantrons' and develop easier methods of assessing their large population of students. Promote online usage of technology, like TI calculators that allow students to graph, show linear equations, etc. to promote the paperless climate. Find alternative models of assessment that allow for more frequent check-points to assess student understanding. The Chinese also can learn to adopt a larger quantity of standards, such as mathematical reasoning or other standards to better the conceptual understanding of mathematics and number theory. Usage of wipe board (or interactive dry erase boards for instant feedback when teaching.)

*Teacher E's view.* The use of horizontal lesson planning with the use of a task analysis is Teacher E's suggestion:

> Chinese teachers should consider the use of horizontal lesson planning with the use of a task analysis. For example: suppose a teacher is teaching a lesson on solving two-step equations. At my district, a teacher will teach a mini lesson on how to solve one-step equations by adding. Secondly, a teacher will teach a mini lesson on how to solve one-step equations by subtracting. Thirdly, a teacher will teach a mini lesson on how to solve one-step equations by multiplying and another lesson by dividing. At this point, the teacher is ready to teach how to solve two-step equations. However, the first example will only have positive numbers. The teacher will check the understanding of students using a problem that matches the modeled example. The second example may include one or two negative numbers and the teacher will continue the process until the objective has been met. Another recommendation for Chinese math teachers, as I stated above, is the frequent use of active participation to check for understanding during a lesson.

## Impacts of the International Experience on the U.S. teachers' Own Teaching

The analysis of the 14 video lessons shows that all the U.S. teachers displayed changes in their teaching in classrooms after their trip to China. The Table 8 shows the difference in their teaching prior to and after the trip to China.

*Table 8*

**Differences in the U.S. Teaching Prior to and After the China Trip**

| | Modeling for conceptual understanding | | Developing strategies for procedural fluency | | Building competence in application for problem solving | |
|---|---|---|---|---|---|---|
| Teacher N | Prior graphic | After Graphic, concrete, Role play, connection | Prior Basic facts | After Basic facts beyond grade level, strategies of solving | Prior Word problem | After Connection to real life experience |
| Teacher D | Graphic | Graphic, table, manipulative, & connection | Computation from books | Students discover multiple strategies | Real word Story | Connection of the story & Solving |
| Teacher G | Symbol & graphic | Student draw models | Computation from books | Students develop & explain strategies | Projects | Cultural connect and reflection on application |

*Note*. Teacher E was promoted to a coach at the district level after the trip. He was not included in this table.

The following is an example of Teacher N's reflection of her China trip：

> Through my experiences in working with the Chinese students, I have been able to reflect upon my teaching, especially in the areas of language arts, mathematics, and science and incorporate what I learned into my instructional strategies I use with my current class of second graders.
>
> My international experience of teaching in China has had a strong impact in current teaching and lesson planning. I find myself constantly assessing my students learning and adapting my lessons to be more challenging, increasing their levels of understanding and comprehension. Throughout the day, I am thinking of new ways to stimulate my students learning, asking my learners to "give me more." I want more of my students; their viewpoints, writing, designing, judging, selecting, and various ways of supporting their decisions.
>
> Since my travels to China, my students have incorporated more writing in mathematics through the use of journals. Each day my students document their learning by taking notes on what I have written on the overhead. This technique has been helpful in reviewing for tests and studying mathematics facts with fellow students. My second graders have increased their level of questioning which has lead to a stronger comprehension of mathematics concepts.

As a district coach now, Teacher E learned that the focusing on basic skills is essential:

> I also think a focus on basic skills is essential, if we want students to be successful in higher level math courses. I have encouraged our teachers to incorporate basic skills practice and to utilize our district resources to help our students strengthen their basic skills. The Chinese students were able to grasp new concepts quickly because they had a firm grasp on their basic skills.

## Discussion

In the new century, international perspectives in mathematics education have been growing broadly in various areas. This study provided outsiders' views on Chinese mathematics education from the U.S. teachers' first-hand cultural immersion experience in China and solicited their suggestions on how U.S. and Chinese mathematics education can learn from one another, which provided some significant insightful implications for current quandary in both Chinese and U.S. mathematics education.

### The Strengths of Chinese Mathematics Education

The U.S. teachers identified the main strength in China as having standardizations and high expectations from both teachers and parents. First, the standardizations to teaching lead to having highly qualified/trained mathematics teachers in China. To insure all teachers become experts in their areas, Chinese teachers have "standardization of expectations" in their teaching and student learning, and also have "standardization of curriculum" with a deep knowledge of curriculum. The most surprising finding that the U.S. teachers identified is that a teacher in China is responsible for one "expert" area of

the curriculum. This expectation in the Chinese educational system allows a teacher to "become extremely well-versed in his or her curriculum, planning, and implementation of lessons" as Teacher D noticed. Notably, because most Chinese teachers teach a single subject, as opposed to teaching multiple subjects, and most of them teach only two classes per day, Chinese mathematics teachers usually spent a considerable amount of time every day writing out detailed lesson plans like a case study, which is supported by An (2004). This leads to a lesson that is well thought out and organized, and leads to a teacher spending a great deal of time ensuring students' mastery of skills and procedures during instruction. The U.S. teachers believed that these two elements (single subject and two classes a day) "make it possible for Chinese teachers to master their content and to give the mathematics curriculum 100% of their focus." As a result, Chinese teachers' levels of expertise are very high and they become an "expert" in one area. Furthermore, the U.S. teachers noticed that because of standardization of curriculum and teaching, the National Exam system, and the One Child Policy, teachers and parents in China have "high expectations" for their students at early levels. Consequently, parents have a high degree of parental involvement and always prioritize their children's education.

Interestingly, the U.S. teachers admired the fact that the classrooms in China are well prepared to use technology to meet the needs of today's students. All Chinese teachers had access to a computer with a linked LCD projector, Elmo, and a screen that was easily visible for all students in the classroom.

**Areas that Chinese Mathematics Education Can Learn from the U.S.**

The U.S. teachers provided valuable suggestions that Chinese mathematics education can learn from. They recommended more teaching thematically in China because they believed that integrating concepts across the curriculum is valuable to all students. By limiting the teachers to their specific subject, the U.S. teachers wonder if Chinese students are seeing and learning about the interrelationship mathematics has to daily life. In addition, they also suggested meeting the individual needs of the students. To know all students' thinking, they recommended the frequent use of active participation to check for individual understanding during a lesson.

The U.S. teachers also suggested integrating manipulatives and real life projects in teaching mathematics. While Teacher N commented that manipulatives do not need to be costly, and can often be found in many grocery stores and homes, she did not know that a variety of manipulatives materials as in the U.S. are not accessible in China. Most classrooms only had some traditional concrete teaching materials in teaching mathematics. Manipulatives in China usually are used in a separate "hands-on and skills" course (劳动课) from K-9 grades once per week, and usually the content does not specifically link with mathematics content. This practice originated from the historical tradition of mathematics teaching: "The cultural traditions of Chinese mathematics education lead people to believe that routine practice is the efficient way for mathematics learning" (Li, 2006, p. 132). As Teacher E remarked, "Many Chinese teachers did not see a reason to do activities that connected the mathematics to real-life and they thought it was easier to just give students the information required and teach them the process." It

will be worth trying to using manipulatives in Chinese mathematics classrooms because it can help students link mathematics content and conceptual understanding to real representations and applications (Lesh, Post, & Behr, 1987). In a study of Chinese 6th graders' learning mathematics with understanding in the three ways of concepts, procedures, and applications, Wu (2006) noted that Chinese students who used the traditional textbooks were fluent at procedures and computations, but very weak at using a variety of models to demonstrate their understanding of mathematics concepts in fractions and decimals, which implied a need in Chinese mathematics teaching: providing students an opportunity with various manipulatives and representations to convey their understanding conceptually.

Although all the U.S. teachers were concerned with the National Exam in China, it is worth noting that the National Exam system has been undergoing gradual change in recent years. Now more provinces are starting to develop different forms of assessments and increasing the number of times exams are given in a year for high school graduates.

**Areas that U.S. Mathematics Education Can Learn from China**

The U.S. teachers connected their own teaching experience in the U.S. to identify the following areas that are necessarily learned from Chinese mathematics education:

First, having higher expectations at an early level. NCTM (2000) calls for high expectations and strong support for all students. However, high expectations usually heavily rely on the curriculum, which leads to different expectations for teachers. For example, Teacher N was greatly impressed to find that Chinese mathematics textbook "BEGAN with multiplication in the first semester of second grade." In contrast, Multiplication is introduced during the third trimester of second grade in her class in the United States. As in effective Chinese mathematics curricula-setting efforts, U.S. mathematics curricula may raise levels of expectations at each grade level so classroom teachers can be allowed an emphasis on enhancing students' proficiency in mathematics.

Second, increasing the level of difficulty of the content. The U.S. teachers believed that "many U.S. teachers do not teach mathematics at a level that is high on Bloom's Taxonomy. Chinese teachers, in preparation for the National exam, require their students to learn at a high level on Bloom's Taxonomy." The levels of Bloom's Taxonomy in mathematics assessments usually only cover the first three levels: knowledge, comprehension, and application in the U.S. classrooms because support for more complex levels – analysis, synthesis, and evaluation – has largely failed to develop (DeLandsheere, 1977; Hopkins, 1998), which limited U.S. teachers teaching at higher cognitive levels. In contrast, Chinese exams consist of a variety of levels of Bloom's Taxonomy (Gu, Yang, & Yang, 2008).

Third, taking time to plan mathematics instruction. The U.S. teachers indicated that "many U.S. teachers don't spend enough time planning well-thought-out lessons and many teachers write complete lesson plans only when they are required to, which could

mean three times a year or less." Unfortunately, they also realized the fact that elementary teachers teach more hours than Chinese teachers do, and more subjects, which compounds this problem. The observation on U.S. teachers' planning and time related to it is consistent with the results from An's study (2004). Yet, the U.S. teachers recognized that although they do not have enough time each day to write out complete lesson plans, the issue is important enough for U.S. teachers to get together and discuss solutions to this problem.

Last, the use of high technology in teaching. The U.S. teachers would like to have more integration of technology into curriculum and use technology as an integral part of the lesson. A comparison study by Wu, An, and Wang (2005) revealed that Chinese teachers have stronger ability in using technology than U.S. teachers do in mathematics classrooms. They do not simply use commercially produced technology; they creatively develop their own mathematics lessons using technology skills, which they call Ke Jian (课件). Technology is essential in teaching and learning mathematics; it influences the mathematics that is taught and enhances students' learning (NCTM, 2000). It is very important to train U.S. teachers to integrate technology that is assessable for all students.

## Implication and Conclusion

### Lesson Planning

From the U.S. teachers' views, this study identified the strengths of Chinese mathematics education in seven areas. The notable strong areas that U.S. can learn from China suggested by the U.S. teachers are lesson preparation using greater effort. A comparative study from An (2004) revealed that Chinese teachers' lesson plans are not simple outlines, as is the case with U.S. teachers, but a detailed teaching note that includes the objectives, materials, teaching methods, types of questions asked, examples given, alternative ways of problem solving, and summary. The planning also differed in terms of time spent on planning between the U.S. and Chinese teachers. "Most U.S. teachers use 30 minutes to one hour for daily planning, while most Chinese teachers would use one to two hours for daily planning" (p.121). Other studies confirmed that U.S. teachers tend to focus on the activities in their planning (Clark & Yinger, 1979), but barely elaborate the content of student learning with the activities (Shavelson & Stern, 1981). The importance of planning is indicated by NCTM (2000), "Effective teachers must know how to ask questions and plan lessons that reveal student prior knowledge; they can then design experiences and lessons that respond to, and build on, this knowledge" (p.12). It is critical for U.S. teachers to spend time to prepare detailed lesson plans that take into consideration students' needs, and levels of difficulty of content. However, with a disadvantage of lack of time, U.S. teachers may consider using summer time to prepare their lessons in advance.

### Cognitive Level

Bloom's Taxonomy's cognitive domain is the core of mathematics curriculum. However, support for the higher levels (analysis, synthesis, and evaluation) has largely failed to develop (DeLandsheere, 1977), which is why when cross-national studies have

included samples of Chinese and U.S. students, the findings consistently show that mathematical performance of Chinese students is higher than that of their U.S. counterparts (Lapointe, Mead, & Askew, 1992; Stevenson, Lee, Chen, & Lummis, 1990). The U.S. teachers who participated in this study noted that Chinese teachers had high expectations of their students and thus provided a high level of difficulty in the content they taught; this observation is consistent with a study from An (2004) that revealed that Chinese teachers usually design a layered practice format at different cognitive levels to help students achieve proficiency in mathematics. To improve and prepare students' mathematics learning, the recent National Mathematics Advisory Panel Report (Department of Education, 2008) has recommended certain critical foundations of mathematics. The Chinese perspective of focusing on different cognitive levels may help U.S. students succeed in the challenge of learning.

**Cultural Factor**

Drawing data from the U.S. teachers' experiences in China in this study, it is not difficult to find that the culture factor plays an important role in mathematics education: Chinese parents' higher expectations and effort of involvement in their children's education contribute to their children's success in school, which cannot be interpreted simply by the influences of formal schooling processes (Wang & Lin, 2005). As Teacher E remarked:

> The international experience has helped me to see that kids are kids whether they are in the U.S. or China. I really believe teacher and parent expectations are the key to a student's success. I noticed that the students in China were more motivated than the students in the U.S. In my opinion, it is because of the high involvement of parents. When I train and coach our middle school math teachers, I share this with them and I encourage them to communicate with parents and keep their level of expectation high for their students.

In conclusion, this cultural-immersion in experiential learning opportunity in China provided the U.S. teachers with rich experience in teaching and learning mathematics and promoted their professional growth. Teacher N expressed appreciation of the cultural immersion learning experience that was echoed by other teachers:

> Teaching in China was an amazing experience that I will never forget and one that I will always cherish. I thoroughly enjoyed working with the young students, teaching them mathematics, science, and language arts. At each school, I found the parents, teachers, and children to be warm, polite, and excited about learning from the Americans.

This study suggests that mathematics teachers should have an opportunity to observe their profession being carried out in another culture so that they may better reflect on their own practices. Further study is needed to understand how these teachers' increased competence from cultural immersion shapes their instruction preparation, technology integration, involvement with parents, and ultimately the success of their students. However, the initial results of the effectiveness of the experiential learning on teacher change are promising. Although this cultural immersion in experiential learning combined with course work included reports from only four U.S. teachers in China, such learning experience can be adapted for use in professional development models for a

larger amount of teachers in school districts as well as for use in mathematics teacher education programs.

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