Beliefs and classroom practices of mathematics learning and teaching between American and Chinese teachers

by

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TABLE OF CONTENTS

LIST OF TABLES

GENERAL INTRODUCTION

Cross-cultural researchers have reported that Asian students far outperform their American counterparts in mathematics (Husen, 1967; McKnight, Crosswhite, Dossey, Kifer, Swafford, Travers, & Cooney, 1987; Stevenson, Lee, & Stigler, 1986a). The consistently excellent performance of Chinese and Japanese children from kindergarten through high school has aroused great interest in the variance in mathematics among cultures.

Using classroom observations, interviews, and questionnaires, Stevenson and his colleagues have focused their attention on Chinese, Japanese and American elementary school children. Their results indicate that the differences in mathematics achievement of American, Chinese, and Japanese children cannot be attributed either to differences in children's intellectual abilities or to the mathematics curriculum used in schools (Stevenson, Stigler, Lee, Lucker, Kitamura & Hsu, 1985; Stigler, Lee, Lucker, & Stevenson, 1982). Noticeable differences, however, in educational policies, classroom practices, and beliefs relating to achievement among schools, childrens and parents in these three countries have been documented in the cross-cultural studies (Lee, Ichikawa, & Stevenson, 1987; Stevenson & Lee, 1990; Stigler, Lee, & Stevenson, 1987).

The differences in mathematics classroom practices in different cultures may be related to teachers' beliefs in mathematics learning and teaching. Studies regarding teachers' beliefs and mathematics classroom practices are needed to determine the relations between teachers' classroom practices and their beliefs of mathematics learning and teaching across countries. More cross-cultural studies of mathematics teaching and learning will be useful for educators, teachers, and parents to improve students' mathematics performance in countries in the future.

SECTION I. CROSS-CULTURAL STUDIES OF TEACHERS' MATHEMATICS CLASSROOM PRACTICES AND THEIR BELIEFS: LITERATURE REVIEW

INTRODUCTION

For more than twenty years researchers have reported that Asian students performed better in mathematics than did their American counterparts. Although earlier studies (Husen, 1967; McKnight, Crosswhite, Dossey, Kifer, Swafford, Travers, & Cooney, 1987) found such differences among high school and junior high students, more recent studies have shown large cross-national differences in mathematics achievement among young children (Song & Ginsburg, 1987; Stevenson, Lee, & Stigler, 1986a; Stigler, Lee, Lucker, & Stevenson, 1982; Stigler, Lee & Stevenson, 1987). Song & Ginsberg (1987) measured the formal and informal mathematics skills of Korean and American children at several age levels. The results showed that, at the ages of 7 and 8, Korean children exhibited superior performance in formal mathematics, although Korean preschool children's performance in informal mathematics was not as good as that of American children.

In the Stigler et al. study (1982), the mean scores of American kindergarten children were below those of Japanese children; and by first grade, American children's scores were significantly below those of both Japanese and Chinese children. By fifth grade, the differences were even greater. Among 20 fifth-grade classrooms in each country, the average score in mathematics of children in the highest-scoring American classroom was below that of all Japanese classrooms and of all but one Chinese classroom (Stevenson et al., 1986a; Stevenson, Stigler, Lucker, Lee, Hsu, & Kitamura, 1986b). These large differences in children's mathematics achievement have inspired many studies trying to find the answer to explain the variance in mathematics achievement among children of different countries.

INTELLECTUAL ABILITIES AND CURRICULUM

Intellectual Abilities

Although evidence has been documented by Lynn and Dziobon (1980) that the average IQ of Asian children exceeded that of American children, other researchers (Stevenson, Stigler, Lee, Lucker, Kitamura, & Hsu, 1985), however, found similarity among Japanese, Chinese and American children in level, variability, and structure of cognitive abilities. Children of these three countries at grades 1 and 5 were given a battery of 10 cognitive tasks and tests of achievement in reading and mathematics. Prediction of achievement scores in mathematics and reading from the cognitive tasks showed few differences among children of the 3 countries. From the results of their study, Stevenson et al. (1985) concluded that the high mathematics achievement of Chinese and Japanese children cannot be attributed to higher intellectual abilities.

Curriculum

Differences in mathematics achievement could be expected if popular textbooks in a country failed to include certain types of material, or if the introduction of material was delayed beyond the grade level at which it was introduced in other countries. Stigler et al. (1982) analyzed the mathematics textbooks series used in elementary schools of Taiwan, Japan, and the United States according to the grade level at which various concepts and skills were introduced. They found that the Japanese curriculum contained more concepts and skills and also introduced these concepts and skills earlier than the curricula of Taiwan and the United States. According to this standard, the curriculum was more advanced in the United States than in Taiwan. Therefore, the lag of American children behind children from Taiwan and Japanese in mathematics performance is not due to substantial differences among textbooks (Stigler et al., 1982). The superior performance of Japanese children may be traced in part to the advanced curriculum used in the elementary schools of Japan, but the curriculum was more advanced in the United States than in Taiwan. Therefore, the explanation of differences in curriculum alone cannot account for the superior performance of children in Taiwan.

The results of Song and Ginsburg (1987) found that, through the first grade, American children showed higher levels of performance than Korean children, but this advantage disappeared by the second and third grades. These results suggest that school experiences may play an important role in the cultural differences in mathematics achievement.

DIFFERENCES IN CULTURAL SCHOOLING CONTEXTS

Educational Systems and Policies

Although many aspects of schooling are similar among Japan, Taiwan, and the United States, differences exist in examinations and centralization of educational policy among the three educational systems of Japan, Taiwan and the United States. Educational policy is more centralized in Japan and Taiwan (Stigler et al., 1987).

In Taiwan, the Ministry of Education decides the length of school days and allots the amount of time to each subject. The Ministry also promulgates curricula for all levels in detail. The objective of school education is to help students achieve the curricula goals. Textbooks with teachers' manuals based on the curricula are published by the National Institute of Compilation and Translation working through subcommittees organized by the Ministry of Education. Every elementary school in Taiwan uses the same set of textbooks, on which nationalwide examination for entrance to high school and the university are based (Lin, 1985; Ministry of Education, 1987).

Chinese teachers under this centralized educational policy are more obliged to meet the standard levels of students achievement in each subject, according to the objectives established by the Ministry (Ministry of Education, 1976; Stevenson & Lee, 1990). In contrast, curriculum and textbooks are decided by local school boards, principals, and even individual teachers in the United States (Stigler et al., 1987; Viteritti, 1983). Smith (1977) has found that teachers are more effective in their teaching when they adhere closely to unit objectives. Teachers who have a great control over the curricula may allocate different amounts of time to the teaching of mathematics (McDonald & Elias, 1976). Their expectations of students' progress may also vary widely.

Research on teacher and school effectiveness indicated that higher expectations for student achievement maximized students' learning gains (Bain, 1989). Schools and teachers who foster progress in academic achievement tend to place a high priority on doing so and to follow up by adopting high but realistic expectations (Brophy, 1986; Brophy & Good, 1986). Teachers having high and realistic expectations also are more likely to use coordinated instructional efforts and more frequent assessments of progress (Brophy, 1986).

In Japan and Taiwan, entrance to both high school and the university is determined by scores on nationwide examinations (Lin, 1985; Stigler et al., 1987; White, 1987). Thus, academic pressure is placed even on young children to study hard and on their teachers to put more effort in teaching to have the best possible preparation for the examinations. Teachers under the pressure of examinations may allocate more time to teaching, evaluate their teaching strategies or practices relating to students' understanding and learning in order to increase the effectiveness of their teaching to the examinations.

A large difference among the three countries also exists in the amount of time children spend in school. American children attend school for an average of 174 days each year in the United States, while the school year in Japan and Taiwan contains between 230 and 240 days (Stigler et al., 1987).

Time for Academic Activities and Mathematics Classroom Practices

Stevenson and his colleagues conducted observational studies in first- and fifth-grade mathematics classes in Chinese, Japanese, and American classrooms in Taipei, Sendai, and Minneapolis in 1985-1986. Activities in 20 representative classrooms were observed in each of two grades and in each country. Some observations were focused on individual children and others on the teachers. Large cross-cultural differences were found in many variables related to classroom practices.

In addition to the longer school year, children in the two Asian countries also devote a larger percentage of time to academic activities. Stigler et al. (1987) reported from their classroom observations that in first grade, American, Chinese, and Japanese children spent 69.8%, 85.1%, and 79.2% of the school time, respectively, engaged in academic activities. At the fifth grade, the corresponding percentages were 64.5%, 91.5%, and 87.4% (Stigler et al., 1987).

As to the number of hours spent each week in mathematics, at the first grade, Stigler et al. (1987) estimated that American children spent 2.7 hours a week in mathematics. Chinese children spent 4 hours, and Japanese children spent 5.8 hours a week in mathematics. At the fifth grade, American children spent 3.4 hours a week in mathematics, Chinese children 11.7 hours, and Japanese children 7.8 hours (Stevenson et al., 1986a). Obviously, these findings indicated that American children spent far less time learning mathematics than did Chinese and Japanese children.

Classroom Organization

Regarding classroom organization, results from the classroom observations focusing on children found that Japanese and Chinese children spent the vast majority of their time in mathematics classes working, watching, and listening together as a class (74% for Japan; 82% for Taiwan). They were rarely divided into small groups for instruction. American children, on the other hand, spent more time working on their own (52%) than they did in activities involving the whole class (41%). American children also spent more time working on mathematics in small groups (8%) than did either Chinese or Japanese children, who were divided into groups only about 1% of the time (Stigler et al., 1987).

Similar differences among the cultures emerge in observations focusing on teachers. Mathematics teachers in Japan and Taiwan spent, respectively, 86% and 77% of their time working with the whole class. American teachers worked with the whole class only 46% of the time. On the other hand, American teachers were coded as working with individual students 33% of the time, compared with only 13% in Taiwan and 11% in Japan (Stigler et al., 1987).

When used effectively, the whole-class method is more efficient for mathematics instruction (Good & Grouws, 1977). Although teaching the whole class is more demanding than teaching in a small group, whole-class instruction is simpler in that the teacher needs to plan only one set of lessons and is free to circulate during seatwork times. The excellence of Chinese children's mathematics performance may be due to that they benefit from attending mathematics learning activities in a whole class in which the lessons are well prepared.

On the other hand, small-group instruction is more complex to implement than whole-class instruction. It involves preparing differentiated lessons and assignments. Small-group instruction also keeps the teacher busy teaching in small groups most of the time. It may be difficult for teachers to monitor and assist the majority of students who are working on assignments. Consequently, the small-group approach requires both well-chosen assignments that students are willing to engage in and able to complete successfully, and rules and procedures that enabling them to get help or direction without disrupting the learning process of other students. Teachers with the competency to handle the small-group instruction may still find that it takes too much effort to adopt small-group instruction if they do not have an aide in their classroom (Brophy & Good, 1986).

The excellence of Chinese children's mathematics performance may be due to that they benefit from attending mathematics learning activities in a whole class in which lessons are well-prepared. Contrary to Chinese children, American children learn mathematics in a small group or work individually (Stigler et al., 1987). Because of the complexity of small-group instruction, American children may not benefit much from the learning activities even when their teachers have much adquate class preparation.

There were also important differences in the use of time for activities led by teachers. In Taiwan, the teacher was leader of the class 90% of the time, as contrasted to 74%

of the time in Japan, and 46% of the time in the United States. Thus, even though the number of children in American classrooms was smaller than the numbers in Taiwan and Japan, the American child actually received less direct instruction from his/her teacher than did the Japanese or the Chinese child (Stigler et al., 1987).

Direct Teaching

In addition to the differences in classroom organization, Stigler et al. (1987) also reported that the largest cross-national differences were observed in the percentage of time teachers spent direct-teaching their students, such as explaining mathematics concepts or demonstrating procedural skills, etc. Averaging across grade levels, Stigler et al. (1987) observed that teachers in the United States spent 25% of their time direct-teaching, compared to teachers in Taiwan who spent 63% of their time, and teachers in Japan who spent 33% of their time direct-teaching. These percentages reflect three approaches to teaching. The extremes were represented by the American and Chinese classrooms: little time was spent in the American classroom on substantive matters, such as teaching conceptual understanding and procedural skills in mathematics. In comparison to American classrooms, much more time on these subjects was spent in the Chinese classrooms (Stigler et al., 1987).

The Chinese teachers spent more than half of their mathematics class time giving information about mathematics. They imparted and explained mathematical concepts, demonstrated mathematical procedural skills and asked students mathematics-related questions and sometimes initiated discussions between students and teacher, or among students. After these teaching procedures, observed Chinese teachers allocated 35% of the mathematics class time to seatwork, which is much lower than that observed in the American classrooms. The American teachers allocated about one-fourth of their mathematics class time on teaching in mathematics and more than half of the class time to seatwork (Stigler et al., 1987).

A picture of American mathematics classrooms from kindergarten to 12th grade has been drawn from a study of American elementary school mathematics instruction (Conference Board of Mathematical Science, 1975). It is as follows:

> The "median" classroom is self-contained. Mathematics period is about 43 minutes long and about half of this time is spent on written work. A single text is used in whole-class instruction. The text is followed fairly closely, but students are likely to read at most one or two pages out of five pages of textual materials other than problems. It seems likely that the text, at least

> as far as the students are concerned, is primarily a source of problem lists. Teachers are essentially teaching the same way they were taught in school. Almost none of the concept, methods, or major ideas of median classroom are applied (p. 77).

In their review of several studies of teacher behavior and student achievement in upper elementary grades through high schools, Brophy and Good (1986) concluded that teachers with high achieving classes tended to use more class time for direct teaching. Such direct teaching allows students to comprehend and integrate all mathematical concepts and skills from teachers' explanations and demonstrations. Students achieve best in classes in which they spend most of their time being taught or supervised by their teachers, rather than working on their own (Arehart, 1979; Brophy & Evertson, 1976; Good & Grouws, 1977). Chinese students' superiority in mathematics performance may be due to the effective teaching given by their teachers.

The differences between Chinese and American classrooms in the use of time in direct teaching of mathematics by teachers are suggested as the causes of the differences in mathematics achievement (Stigler et al., 1987). Several studies on information-processing in both reading and mathematics (LaBerge & Samuels, 1974; Perfetti & Lesgold, 1977; Greeno, 1978) concluded that students taught with structured curricula generally did better than those taught either with more individualized or with discovery-learning approaches. They also demonstrated that young students who received the instruction from teachers usually achieved higher scores on mathematics than did those who were expected to learn new material and skills on their own or from each other in small groups. Rosenshine and Stevens (1986) contended that when young students are expected to learn on their own, particularly in the early stages, the students run the danger of not attending to the right clues, or of not processing the important points, and of proceeding on the later points before they had done sufficient elaboration and practices.

Homework

Through the questionnaires and interviews, large differences in the amount of time students spent on doing their homework were reported (Chen & Stevenson, 1989; Stevenson et al., 1986a). American mothers estimated that, on weekdays, their first-grade children spent an average of 14 minutes a day on homework; the daily average for Chinese first-grade children was 77 minutes, and for Japanese first-grade children, 37 minutes. On weekends, American children studied about 7 minutes on Saturday and 11 minutes on Sunday. In addition to the half day in school on Saturday, Chinese children spent 83 and 73 minutes doing their homework on

Saturday and Sunday; 37 and 29 minutes for Japanese children.

According to Stevenson et al. (1986a) teachers' estimates of time spent on homework were in line with the mother's estimates. Chinese teachers reported that they assigned more homework than Japanese teachers did; Japanese teachers reported that they assigned more homework than the American teachers did. According to teachers' estimates, Chinese first-graders were assigned more than twice as much homework as were Japanese first-grades, and more than 10 times the amount as were their American counterparts.

In comparison, Chinese teachers not only spent much more time in mathematics teaching in the classroom, but they also assigned more homework for the class, besides the classwork. From their findings of classroom behavior and achievement study, Stigler and his colleagues (Stigler et al., 1982) suggested that reserving the class time for efficiently teaching mathematics and practicing the mathematics assignment as homework after school might be an effective way of teaching that would increase students' achievement.

Effective homework does not only provide practice beyond the classroom; it also teaches students to be independent learners. Homework gives students experience in following directions, making judgements and comparisons, raising additional questions for study, and developing responsibility of self-discipline (Walberg, 1986). From the studies of the fourth-grade mathematics teachers, Good, Grouws and Ebmeier (1983) concluded that effective teachers, in contrast to less effective teachers, presented their instruction more actively and clearly; they spent most of the instructional period on mathematics. Their students relatively spent a greater percentage of class time doing substantial mathematics learning in the class.

Manipulatives and Real-World Problems

According to Piaget (1972), children learn mathematics better through concrete and manipulative objects, or through considering real-world problems (Kamii, 1985). Stigler and Perry (1988) reported from the observational study that both Japanese and Chinese teachers relied more on manipulatives and on real-world problem situations than did teachers in the United States. In first-grade, both manipulatives and real-world problems were used more frequently in Chinese classrooms than in either Japanese or American classrooms. The proportion of instructional segments using concrete manipulation was more than 50% in Chinese first-grade mathematics class, more than 40% for Japanese mathematics class, and about 30% for American classes. Japanese first-grade classes used more real-world problems than did either the Chinese or American classes; Chinese children used more than American children did. The proportion of segments using combinations of concrete manipulative and real-world problems was higher in Chinese classrooms than in the Japanese and American classrooms, and the proportion was higher in the Japanese classrooms than in the American classrooms.

REVIEW OF METHOLODOGIES

Previous results (Stevenson et al., 1986b; Stigler et al., 1987; Stigler & Perry, 1988) relating the differences in mathematics classroom practices in Japan, Taiwan and the United States were obtained from observing elementary schools in Sendai, Taipei and Minneapolis metropolitan areas. These metropolitan areas may be cultural homogenous. However, the findings relating time spent in mathematics and language arts of Taipei classrooms were different from the requirements of the Ministry of Education (Ministry of Education, 1987). For example, Stigler et al. (1987) reported that at first grade, Chinese children in Taipei spent 4 hours learning mathematics every school week which were contradictory to the required 120 minutes by the Ministry. At fifth grade, the time allocated for mathematics was three times as much as allotted by the Ministry; 11.4 hours reported versus 240 minutes required. Contrary to 400 minutes required for language arts for both first and fifth grades, Taipei first-graders were reported spending 10.5 hours and fifth-grade 11.2 hours every week, more than twice the time allotted by the Ministry. These conflicts between the findings reported and the requirement of the Ministry may due to the use of time sampling method and the computation of the amount of time. For example, the Chinese teachers might have allocated more class time to mathematics than they were required because of the awareness of the observational study.

In addition to the discrepancy between the findings and the requirement of the Ministry, Taipei is a special municipality of Taiwan. More than one-seventh of people in Taiwan live in Taipei--with a population of 2.6 million (Government Information Office, 1988). The differences between Taipei and other areas of Taiwan in fundings and staffings may also affect the validity of the representativeness of Taipei to Taiwan. For example, the expenditure per pupil in Taipei is 818.88 U.S. dollars; whereas it is 658.11 dollars in other county schools (Taichung County Government, 1989; Taipei Bureau of Education, 1989). The pupil-administration ratio in Taipei is 317:1 and 1,379:1 in other county schools; the pupil-teacher are 29:1 and 34:1 respectively in Taipei and other counties (Ministry of Education, 1989; Taichung County Government, 1989; Taipei Bureau of Education, 1989). Taiwan teachers working in counties may thus have heavier responsibilities for their students and school-related work than those in metropolitan areas. They may also not have facilities comparable to those in Taipei to promote their teaching. Similarly, school budgets and school board structures vary significantly in the United States between urban and rural areas (Nespor, 1987; U.S. Department of Education, 1989; Viteritti, 1983).

The differences in budgets between the metropolitan and rural areas, among other things, affect the resources facilitating the teaching and learning process, as well as the environment's ability to enhance children's academic success (Corcoran, Walker, & White, 1988; Wilson & Corcoran, 1987). Moreover, budget differences between urban and rural schools may influence the working conditions affecting teacher attitudes and behaviors in their classroom practices (Wilson & Corcoran, 1987). Because of the limitations of the methodologies and the invalidity of representativeness, new research is necessary to describe sufficiently the mathematics classroom in each country.

TEACHERS' BELIEFS AND CLASSROOM PRACTICES

Teachers' Beliefs

Stevenson et al. (1986a) have suggested a possibility that the differences between teaching practices in American and Chinese classrooms may be related to teachers' beliefs regarding mathematics learning. A belief is "an attitude consistently applied to activities in which the person holding the beliefs is engaged" (Eisenhart, Shrum, Harding, & Cuthbert, 1988, abstract). Teachers' ways of thinking and understanding are vital components of their classroom practices. With videotaping teachers' classrooms and using the videotapes to construct verbatim records of classroom action, Nespor (1987) reported that teachers' beliefs and knowledge had a profound effect on the way they taught, as well as on the way students learned in their classrooms. The study found that teachers' beliefs played a major role in defining teaching practices and organizing the knowledge and information relevant to these practices. Through questionnaires and interviews, Peterson, Fennema, Carpenter, and Loef (1989) found that teachers' beliefs affected how they personally thought about teaching a new curriculum and to what extent they implemented the training or curriculum as intended by its developers. Reviewing results of studies on teachers' beliefs, Clark and Peterson (1986) have also concluded that a teacher's teaching practices are guided by and make sense in relation to a personally held system of beliefs.

Teachers' Beliefs and Classroom Practices

Teachers' classroom practices are very often related to the ways in which they maintain control in the class (Romberg & Carpenter, 1986). Peterson et al. (1989) also concluded that teachers' beliefs and knowledge are importantly linked to teachers' classroom activities, and ultimately, to students' learning.

The link between belief and classroom practices is illustrated in Nespor's teachers' beliefs study (1987). For example, two mathematics teachers involved in this study both held strong beliefs about student ability, maturity and laziness. One of them believed that learning mathematics was primarily a function of practice and drilling, and that student who failed to learn did so because they were too lazy to do work. He thus emphasized individual seatwork and spoke of forcing students to learn by making them do more work and of motivating students to work by showing them the practical uses of mathematics. In contrast, another teacher in this study thought that learning mathematics was primarily a function of maturity. She allowed students to work together in class on the assumption that the differences in maturity between students would be small enough to allow effective communication where her lectures had failed, and explicitly rejected the notion of forcing students to learn on the grounds that one could not force mental maturation (Nespor, 1987).

The results of cross-cultural studies (Chen & Stevenson, 1989; Lee, Ichikawa, & Stevenson, 1987; Stevenson & Lee, 1990) also have shown that parents' and teachers' beliefs play a vital role in children's academic experience. For example, the Chinese teachers valued homework higher than did the American teachers; they also reported that they assigned more homework to their students than did the American teachers (Chen & Stevenson, 1990). Both Japanese and Chinese mothers valued academic achievement higher than did the American mothers, they also put more special effort in participating their children's academic activities (Lee et al., 1987; Stevenson & Lee, 1990). In contrast, American mothers did not value their children's academic work as high as Chinese and Japanese mothers did; they also expressed fewer demands of their children in terms of their academic achievement (Lee et al., 1987; Stevenson & Lee, 1990)

<u>Beliefs in Effort or Ability</u>

Effort has been valued more highly than ability to account for the success of learning in Chinese culture. Chinese culture emphasized that success of work is based on consistent effort (Han, 1964; Wang, 1961). When asked about the role of effort, both Japanese and Chinese mothers and children expressed more strongly than did American mothers and children the belief that any student can be good at reading and mathematics if he/she works hard enough (Stevenson & Lee, 1990). The belief that increased effort pays off in improved performance is suggested as an important factor in accounting for the willingness of Japanese and Chinese children, teachers, and parents to spend so much time and effort on the children's academic work (Stevenson & Lee, 1990).

In contrast, American mothers and children placed greater emphasis on ability as an explanation for achievement than on effort. When parents believe that success in school depends on ability in contrast to effort, they are less likely to foster participation in activities related to academic achievement that would elicit strong effort toward learning on the part of their children (Stevenson & Lee, 1990).

Belief in Uniform Educational Experiences

The large percentage of time spent in whole-class instruction of Chinese classroom may be related to the belief that children can benefit from the same educational experience. The malleability of human behavior has often been described by Chinese philosophers (Hall, 1987; Wilson, 1970), and the uniformity of human nature is assumed (Graham, 1967), except among those who are gifted or mentally retarded. Differences arising among people are believed by the Chinese to be primarily a result of life experiences rather than an expression of innate differences among individuals (Stevenson, 1987a; 1987b; Hall, 1987). Chinese people are more likely to believe that human beings are like clay, shaped by the events of daily life (Stevenson et al., 1986a). Differences in innate ability are de-emphasized and the potential for change throughout life is believed to lie within the individual (Stevenson, 1987b). As a result, Chinese educators believe that children of normal development can benefit from the same instructional experiences (Ministry of Education, 1976; Stevenson, 1987b). Thus, children's achievement in mathematics may be, according to the Chinese, more related to their own and their teachers' efforts than to their mathematics learning abilities.

Beliefs in Teachers' Expectation

Chinese teachers are highly committed to teaching because they perceive that their efforts are more responsible for the success of children's learning than anyone else's (Stevenson 1987a; 1987b). Furthermore, Chinese teachers, as teachers in other Asian cultures, believe that it is their responsibility to motivate and to supervise children's study (Stevenson et al., 1986b; Song & Ginsburg, 1987), though they had larger class size (Stigler et al., 1987) and more school-related work than did American teachers (Stevenson & Lee, 1990). In contrast, American teachers have expressed that they are often burdened with so many noneducational responsibilities that they lose their commitment to the profession, as well as their sense of purpose (Boy & Gerald, 1987). However, the relative amount of time spent on class preparation by both American and Chinese teachers is not clear.

Research on teacher and school effectiveness indicated that higher expectations for student achievement are some of the characteristics of teachers that are successful in maximizing students learning gains (Bain & others, 1989). Schools and teachers who foster progress in academic achievement tend to be those that place a high priority on doing so and follow up by adopting high but realistic expectations (Brophy, 1986). Teachers with higher expectations of their students' progress also have a tendency to use coordinated instructional efforts, and periodic assessments of progress to help students achieve the objectives they set for their students (Brophy, 1986). Previous results (Stevenson & Lee, 1990) have found that American children were more convinced than Chinese and Japanese children that they were meeting their teachers' expectations. American children's inferiority in mathematics may be related to their teachers' disagreement with the statement that children's mathematics achievement is more related to their teachers' expectations than students' abilities. American teachers may thus not have high expectations of their students.

<u>Beliefs in Teachers' Confidence</u>

Not much research on children's mathematics achievement and their teachers' confidence with mathematical knowledge has been documented at the elementary school level. However, Bodenhausen (1988) has found that secondary school classes that did poorly in the examinations on calculus, English literature, and American history were more likely to have teachers with weak backgrounds in these subjects. Conversely, classes in which the average exam score was higher were more likely to have had competent and confident teachers with strong background in the subject they taught. The same results were found in the Beginning Teachers Evaluation Study (Berliner & Tikunoff, 1976; Tikunoff, Berliner, & Rist, 1975), more effective teachers were more knowledgeable about their subject matter and more effective in structuring it for the students. Rodriguez (1980) also found that teachers' confidence is identified as a characteristic of competent teachers who are described as having the self-assurance to trust their own judgment and act on it. Thus, the superiority of Chinese children's mathematics achievement may be related to their agreement with the statement that children's mathematics achievement is more related to teachers' confidence in their own mathematics knowledge than to children's learning ability.

CONCLUSION

The differences between American and Asian children's mathematics achievement are related to the educational policies and children's school experiences including the length of school year, and teachers' classroom practices. Previous researchers have shown that both Chinese and Japanese teachers' teaching practices appear to be more aligned with the current research theory on effective teaching in mathematics class than did the American teachers. For example, Chinese and Japanese teachers allocated more time for mathematics class, used more direct teaching and manipulatives and real-world problems. The cultural differences of mathematics classroom practices may be related to the beliefs held by the teachers, for example, Asian teachers may emphasize more effort than ability leading to the success in mathematics learning and they may believe that children can benefit from uniform educational experiences.

However, the samples of previous studies (Stevenson et al., 1986a; Stigler et al., 1987; Stigler & Perry, 1988) relating the mathematics classroom practices from metropolitan areas of each country may not be generalizable to its culture. Furthermore, little study has been done on the comparison of teachers' beliefs between Taiwan and the United States. New cross-cultural research with larger samples including urban and rural areas is needed to compare teachers' beliefs in mathematics learning and teaching and their mathematics classroom practices.

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SECTION II. BELIEFS AND CLASSROOM PRACTICES OF MATHEMATICS LEARNING AND TEACHING BETWEEN AMERICAN AND CHINESE TEACHERS

ABSTRACT

The present study surveyed the beliefs and classroom practices in mathematics teaching and learning among first-grade teachers in Taiwan (n = 210) and in the United States (n = 129). The relations between teachers' beliefs and their practices in mathematics instruction were also examined. Results of this study indicated that cultural differences do exist between American and Chinese teachers with respect to beliefs about mathematics learning and teaching. Significant correlations were found between teachers' mathematics classroom practices and their beliefs about children's mathematics learning. Nevertheless, several findings relating to teachers' beliefs and classroom practices were contrary to those of previous studies. Educational implications and suggestions for future studies are also discussed.

INTRODUCTION

For years, researchers have been reporting that Asian students perform better in mathematics than do their American counterparts (Husen, 1967; McKnight, Crosswhite, Dossey, Kifer, Swafford, Travers, & Cooney, 1987; Stevenson, Lee, & Stigler, 1986). The consistently excellent performance of Chinese and Japanese children from the first grade through high school has aroused great interest in the variance in mathematics achievement among cultures.

Using classroom observations, interviews, and questionnaires, Stevenson and his colleagues have focused their attention on Chinese, Japanese, and American elementary school children in Taipei, Sendai, and Minneapolis. They report that the differences in mathematics achievement of American, Chinese, and Japanese children cannot be attributed either to differences in intellectual abilities or to the curriculum (Stevenson, Stigler, Lee, Lucker, Kitamura & Hsu 1985; Stigler, Lee, Lucker, & Stevenson, 1982). Stevenson and his colleagues have reported noticeable differences, however, in educational policies, classroom practices, and beliefs relating to achievement among schools, children and parents in these three countries (Lee, Ichikawa, & Stevenson, 1987; Stevenson & Lee, 1990; Stigler, Lee, & Stevenson, 1987).

Educational Systems and Policies

Educational policy is more centralized in Taiwan than it is in the United States. In Taiwan, the Ministry of Education allots the amount of class time to each subject. The Ministry also promulgates curricula for all levels in detail. The objective of school education is to help all students master the curricula goals; however, attention to students' individual needs is not emphasized. Textbooks with teachers' manuals based on the curricula are published by the National Institute of Compilation and Translation working through subcommittees organized by the Ministry of Education. These subcommittees usually include college professors, curriculum specialists, classroom teachers, and representatives of the Ministry of Education. Every school in Taiwan uses the same set of textbooks, on which nationwide examinations for entrance to high school and the university are based (Lin, 1985; Ministry of Education, 1987). Chinese teachers under this centralized educational policy are more obliged to meet the standard levels of students achievement in each subject, according to the objectives established by the Ministry (Ministry of Education, 1976; Stevenson & Lee, 1990). Smith (1977) has reported that teachers are more effective in their teaching when they adhere closely to the unit objectives.

In contrast, curricula and textbooks are decided by local school boards, principals, and even individual teachers in the United States (Stigler et al., 1987; Viteritti, 1983). Teachers who have more control over the curricula may allocate different amounts of time to the teaching of mathematics (McDonald & Elias, 1976). Their expectations of students' progress may also vary widely.

Research on teacher and school effectiveness indicated that higher expectations for student achievement maximized students' learning gains (Bain & others, 1989). Schools and teachers who foster progress in academic achievement tend to be those placing a high priority on doing so and to follow up by adopting high but realistic expectations (Brophy, 1986; Brophy & Good, 1986). These teachers also have a tendency to use coordinated instructional efforts and periodic assessments of progress (Brophy, 1986).

The differences in budgets between the metropolitan and rural areas may, among other things, affect the resources facilitating the teaching and learning process, as well as the environment's ability to enhance children's academic success (Wilson & Corcoran, 1987). Moreover, budget differences between urban and rural schools may influence the working conditions affecting teacher attitudes and behavior in the classroom (Wilson & Corcoran, 1987).

Academic Pressure

In Taiwan, two major examinations exist in the current educational system. Periodical subject-area examinations are used to assess whether students have mastered the objectives of the course. Entrance examinations which determine who is accepted into a particular type of school are required for admission to schools beyond the junior high school level. Because of the extremely keen competition, the pressure to pass the examinations is placed even on young children who tend to study hard. Teachers tend to contribute special efforts in preparing their students for these examinations (Stigler et al., 1987). Such pressure may also lead to the distortion of the curriculum prescribed by the Ministry of Education.

For example, teachers in Taiwan have been reported that they allocated more time to teach those subjects, such as mathematics and language arts, that would be tested in future examinations by using the time allotted for other subjects but not included in the examinations, such as music, art, health education, civics and ethics, and group activities. Stigler and colleagues (1987) have reported that at first grade, Chinese children in Taipei spent 4 hours every school week learning mathematics which were contradictory to the required 120 minutes by the Ministry. At fifth grade, the time allocated for mathematics was three times as much as allotted by the Ministry; 11.4 hours observed versus 240 minutes required. Contrary to required 400 minutes for both first and fifth grades, Taipei first-graders spent 10.5 hours and fifth-graders 11.2 hours in language arts every school week, nearly twice the time allotted by the Ministry.

Both entrance examinations for high schools and universities are heavily weighted towards mathematics. Under the pressure of examinations, Chinese teachers may spend more time preparing lessons, allocate more time to teaching, assign more homework to students, and continually evaluate their teaching strategies to improve their students' level of mathematics performance in examinations. However, those subjects not included in the examinations may be neglected. When asked about what problems of schools need to be improved, Taipei mothers reported that more emphasis needs to be paid on those subjects not included in entrance examinations (Stevenson & Lee, 1990).

In contrast, there is no entrance examination for high schools in the United States. Although the requirement of admission is strict for some colleges or universities, the majority of high school graduates can enroll in college. Academic pressure in American schools may be less than that in Chinese schools. Consequently, the attention on mathematics may thus not be emphasized. American teachers may spend less time preparing lessons, allocate less time to teaching mathematics, assign less homework to students, and spend less time evaluating students' progress.

Classroom Practices

Class time In addition to the longer school year in Taiwan, Chinese teachers in Taipei have been observed to allocate more time than Minneapolis teachers do for mathematics instruction. American first-grade children were observed spending 2.7 hours a week for mathematics learning whereas their Taipei counterparts spent 4 hours a week on this subject (Stigler et al., 1987). At the fifth grade, American children spent 3.4 hours in mathematics whereas Chinese children spent 11.7 hours.

Homework time Large differences also existed between American and Chinese children in the amount of time that they spent on homework (Chen & Stevenson, 1989; Stevenson & Lee, 1990; Stevenson et al., 1986). According to teachers' estimates, the Taipei first-graders spent 280 minutes per week doing homework. It was more than 10 times the amount of homework as the American first-grade children did (Chen & Stevenson, 1989; Stevenson et al., 1986).

Whole-class instruction The majority of mathematics class time in Chinese schools was used for whole-class instruction led by teachers. In contrast, American children spent more time working on their own and less time learning mathematics in whole-class instruction. In comparison, American teachers spent more time working with individual students than did Chinese teachers in Taiwan (Stevenson et al., 1986; Stigler et al., 1987).

When used effectively, the whole-class method is more efficient for mathematics instruction (Good & Grouws, 1977). Moreover, whole-class instruction is simpler in that the teachers needs to plan only one set of lessons and is free to circulate during seatwork times.

On the other hand, small-group instruction is more complex to implement than whole-class instruction. It involves preparing differentiated lessons and assignments. Small-group instruction also keeps the teacher busy teaching in small groups most of the time. It may be difficult for them to monitor and assist the majority of students who are working on assignments. Consequently, the small-group approach requires both well-chosen assignments that students are willing to engage in and able to complete successfully, and rules and procedures enabling them to get help or direction without disrupting the learning process of other students. Teachers with the competency to handle the small-group instruction may still find that it takes too much effort to adopt small-group instruction if they do not have an aide in their classroom (Brophy & Good, 1986).

<u>Directing teaching</u> In addition to differences in classroom organization, other differences were also observed

between the United States and Taiwan were observed in terms of the amount of time teachers spending on direct-teaching of mathematics, such as explaining mathematics concepts and demonstrating procedural skills. American teachers allocated about one-fourth of their mathematics class time to giving information and more than half of the class time to seatwork. In contrast, Taipei teachers spent 63% of their time giving information and 35% to seatwork (Stigler et al., 1987).

Teachers with high achieving classes tended to use more class time for direct teaching to the whole class. Such direct teaching allows students to comprehend and integrate the whole materials through teachers' explanation, demonstrations, etc. Students achieve best in classes in which they spend most of their time being taught or supervised by their teachers, rather than working on their own (Arehart, 1977; Brophy & Evertson, 1976; Good & Grouws, 1977). Chinese students' superior performance in mathematics may due to the effective teaching given by their teachers.

Bodenhausen (1988) and Rodriguez (1980) both reported that classes performancing poorly in examinations were more likely to have teachers with weak background in the subject they taught. Conversely, classes in which the average exam score was higher were more likely to have had competent and confident teachers with strong background in the subject they taught. The same results were found in the Beginning Teacher

Evaluation Study (Berliner & Tikunoff, 1976; Tikunoff, Berliner, & Rist, 1975) that the more effective teachers were more knowledgeable about their subject matter and effective in structuring it for the students. Hence, Chinese children's mathematics achievement may be related to their teachers' confidence in their own mathematics knowledge. The high mathematics achievement of Chinese children may be related to their teachers' confidence with their own mathematics knowledge. In contrast, American teachers observed who allocated less time to mathematics might have not have much confidence with their own ability in teaching mathematics (Stigler et al., 1987).

Employment of manipulatives and real-world problems According to Piaget (1972), children learn mathematics better through manipulating concrete objects, or through considering real-world problems (Kamii, 1985). Stigler and Perry (1988) reported that Chinese teachers relied more on manipulative objects and on problems of real-world situations than did teachers in the United States. For example, in first-grade, the proportion of instructional segments using concrete manipulation was more than 50% in Chinese classes and about 30% in American classes. The proportion of time for using problems including real-world situations in the Chinese classrooms was also higher than that in the American classrooms.

The use of manipulative objects and real-world problems, however, may depend on teachers' class preparation and/or the availability and facilities the school provides. The differences between metropolitan and rural areas in budget and different responsibilities teachers assigned may affect teachers' use of manipulatives and real-world problems. Thus, a close study regarding the use of manipulatives and real-world problem between American and Chinese mathematics classroom may provide a better explanation of the differences in mathematics performance.

<u>Beliefs in Effort and Ability</u>

Differences also exist between American and Chinese children and their mothers in terms of beliefs regarding achievement. Previous studies (Lee et al., 1987; Stevenson & Lee, 1990) reported that both Chinese mothers and children expressed more strongly than did American mothers and children that students' performance is related to their effort. Stevenson and Lee (1990) suggested that the belief that increased effort pays off in improved performance is an important factor in accounting for the willingness of Chinese children, teachers, and parents to spend large amounts of time and effort on children's academic work. In contrast, American mothers and children placed greater emphasis on ability as an explanation for achievement than did Chinese mothers and children. When parents believe that success in school depends on ability rather than effort, they are less likely to foster participation in activities related to academic achievement that would elicit strong efforts to learn on the part of their children (Stevenson & Lee, 1990).

Review of Methodologies

Previous results (Stevenson et al., 1986; Stigler et al., 1987; Stigler & Perry, 1988) relating the differences in mathematics classroom practices between Taiwan and the United States were obtained from observing elementary schools in Taipei and Minneapolis. The percentages of children and teachers from minority groups in Minneapolis are smaller (1%) than in many other cities in the United States (Chen & Stevenson, 1989). More than one-seventh of people in Taiwan, however, live or work in Taipei. Thus, Taipei consists of a more diverse population than other places in Taiwan. Teachers in Taipei have been reported that they spent a greater length of time teaching mathematics than that was allotted by the Ministry (Ministry of Education, 1987; Stigler et al., 1987). This discrepancy of mathematics classes between that of Taipei classrooms and that required by the Ministry may be due to nonrepresentative sample or the methodology employed in the previous studies (Stevenson et al., 1986; Stigler et al., 1987). To sufficiently describe the mathematics classroom in each country, research is needed with larger samples including subjects from urban and rural areas.

Previous findings (Chen & Stevenson, 1989; Lee et al., 1987; Stevenson & Lee, 1990) also indicated that in Taiwan and the United States, academic practices by both children and mothers are related to their beliefs and attitudes. Thus, differences in teachers' classroom practices in these two countries may also be affected by the differences in their beliefs. For example, Chinese teachers valued homework higher than did American teachers, and they also assigned more homework to their students. Nevertheless, little research on cultural differences in teachers' beliefs has been reported. Therefore, to identify possible explanations for the cross-cultural differences in mathematics achievement between American and Chinese children, an examination of teachers' beliefs regarding mathematics learning and of their classroom teaching practices in these two countries is needed.

<u>The Study</u>

Therefore, the objectives of the present study were to investigate and compare first-grade teachers' beliefs regarding mathematics learning and their classroom teaching practices in Taiwan and the United States, and to describe the relations between teachers' beliefs and classroom practices in mathematics learning and teaching. First-grade teachers were selected to examine the cross-cultural differences related to their beliefs and classroom practices during children's early years of schooling.

Differences in beliefs I predicted that, compared to American teachers, Chinese teachers would express more agreement with each of the following statements: 1) Children's mathematics achievement is more related to effort, to teachers' expectations of children's progress, and to teachers' confidence in their own knowledge of mathematics than to children's learning ability. 2) Children can benefit most from their educational experiences when they learn mathematics concepts and skills from direct-teaching in a large group and from doing the identical assignments, rather than by working in small groups and doing individualiaed work.

Differences in classroom practices Compared to American teachers, Chinese teachers of first-graders were predicted to report that they 1) allocated more time to mathematics instruction, including, time for mathematics class, checking assignments, and evaluating students' understanding and amount of homework (Chen & Stevenson, 1989; Stevenson et al., 1986; Stigler & Perry, 1988; Stigler et al., 1987); 2) used more direct-teaching (giving information), manipulatives, and real-world problems in mathematics class (Stevenson & Lee, 1990; Stigler & Perry, 1988); and 3) spent more time in preparation for mathematics lessons and materials.

<u>Relations between beliefs and classroom practices</u> In addition to examining cross-cultural differences in beliefs and classroom practices among Chinese and American first-grade teachers, the third hypothesis attempted to examine the relations between teachers' beliefs and classrooms practices. The prediction was that compared with learning ability, teachers who expressed more agreement with the links between children's success in mathematics, and effort, direct-teaching in a large group, teachers' expectations, and confidence, would also report that they spent more time on those classroom practices, including time for class, checking, evaluation, and homework. Teachers expressing more agreement with these links would also report that they spent more time on class preparation, used more direct teaching, manipulative objects, and real-world problems in their mathematics classes.

METHOD

Subjects

The subjects consisted of 339 first-grade teachers who completed questionnaires on their teaching beliefs and classroom practices. In total, 210 first-grade teachers in Iowa, and the same number of first-grade teachers in Taiwan, were randomly selected to answer the questionnaire. The pool population in each location was approximately 500 teachers. In addition to being "sister" states and engaging in frequent agricultural exchanges, Iowa and Taichung County share many characteristics. They both are midwest regions in their respective countries and are primarily agricultural regions surrounded by industrial areas. Iowa was also chosen because there were few minority teachers in the state, and thus the samples were both culturally homogeneous.

Instrument

The questionnaire, which consisted of 27 5-point Likert items and a few open-ended questions, was designed to measure teachers' practices and beliefs regarding mathematics teaching and learning. Generally speaking, favorable or positive responses were given higher values on the scales although some items used reversed scores to avoid response set (see Appendix D).

The questionnaire was developed in English and later translated into Chinese. Items were revised following pilottesting with first-grade teachers in Taichung and Iowa. Both questionnaires were reviewed by the Bureau of Education of Taichung County to ensure that the questions were relevant to Chinese culture and that their wordings conveyed the same meanings in both language.

<u>Procedure</u>

Questionnaires were distributed in the two countries on the same day, with letters explaining the study and its purpose (Appendices B and C). The mailing list of the Iowa subjects was obtained from the Iowa Department of Public School. After the first mailing, a few teachers returned the unanswered questionnaire because they were resource teachers and not currently teaching in a self-contained first grade. A second mailing (see Appendix F) was sent to the 116 teachers who had not answered or returned the questionnaire two weeks after the first mailing. In total, 129 Iowa first-grade teachers answered and returned the questionnaires for this study with a 61.4% return rate.

The list of teachers in Taiwan was obtained from the Personnel Office of the Bureau of Education of Taichung County. Chinese teachers receiving the questionnaire were all currently teaching in self-contained first-grade classrooms in the public schools. The Chinese questionnaires were sent to teachers by a research assistant in Taiwan, following the same procedure used for the Iowa subjects.

Before and after the mailing of the questionnaire, the study was advertised in several local newspapers and the importance of returning the questionnaire was emphasized. The initial return rate was 90% (188/210). After being reminded by the second mailing (Appendix G), the remaining teachers also returned the questionnaire in six weeks. The return rate was 100%.

RESULTS

The general information about teachers and schools were summarized from teachers' self-reports. The cross-comparison of teachers' beliefs will be followed by the results relating to classroom practices and to the correlations between teachers' beliefs and classroom practices.

Demographics

From their self-reports, the educational levels attained by the Iowa first-grade teachers were higher than those attained by the Taichung first-grade teachers. Thirty-three of the Iowa teachers of this study had earned their M.A. or M.S. degrees; and 22% of the remainder were college graduates with credits towards advanced degrees. In contrast, most Chinese teachers (86.7%) were graduates of junior colleges with a 5-year training program for teachers, which the respondents had entered after completing the 9th grade. More than 90% of the teachers in both countries had majored in elementary education.

On the average, there was no difference in years of teaching in the elementary school between the American and Chinese teachers. Iowa teachers, however, had more first-grade teaching experience ($\underline{M}$ = 10.20, $\underline{SD}$ = 8.2) than did the Chinese teachers ($\underline{M}$ = 7.4, $\underline{SD}$ = 6.69). Table 1 indicates the general information about American and Chinese teachers.

Insert Table 1 about here

Multiplying the number of teachers who selected each alternative by the average of the interval, we estimated the hours that teachers spent in various activities and class sizes. The American teachers reported that they spent more time with their students (32.8 hours per week) than did the Chinese teachers (26.8 hours per week). American teachers also reported that they had more confidence in their preparedness to teach mathematics than did Chinese teachers. In line with the results of previous studies (Stevenson et al., 1986; Stevenson & Lee, 1990), Chinese teachers reported that they had more school-related responsibilities in addition to teaching (18.2 hours per week) than did the American teachers (11.8 hours per week). The Chinese teachers also reported that they had much larger classes (45 students each class) than did the American teachers (24 students each class). Nearly 90% of the Chinese teachers reported that they had more than 40 students in their classes; 54 of them had more than 50 students in their classes.

Teachers' Beliefs

Results of a *t* test were used to compare the differences in teachers' beliefs and classroom practices between the

American and Chinese first-grade teachers. Cohen's (1977) d values were calculated to indicate the effect size on the sample. The d value was calculated from the difference of the means between two groups, divided by the average of the standard deviations. Where $d > .80$, the effect size of difference between groups is strong; $d = .50$ is considered moderate and $d = .20$ small. Table 2 compares the beliefs between American and Chinese teachers. In comparison to the American teachers, the Chinese teachers expressed more agreement with the belief that children's mathematics achievement is more related to effort than to children's learning ability, [$t(251.29) = -3.75$, $p<.001$, $d = -.42$]. Similar difference was found between American and Chinese teachers in the beliefs linking children's effort and mathematics achievement, [$t(330) = -8.52$, $p<.001$, $d = -.97$].

Insert Table 2 about here

There was no difference between American and Chinese teachers with respect to the belief that children's achievement in mathematics is related to teachers' effort or to the effort of both children and teachers. Teachers in both groups, however, expressed more agreement with the statement linking children's mathematics achievement and effort than that linking achievement and ability.

There was no significant difference between American and

Chinese teachers in terms of the belief that children can benefit most from their educational experiences when learning mathematics concepts and procedural skills from their teacher's direct teaching in a whole class and doing the same assignments. The Chinese teachers, however, expressed more preference for small-group teaching in mathematics learning, [$t(331) = -3.02$, $p<.01$, $d = -.34$].

Contrary to our prediction, Iowa teachers reported more agreement than Chinese teachers did with the statement that children's mathematics achievement is more related to teachers' expectations of children's progress than to children's mathematics learning ability [$t(330) = 2.88$, $p<.01$, $d = .32$]. American teachers also expressed more agreement than did Chinese teachers with the belief that children's mathematics achievement is more related to teachers' confidence in their own mathematical knowledge than to children's ability, [$t(294.05) = 7.57$, $p<.001$, $d = .84$].

Classroom Practices

Similar to the previous studies (Stevenson et al., 1986; Stigler et al., 1987; Stigler & Perry, 1988), we multiplied the frequency and the amount of time spent in the classroom to calculate the total time spent in a week. Table 3a indicates the results of the mathematics classroom practices. Chinese teachers reported that they assigned more mathematics homework to their students, [$t(324.55) = -15.84$, $p<.001$, d =

-1.74], spent more time checking their students' work, [$t(334) = -6.17$, $p<.001$, $d = -.69$], and evaluating their students' understanding of mathematics learning than did the American teachers, [$t(209.57) = -2.27$, $p<.05$, and $d = -.26$].

Insert Table 3a about here

The American teachers, however, reported that they allocated more time to mathematics class, [$t(312.79) = 15.38$, $p<.001$, $d = 1.69$]. Including homework, there was no significant difference between American and Chinese students in terms of the amount of time they spent on mathematics-related activities. Compared with Chinese teachers, American teachers reported that they allocated more time to direct teaching, [$t(236.41) = 8.67$, $p<.001$, $d = 1.00$], to seatwork, [$t(231.09) = 4.47$, $p<.001$, $d = .53$]; and to manipulatives, [$t(183.26) = 8.00$, $p<.001$, $d = .98$]. No differences were reported, however, in the amount of time spent on class preparation. Table 3b shows the estimated amounts of time spent on mathematics classroom practices of American and Chinese teachers.

Insert Table 3b about here

Relations between Teachers' Beliefs and Classroom Practices

The differences in teachers' beliefs and classroom practices between American and Chinese first-grade teachers were so large that culture became the most significant predictor. Pearson correlation coefficients, however, were used to examine the relations between teachers' beliefs and classroom practices within each country and among teachers in both countries. Table 4 shows the significant correlations between teachers' beliefs and classroom practices among American first-grade teachers. American teachers expressing more agreement with the link between children's mathematics achievement and effort were more likely to allocate more time to direct teaching and seatwork, but allocate less time to the use of manipulatives and to a combination of manipulatives and real-world problems.

Insert Table 4 about here

Significant correlations were found between American teachers who believed in the link between children's mathematics achievement and learning ability, and the amount of time spent on checking students' assignments. Negative correlations were found between beliefs in ability, and teachers' class preparation time and the use of real-world problems. American teachers who expressed more agreement with the link between children's mathematics achievement and ability were more likely to spend time checking students' assignments, but less likely to spend time on class preparation and using real-world problems.

The amount of time allocated to direct teaching was correlated to American teachers' agreement with the statement that children can benefit most from the same educational experience in a whole class. The amounts of time allocated to using manipulatives and combining manipulatives and real-world problem situations, however, were negatively correlated to teachers ascribing to the belief that children can benefit most from the same educational experience in a whole class. American teachers who expressed agreement with the link between children's mathematics achievement and teachers' expectations of students' progress and the link between children's mathematics achievement and teachers' confidence in mathematics knowledge were more likely to use seatwork in mathematics class, but to spend less time on class preparation, using manipulatives, real-world problems and combining manipulatives and real-world problems.

Table 5 indicates the correlations between the classroom practices of Chinese first-grade teachers and their beliefs. Significant correlations were found between the amount of time Chinese teachers allocated to mathematics instruction, class time, checking assignments, direct-teaching, total time students spent on mathematics learning-related activities, total time teachers spent on mathematics instruction-related activities and teachers' agreement with the link between children's mathematics achievement and effort. Chinese teachers expressing a stronger belief in the link between children's effort and success in mathematics were more likely to allocate a larger amount of time for mathematics class, checking students assignments, and direct-teaching. They spent more time on mathematics instruction-related activities, and their students spent more time on mathematics learning-related activities.

Insert Table 5 about here

The amount of time that Chinese teachers allocated to mathematics class, that students spent on mathematics learning-related activities, and that teachers spent on mathematics instruction-related activities, seatwork, and combination of manipulatives and real-world problems were correlated with teachers' belief in the link between children's mathematics achievement and their ability.

Significant correlations were also found between Chinese teachers' belief in providing similar educational experiences for all children and the time they spent on seatwork and direct teaching. Chinese teachers who expressed more agreement with the link between children's mathematics achievement and same educational experience in a whole class were more likely to allocate time to direct teaching and seatwork.

The amount of mathematics class time that Chinese teachers allocated was correlated to their belief in the link between children's mathematics achievement and teachers' expectations. There were no correlations between Chinese teachers' belief in confidence and their classroom practices.

Table 6 shows the significant correlations between teachers' beliefs and classroom practices found among American and Chinese teachers. Although the percentages of variance accounted for in the correlations were not very high, they were statistically significant.

Insert Table 6 about here

Significant correlations were found between teachers' beliefs in effort and the amount of homework assigned, time for checking, and total time students spent on mathematics-related activities. Both American and Chinese teachers with beliefs in the linkage between children's mathematics achievement and effort reported that they allocated more time for mathematics instruction, assigned more homework to their students, and spent more time checking students' assignments.

Their students were more likely to engage in mathematics learning-related activities. A negative correlation was found between teachers' beliefs in effort and time used for manipulations. Teachers who believed in the link between achievement and effort reported that they were less likely to use manipulative objects in their mathematics class. Significant correlations were also found between teachers' belief in ability and the amount of time spent on checking assignments, and using seatwork. Teachers who expressed a stronger belief in mathematics ability, however, reported that they spent less time on class preparation.

Teachers in both groups who believed in the link between children's success in mathematics and the same educational experience in a large group were more likely to spend time on direct teaching and seatwork. They also evaluated students' progress more often than did those not ascribing to this belief. A negative correlation was also found between belief in providing the same educational experiences and the use of manipulatives.

Among American and Chinese teachers, those who expressed agreement with the link between children's achievement and teachers' expectations were more likely to report that they allocated more time for mathematics class and seatwork. They were more likely to engage in mathematics instruction-related activities. Negative correlations were found between teachers' belief in the link between children's mathematics achievement and their expectation and the amount of homework assigned, time used for class preparation, and combining manipulatives and real-world problems.

Significant correlations were found between teachers' belief in confidence and the amount of time they allocated for mathematics class, direct-teaching and seatwork, and total time teachers spent on mathematics instruction-related activities. The amount of homework assigned, and checking time were negatively correlated with teachers' belief in confidence. Teachers in both countries who believed in the link between children's achievement and teacher confidence reported that they allocated more time for mathematics class, used more direct-teaching and seatwork. On the other hand, they assigned less homework to their students.

DISCUSSION

Mathematics Class Time

We found, contrary to our hypothesis, that American first-grade teachers reported that they allocated more time to mathematics class (3.3 hours/week) than the Chinese first-grade teachers did (2.2 hours/week). American and Chinese teachers allocated about the same amount of time for each mathematics class (39.3 minutes for American classes and 37 minutes for Chinese classes). Chinese first-grade teachers reported that they allocated 129 minutes to mathematics class each week, which was slightly more than the three 40-minute class periods required by the Ministry of Education. Nevertheless, the centralized educational policy restricted Chinese teachers from allocating as much time to mathematics class as they would have liked. For example, several Chinese teachers wrote in questionnaire comments similar to these: "The mathematics class time allotted is insufficient for teaching the material prescribed in the curriculum". About 60% (n = 125) of Chinese teachers reported that they followed the prescriptions of the Ministry, whereas about 36.7% (n = 77) allocated four or five periods each week to teaching mathematics, which exceeded the Ministry standards.

Previous results (Stigler et al., 1987) indicated that Chinese first-grade teachers in Taipei spent four hours every week teaching mathematics. Chinese first-grade teachers in our study appeared more closely to follow the time requirements of the educational authority than did first-grade teachers in Taipei. One possible explanation for this difference is that teachers in Taipei might have been more pressured to have their students succeed at examinations than teachers in Taichung were. Thus, Taipei teachers might have been more concerned about students' performance, and subsequently have assumed more responsibility for their achievements (Brophy & Good, 1986). In fact, the Taipei teachers observed allocated twice as much time to mathematics class as was permitted by the Ministry. Another possible explanation is that Taichung teachers under-reported the amount of time they actually allocated to mathematics class because they were aware of offending the Ministry standards.

Our results indicated that American first-grade teachers spent 197 minutes (3.3 hours) each week for mathematics class, a figure much higher than that reported in a previous study (2.7 hours) (Stigler et al., 1987). Of observed Minneapolis teachers, one-third of them allocated less than 10% of classroom time to mathematics. A possible explanation is that American teachers in the present study over-reported the amount of time they allocated to mathematics class, as well as over-expressing their confidence in their ability in teaching mathematics.

Teachers' Beliefs and Time for Homework, Checking Assignments and Evaluation

Chinese teachers believed more strongly than did the American teachers that effort is an important component in children's mathematics achievement. They believed that children need to work hard to succeed. Under the limitation of the centralized educational policy, Chinese teachers did not have much freedom to allocate as much time as they believed sufficient for mathematics instruction, and for this reason, they might have assigned additional practice through homework.

Chinese teachers reported assigning more homework than did American teachers. Our results supported the earlier findings (Chen & Stevenson, 1989; Stevenson et al., 1986). Further evidence for this difference between cultures can be found in the statements regarding homework that some American teachers wrote in their questionnaires, for example, "Written homework is not permitted to be assigned to the first-graders in our school district". Clearly, whether or not to assign homework in the United States is not left to teachers' preference, but is set by school policy. Therefore, school policy differences appear to account for the difference in homework assigned to the first-grade students in the two cultures.

The large amount of mathematics homework Chinese students engaged in might have been intended to compensate for insufficient class time. Our results indicated that there were no differences in the overall time American and Chinese students spent doing mathematics learning-related activities.

Compared to American teachers, Chinese teachers reported that they spent more time checking students' assignments and homework. They also reported that they evaluated students' progress more often by tests or quizzes. Quizzes and monthly tests may encourage teachers and students to review old materials and may thus enhance the learning of new materials (Good & Grouws, 1979). They may also provide an opportunity for teachers to check student understanding and lead to subsequent remediation. Although time spent on homework may not be correlated with higher levels of mathematics achievement, through homework, evaluation, review and reteaching, children may integrate the old and new mathematics concepts and skills that must be mastered in the lower grades if these children are to succeed in later years (Greeno, 1978).

According to teachers' self-reports, compared to Chinese teachers, American teachers more often evaluated student understanding in the process of teaching, through questioning and observing. Chinese teachers, however, gave more tests and quizzes. Teaching much larger classes, Chinese teachers might not be able to pay as much attention to individual students by oral questioning and observing as American teachers might. Thus, to check student progress and to keep students in step with the prescribed objectives, Chinese teachers reported that they employed written tests and quizzes more often.

Beliefs in Uniform Educational Experiences and Classroom Practices

There was no significant difference between American and Chinese teachers in terms of the belief that children would benefit most from the whole-class gaining the same educational experiences when learning mathematics concepts and skills, either from direct-teaching or from large-group work. Teachers in both Taiwan and the United States believed that student learning styles and teacher instructional strategies can affect each other. Some students may learn mathematics better by listening, watching, and working together in a whole class; others may benefit most from learning in small groups with the teacher's or peers' individualized help.

Chinese teachers expressed more preference than American teachers did for small-group teaching, $t(331) = -3.02$, $p<.01$, $d = -.34$. A significant number (n = 23) of Chinese teachers added written comments to the effect that they would like to teach mathematics in small groups rather than in large groups and would like to give more individualized help to slower learners if they could have smaller classes. Although Chinese teachers reported that, in big classes, they had students with different learning abilities; they also reported that they did not have much time or opportunity to give such students special attention. Several Chinese teachers wrote statements on the questionnaire that they had to pursue uniform level of performance across the whole class in mathematics instruction. The educational policies and environments in Taiwan may limit the teacher's ability to individualize instruction.

Small-group teaching has always been an ideal of Chinese teachers. Small-group approaches, however, require well-chosen assignments that students will be willing to engage in and able to complete successfully, as well as rules and procedures enabling students to receive help (if confused) or direction (if finished) without disrupting the momentum of the teacher's approach to small-group work (Brophy & Good, 1986). Thus, teachers who attempt to work with small-groups in classes with nearly 50 first-graders without any assistants may find that the small-group approach takes too much effort than it is worth.

The results of this study failed to support the prediction that Chinese teachers would report that they used direct teaching more often than American teachers did. Conversely, American teachers reported that they used more direct teaching in mathematics instruction each week than the Chinese teachers reported of themselves. In fact, our results indicated that both American and Chinese teachers reported that they used about 41% of each mathematics class time for direct teaching. This finding was in serious disagreements with previous results (Stigler et al., 1987), in which American teachers used about 25% and Chinese teachers more than 50% of mathematics class time in direct teaching. The differences in total time used for direct teaching may result from the differences between American and Chinese mathematics class time. Chinese teachers perceived that they did not have sufficient time to teach materials prescribed in the curriculum and to meet the expectations outlined regarding student progress while at the same time attending to the needs of students with learning abilities above or lower average. For example, several Chinese teachers wrote the following and similar comments: "too many students in a class"; and "insufficient time for emphasizing the individual needs".

Beliefs in Teacher Expectation and Classroom Practices

Contrary to our prediction, in comparison with Chinese teachers, American teachers expressed more agreement with the statement that children's mathematics achievement is more related to teacher expectations than to children's learning ability. There was no significant differences between

American and Chinese teachers in terms of the level of satisfaction with student progress. With a centralized and detailed curriculum, by which all lessons are planned and all unit objectives defined, the Chinese teachers did not have much freedom to adjust expectations for students to progress at their own levels. They were obliged to follow the curriculum, which assumes that all students can achieve the unit objectives. In fact, several Chinese teachers wrote on the questionnaire that they were happy with the curriculum and that almost all of their students could achieve the unit objectives, excepting the really slow learners.

With the pressures of schoolwide or districtwide examinations each month, Chinese teachers were more concerned with finishing the units prescribed in the limited periods allocated by the Ministry so that they could keep pace with other classes of the same grade (Ministry of Education, 1976). The nationwide entrance examinations for high schools and colleges are based on the national curriculum (Ministry of Education, 1987), and completing the prescribed units in the primary grades can be considered very important to the students' future education.

<u>Belief in Teacher Confidence and Classroom Practices</u>

The results failed to support the prediction that Chinese teachers would express more agreement than American teachers would with the beliefs that children's success in mathematics is most related to teachers' confidence in their own knowledge of mathematics. The results of this study indicated that American teachers expressed stronger agreement with the link between children's mathematics achievement and teachers' confidence with their own mathematics knowledge. American teachers also indicated that they had more confidence in their own ability to teach mathematics, allocated more time for mathematics class, and spent more time on direct teaching than did the Chines teachers. The discrepancy in results may be due to the different samples studied in Taiwan and the United States, or to the different methodologies employed.

Another explanation of our results is that 5-year teacher-training program which enrolls students after junior high school might not adequately help future teachers obtain a level of confidence equivalent to that of teachers with baccalaureate degrees. Elementary teacher education in Taiwan, however, is changing to a college required program. At least a B.A. or B.S. degree will be required for those teaching in the elementary school in the near future. Research is needed to describe teacher confidence among Chinese elementary teachers with and without a degree.

Manipulatives and Real-World Problems

Regarding the use of manipulatives and real-world problems, the results failed to support the prediction that

Chinese teachers would report that they spent more time using manipulative objects and real-world problems than the American!teachers would. Contrary to an earlier study (Stigler & Perry, 1988), American teachers in our study reported that they spent more time using manipulatives in their mathematics class. One possible explanation of this discrepancy is that the Chinese teachers in the earlier study (Stigler & Perry, 1988) were from a metropolitan area of the capital city, whose yearly budget for educational expenditures is higher than that of Taichung (Ministry of Education, 1987; Taichung Bureau of Education, 1989). Thus, the class sizes, pupil-teacher ratios, pupil-staff ratios and school facilities differed between these two samples. Manipulative objects in Taichung schools might not be provided as freely as in Taipei and the heavy responsibilities of school-related work of Taichung teachers might not allow them to prepare manipulative objects for their mathematics class (Ministry of Education, 1989). Indeed, several Chinese first-grade teachers in the current study wrote their comments on the questionnaires that their schools did not provide enough manipulative objects for their mathematics instruction.

Relations between Teachers' Beliefs and Classroom Practices

Teachers who believed in the link between children's mathematics achievement and effort were more likely to assign homework to their students, a finding in line with our hypothesis. Teachers who believed that effort was the major contributor to children's success in mathematics may also have believed that children needed to extend their learning effort from school to home. They may also have believed that homework provided more time and opportunity for students to practice and apply, as well as to achieve automatizing. The current study, however, did not provide information about how teachers in these two cultures viewed the function of homework in mathematics learning. Future studies are needed to answer this question.

Results relating to beliefs in the link between children's success in mathematics and teachers' confidence also supported our hypothesis that teachers holding such a belief would allocate more time to mathematics class. Teachers who held the belief that children's success in mathematics is related to teachers' confidence also reported that they had more confidence in their own mathematics teaching ability and that they used more direct teaching in mathematics class than did those not expressing this belief.

Within each culture, significant correlations support more of our hypotheses regarding the relation between teachers' beliefs and classroom practices. Of the Chinese group, teachers who expressed agreement with the link between achievement and effort were more likely to report that they allocated extra time for mathematics instruction, including time for mathematics class, checking assignments, and direct teaching. Also, the amounts of time assigned for direct teaching and seatwork were correlated to teachers' belief that students benefit from receiving uniform educational experiences. Chinese teachers reporting that they used direct teaching in mathematics class were also more likely to report that they used more seatwork for mathematics instruction. In the current study, we found that direct teaching existed in parallel with seatwork in both American and Chinese mathematics classes. Those American teachers who reported using direct teaching were more likely to report that they also used seatwork.

The current study, however, did not provide the information about how teachers in Taiwan and the United States direct-teach mathematics in their classes. Future studies of cross-cultural differences in mathematics achievement need to focus on direct-teaching mathematics strategies, such as how to organize concepts and analogies and how to actively present materials helping students integrate concepts.

Although several American and Chinese teachers wrote their opinions on the questionnaires that they emphasized the use of concrete objects and real-world problems in their mathematics class, negative correlations were found between the time teachers spent using manipulatives and real-world problems and 1) teachers' believing in effort, 2) teachers' believing in the uniform educational experiences, 3) teachers' believing in their expectations, and 4) teachers' believing in their confidence to students' achievement in mathematics. Future studies on cultural differences relating to teachers' beliefs and mathematics classroom practices need to determine teachers' values and attitudes towards the use of manipulatives and real-world problems, because children learn mathematics better when using concrete objects and real-world problems (Kamii, 1985; Piaget, 1972).

Some of the discrepancies between current results and those of previous studies may be due to methodological differences. In addition to such differences, (e.g., Stevenson and his colleagues collected their data through observations, and the authors of the current study through questionnaires), subjects in the study of Stigler et al. (1987) were from metropolitan areas, whereas subjects in the present study were from an agricultural state and from a county encompassing urban and rural areas. Moreover, the present study did not assess children's mathematics achievement. Thus, it may not be appropriate to assume that the Taichung first-graders performed better in mathematics than their Iowa counterparts did. Future research comparing teachers' beliefs and classroom practices needs to measure children's mathematics achievement. Together with questionnaires or interviews, an observation of teachers' classroom practices may present a clearer picture of cultural differences in both urban and rural schools.

EDUCATIONAL IMPLICATIONS

Although most teachers placed more emphasis on effort than on ability as a basis for achievement, Chinese teachers expressed stronger agreement than American teachers did in the effort. We found that the belief among Chinese teachers that increased effort results off in improved performance was an important factor in accounting for the amount of time Chinese teachers and students engaged in mathematics teaching and learning related activities. Based on their belief in effort and the emphasis on academic work and mathematics of the culture, Chinese teachers may employ various teaching strategies to motivate and encourage their student to put more effort into academic work, in general, as well as into mathematics. For example, Chinese teachers may convey their belief in effort by telling their student that his/her degree of success in mathematics is attributed to the effort he/she puts into the task or to his/her failure to put forth sufficient effort. The large amount of additional time Chinese teachers spent checking assignments and evaluating children's understanding were related to the belief that increased effort pays off in improved performance. Increasing the emphasis on effort among American teachers, parents, and children may be one way of improving American children's mathematics performance.

Contrary to the results of the earlier study (Stigler et al., 1987), Chinese students in this study did not have as much time as the American students did for mathematics class. The mathematics time of Chinese classes in this study was more aligned with the requirement of the Ministry than that in the earlier findings (Stigler et al., 1987). However, when homework was included, the total time that Chinese students engaged in mathematics learning-related activities weekly was the same as the time the American students did. Regarding the length of school year, previous studies (Stigler et al., 1987; Stigler & Perry, 1988) indicated that Chinese students had 240 school days in a year whereas American students had 180 days. The longer school year of Chinese students may account for the differences in mathematics class time and in achievement levels found by Stigler et al. (1987). American educators needs to examine the length of the school year for their children and society, including issues such as longer school days and/or longer school year.

Our results suggested that American teachers, who have more freedom in implementing the curriculum, assume greater responsibility for the success of their mathematics instruction (Brophy & Evertson, 1976). They reported that not only did they work hard with students, but also that they attended workshops and conferences to promote their professional knowledge and to be more effective instructors.

In comparison, Chinese teachers did not attend mathematics workshops or conferences as often. They had studied only one curriculum for each subject in their teacher-training program and had otherwise relied on what the mathematics curriculum provided. This situation may be due to a lack of choice; nevertheless, Chinese teachers reported no interest in studying alternative mathematics curricula. Adopting the authorized curriculum may help teachers who lack experience and/or confidence in teaching mathematics. It may be still more effective, however, for preservice teachers to develop their perspectives about mathematics instruction by exploring various curricula; and it may be more challenging for inservice teachers to become involved in selecting the best curricula fitting their teaching styles and students' learning abilities.

Both American and Chinese teachers reported that they were unprepared for teaching mathematics when they began teaching the first-grade and that their professional confidence developed as they gained teaching experiences. More research is needed regarding ways to help new teachers improve their professional confidence.

CONCLUSION

Overall, our results suggest that there are cultural differences between American and Chinese teachers in terms of beliefs and classroom practices about mathematics learning and teaching. Contrary to earlier findings by Stevenson and his colleagues, American teachers reported that they were more aligned with active mathematics teaching methods (e.g., allocating more time for mathematics class, spending more time in direct teaching and using manipulatives) than did the Chinese teachers.

The discrepancy between the current results and earlier findings may be due to the differences in samples, locations, methodologies, and dates of data-collecting. However, there may have been some changes in American mathematics classrooms since Stevenson and his colleagues started assessing children's mathematics achievement in 1979 and observing mathematics classroom in 1985. Much effort has been put forth in the United States to improve American children's mathematics performance (Confrey & Lanier, 1980; Ebmeier & Good, 1979; Evertson, Anderson, Anderson & Brophy, 1980; Good & Grouws, 1981). American teachers may now pay more attention to mathematics and be more aware of the link between students' achievement and their classroom practices than they were earlier. American students' mathematics achievement needs to be re-examined to decide its status among that of the children of other countries.

Without assessing children's mathematics achievement, however, the beliefs and classroom practices of the current study cannot identify differences in mathematics achievement between American and Chinese children. Future studies comparing teachers' beliefs and classroom practices in different cultures need to assess children's academic achievement and select larger samples from locations in addition to metropolitan areas.

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Table 1

General Information about American and Chinese Teachers

	American[a]	Chinese[b]
Time with students in class (hours/week)[c]	32.8	26.8
Time other than with students in class (hours/week)[c]	11.8	18.2
class size (students)[c]	24	45
Confidence in teaching math[d]	3.7	1.9
Confidence in teaching reading[d]	3.9	1.9
Experience in teaching elementary school (years)	16	16.1
Experience in teaching first-grade (years)	10.2	7.4

[a]n (American teachers) = 129.

[b]n (Chinese teachers) = 210.

[c]Calculated by multiplying the number of teachers who selected each alternative by the the average of the interval.

[d]1 = very unprepared, 5 = very well-prepared.

Table 2

Comparison of Beliefs between American and Chinese Teachers

	American[a]		Chinese[b]		
	M	SD	M	SD	d
Belief in effort[c]	2.66	.92	3.04***	.88	-.99
Belief in ability[c]	2.00	1.48	2.07	1.11	N.S.[d]
Belief in whole-class instruction[c]	.43	1.41	.76	1.80	N.S.[d]
Belief in small-group instruction[c]	1.91	2.44	2.75**	2.49	-.34
Belief in teacher expectation[c]	3.40**	1.23	3.01	1.17	.32
Belief in teacher confidence[c]	3.33***	1.04	2.36	1.22	.84

[a]n (American teachers) = 129.

[b]n (Chinese teachers) = 210.

[c]1 = strongly disagree, 5 = strongly agree.

[d]N.S. -- not significant.

** $p<.01$. *** $p<.001$.

Table 3a

Mathematics Classroom Practices of American and Chinese Teachers

	American[a]		Chinese[b]		
	M	SD	M	SD	d
Class time[c]	17.32***	3.06	11.50	3.84	1.69
Homework time[c]	2.24	2.32	7.03***	3.20	-1.74
Evaluation time[d]	2.44	1.54	2.79*	1.12	-.26
Checking time[d]	1.36	.62	1.78***	.62	-.69
Satisfactory level[d]	3.88	.57	3.86	.52	N.S.[e]
Direct teaching[c]	14.54***	5.62	9.33	4.80	1.00
Seatwork[c]	11.90***	5.51	9.36	4.14	.53
Manipulatives[c]	13.53***	6.53	8.43	3.88	.98
Real-world problems[c]	7.34	4.40	8.10	4.42	N.S.[e]
Combination of manipulatives and real-world problems[c]	9.26	5.81	9.76	4.25	N.S.[e]
Class preparation[d]	2.31	.99	2.11	1.11	N.S.[e]

[a]n (American teachers) = 129.

[b]n (Chinese teachers) = 210.

[c]Calculated by multiplying the scales of frequency and the amount of time spent in the classroom; 1 = low, 25 = high.

[d]1 = low, 5 = high.

[e]N.S. -- not significant.

* $p<.05$. *** $p<.001$.

Table 3b

Time Spent in Mathematics Classroom Practices of American and Chinese Teachers

	American[a]	Chinese[b]
Frequency of math class (days/week)	4.98	3.49
Time of each math class (minutes)	39.25	37.02
Frequency of math homework (days/week)	1.38	3.33
Time of each homeowrk (minutes)	13.13	17.91
Time spent in checking student assignments (minutes/week)	61.52	86.12
Frequency of evaluation (times/week)	2.44	2.79
Level of satisfaction of student progress (%)	85.47	85.35
Frequency of direct teaching (times/week)	4.53	2.31
Time of direct teaching (minutes/math class)	16.29	16.43
Frequency of seatwork (times/week)	2.72	2.41
Time of seatwork (minutes/math class)	14.61	15.49
Frequency of manipulatives (times/week)	3.22	2.13
Time of manipulatives (minutes/math class)	17.53	15.40

Frequency of real-world problems (times/week)	3.19	2.48
Time of real-world problems (minutes/math class)	10.57	11.75
Frequency of combining manipulatives and real-world problems (times/week)	2.59	2.45
Time of combining manipulatives and real-world problems (minutes/math class)	14.03	15.90
Time spent on classroom preparation (minutes/week)	56.48	50.53

[a] n (American teachers) = 129.

[b] n (Chinese teachers) = 210.

Table 4

Correlations between American Teachers' Beliefs and Mathematics Classroom Practices

Classroom practices	Effort	Ability	Beliefs in Whole-class	Expecataion	Confidence
Checking assignments		.15*			
Class preparation		-.27***		-.25**	-.18*
Direct teaching	.18*		.20**		
Seatwork	.23**			.25**	.17*
Manipulatives	-.19*		-.17*	-.24**	-.18*
Real-world problems		-.18*		-.23**	-.19*
Combination of manipulatives and real-world problems	-.17*		-.16*	-.25*	-.21**

* $p < .05$. ** $p < .01$. *** $p < .001$.

Table 5

Correlations between Chinese Teachers' Beliefs and Mathematics Classroom Practices

Classroom practices	Beliefs in Effort	Ability	Whole-class	Expectation
Class time	.15*	.14*		.14*
Checking assignments	.13*			
Class preparation				-.19**
Direct teaching	.16**		.20**	
Seatwork		.12*	.27***	
Real-world problems				-.23**
Combination of manipulatives and real-world problems		.13*		
Total time student spent in mathematics learning	.14*	.16**		
Total time teacher spent in mathematics teaching	.14*	.15**		

* $p < .05$. ** $p < .01$. *** $p < .001$.

Table 6

Correlations between Beliefs and Mathematics Classroom Practices of American and Chinese Teachers

Classroom practices	Beliefs in Effort	Ability	Whole-class	Expectation	Confidence
Class time				.16***	.21***
Homework time	.20***			-.15**	-.22***
Checking assignment	.13**	.11*			-.10*
Evaluation time			.11*		
Class preparation		-.11*		-.19***	
Direct teaching			.13**		.23***
Seatwork		.10*	.13**	.13**	.15**
Manipulatives	-.19***		-.10*		
Combination of manipulatives and real-world problems				-.11*	

Total time student in mathematics learning	.11*		
Total time teacher spent in mathematics teaching		.10*	.13**

* $p < .05$. ** $p < .01$. *** $p < .001$.

SUMMARY

The objectives of the present study were to compare first-grade teachers' beliefs regarding mathematics learning and their classroom practices in Taiwan and the United States, and to describe the relations between teachers' beliefs and classroom practices in mathematics learning and teaching.

Chinese teachers in the present study reported that they believed more in the link between children's mathematics achievement and effort than did the American teachers. This is in accordance with previous results (Lee et al., 1987; Stevenson & Lee, 1990) regarding the belief in effort held by Chinese children and mothers. Based on their belief in effort and the emphasis on academic work and mathematics of the culture, Chinese teachers may employ various teaching strategies to motivate and encourage their students to put more effort into academic work in general as well as into mathematics. For example, Chinese teachers may convey their belief in effort by telling their student that his/her degree of success in mathematics is attributed to the effort he/she puts into the task or to his/her failure to put forth sufficient effort. The large amount of homework and additional time Chinese teachers spent checking assignments and evaluating children's understanding may be related to the belief that increased effort pays off in improved

performance. Increasing the emphasis on effort among American teachers, parents, and children may be one way of improving American children's mathematics performance.

Contrary to the results of the earlier study (Stigler et al., 1987), Chinese students in this study did not have as much time as the American students did for mathematics class. The mathematics time of Chinese classes in this study was more aligned with the requirement of the Ministry than that in the earlier findings. However, when homework was included, the total time that Chinese students engaged in mathematics learning-related activities weekly was the same as the time the American students did. Regarding the length of school year, previous studies (Stigler et al, 1987; Stigler & Perry, 1988) indicated that Chinese students had 240 school days in a year, whereas American students had 180 days. The longer school year of Chinese students may account for the differences in mathematics class time and in achievement levels found by previous studies (Stigler et al., 1987). American educators need to examine the length of the school year for their children and society, including issues such as longer school days and/or a longer school year.

The results of the present study suggested that American teachers, who had more freedom in implementing the curriculum, assumed greater responsibility for the success of their mathematics instruction. American teachers reported that they attended workshops and conferences to promote their professional knowledge and to be more effective instructors. In comparison, Chinese teachers who had been exposed to one prescribed and detailed mathematics curriculum did not attend mathematics workshops or conferences as often and reported no interest in studying alternative mathematics curricula. It may be more effective, however, for preservice teachers to develop their own perspectives about mathematics instruction by exploring various curricula, and it may be more challenging for inservice teachers to become involved in selecting the best curricula fitting their teaching styles and students' learning abilities.

Overall, our results suggest that there are cultural differences between American and Chinese teachers in terms of beliefs and classroom practices about mathematics learning and teaching. Contrary to earlier findings by Stevenson and his colleagues, American teachers reported that they were more aligned with active mathematics teaching methods (e.g., allocating more time for mathematics class, spending more time in direct teaching and using manipulatives) than did the Chinese teachers. The discrepancy between the current results and earlier findings may be due to the differences in samples, locations, methodologies, and dates. However, there may have been some changes in American mathematics classrooms since Stevenson and his colleagues started assessing children's mathematics achievement in 1979 and observing mathematics classrooms in 1985. Much effort has been put forth by the United States to improve American children's mathematics performance (Confrey & Lanier, 1980; Evertson, Anderson, Anderson & Brophy, 1980; Good & Grouws, 1981). American teachers may now pay more attention to mathematics and be more aware of the link between student achievement and their own classroom practices than they were before. American students' mathematics achievement needs to be re-examined to determine its status among that of the children of other countries.

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My sincere appreciation also goes to my committee, Dr. Joan Herwig and Dr. Robert Strahan, and to Dr. James Sweeney in the College of Education; I am grateful for their thoughtful input and for their continued support of my study.

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I deeply appreciate the support and enthusiasm of Thomas Han-Yuan Wang, former Director of Taichung County Bureau of Education; he made this project possible.

To Pin-Ling Lin, I offer my sincere thanks. Her persistance yielded a surprisingly high return rate for the Chinese survey.

To all the first-grade teachers in Iowa and Taichung, who participated in this project by completing the questionnaire, I offer my gratitude.

I wish to thank the Iowa State University Department of Human Development and Family Studies, which supported this research and my graduate study.

Finally, I am heartily grateful to my family and friends for their understanding, encouragement and continued support, without which I would not have been able to complete this work.

APPENDIX A: HUMAN SUBJECTS FORM

INFORMATION ON THE USE OF HUMAN SUBJECTS IN RESEARCH
IOWA STATE UNIVERSITY

(Please follow the accompanying instructions for completing this form.)

1. Title of project (please type): BELIEFS IN MATHEMATICS LEARNING AND PRACTICES OF MATHEMATICS TEACHING AMONG AMERICAN AND CHINESE TEACHERS

116

2. I agree to provide the proper surveillance of this project to insure that the rights and welfare of the human subjects are properly protected. Additions to or changes in procedures affecting the subjects after the project has been approved will be submitted to the committee for review.

KUEI-ER CHUNG	11-9-89	Kuei-er Chung
Typed Named of Principal Investigator	Date	Signature of Principal Investigator

101 CHILD DEVELOPMENT	294-3040
Campus Address	Campus Telephone

3. Signatures of others (if any) Date Relationship to Principal Investigator

Signatures of others (if any)	Date	Relationship to Principal Investigator
Susan M. Hegland	11-9-89	MAJOR PROFESSOR

4. ATTACH an additional page(s) (A) describing your proposed research and (B) the subjects to be used, (C) indicating any risks or discomforts to the subjects and (D) covering any topics checked below. CHECK all boxes applicable.

- [ ] Medical clearance necessary before subjects can participate
- [ ] Samples (blood, tissue, etc.) from subjects
- [ ] Administration of substances (foods, drugs, etc.) to subjects
- [ ] Physical exercise or conditioning for subjects
- [ ] Deception of subjects
- [ ] Subjects under 14 years of age and(or) [ ] Subjects 14-17 years of age
- [ ] Subjects in institutions
- [ ] Research must be approved by another institution or agency

5. ATTACH an example of the material to be used to obtain informed consent and CHECK which type will be used.

- [ ] Signed informed consent will be obtained.
- [X] Modified informed consent will be obtained.

6. Anticipated date on which subjects will be first contacted: Month 11 Day 27 Year 89

Anticipated date for last contact with subjects: 6 30 90

7. If Applicable: Anticipated date on which audio or visual tapes will be erased and(or) identifiers will be removed from completed survey instruments: Month ____ Day ____ Year ____

8. Signature of Head or Chairperson Date Department or Administrative Unit

Signature of Head or Chairperson	Date	Department or Administrative Unit
[signature]	11-9-89	CD

9. Decision of the University Committee on the Use of Human Subjects in Research:

[X] Project Approved [ ] Project not approved [ ] No action required

George G. Karas	11/16/89	[signature]
Name of Committee Chairperson	Date	Signature of Committee Chairperson

Revised 6/78

APPENDIX B: FIRST MAILING LETTER

Iowa State University of Science and Technology
Ames, Iowa 50011-1030

College of Family and Consumer Sciences
Child Development Department
101 Child Development Building
Telephone 515-294-3040

January 8, 1990

Dear First-grade Teacher:

As part of the continuing efforts to improve the education of future teachers, Dr. Hegland and I are studying the first-grade teachers' beliefs in mathematics learning and their teaching practices in Taiwan and the United States. We hope that the results of this research will help future teachers of both countries have a better understanding of how to use their mathematics class time and what are the effective approaches in mathematics teaching.

You are one of a small number of Iowa first-grade teachers asked to give information on the mathematics practices in your classroom and the beliefs you hold in children's mathematics learning. We are asking you to provide us with information on how you use your time in mathematics class, your preferences for effective teaching approaches and what you believe that will influence your students' mathematics performances. Your name has been selected in a random sample from among Iowa first-grade teachers. In order that the results will truly represent how mathematics is currently taught in Iowa first grade, it is important that each questionnaire be completed and returened.

You may be assured of complete confidentiality. Your name, the identity of your school and district will be kept confidential. Only group results will be summarized and reported.

We would be pleased to send you a copy of the results of the study. To receive this information, please write your name and address on the back of the return envelope. Please do not put this information on the questionnaire itself.

If there are any questions or concerns, please feel free to contact Dr. Hegland or myself at the Child Development Department at Iowa State University. The number to call is 515-294-4616.

Thank you for your cooperation.

Sincerely,

Kuei-Er Chung
Graduate Student

Susan M. Hegland, Ph. D.
Associate Professor

APPENDIX C: FIRST MAILING LETTER (CHINESE)

親愛的　　　　　　老師：您好。

我是愛荷華州立大學兒童發展系研究生，正在進行碩士論文有關研究。因我以前曾在國小服務，對於數學的教學很有興趣，所以指導教授Dr. Susan Hegland 和我決定研究中美兩國小學一年級教師對數學教學的看法和意見。這項調查可以幫助我們瞭解中美兩國學童數學成就的差異，並進一步尋求兩國師範教育發展及小學數學教學的改進途逕。

您是我們從台中縣教育局長王漢源先生所推薦的一年級教師中，用電腦抽選出的少數教師之一。請提供您班上數學課的上課情形，以及您對兒童學習數學的看法。為使這項調查結果真正代表我國國小一年級數學教學的實際情況，煩請您在百忙中撥冗回答，並寄還給我們。

您對所有問題的回答，我們有義務加以保密。問卷的結果僅供整體統計分析和報告之用，請您依照實際的情況回答每一問題。您的熱心協助，我們由衷感激。

如果您對本問卷調查的結果有興趣，請在回郵信封背面寫上您的姓名和地址（但請不要寫在問卷上）。待本研究完成，我們會將結論報告寄送給您。在您回答本問卷時，如有疑問，請寫信或打電話向林品玲老師洽詢（地址：豐原市中興路136 號，電話:045-267342)。

如您認為有需要，也歡迎來信指教。本人在美國地址如下：

Kuei-Er Chung
101 Child Development
Iowa State University
Ames, IA 50011
電話：(515)294-3040

您對本研究所提供的熱心協助和寶貴意見，指導教授Dr. Hegland 和我再度向您表示衷心謝意。　　謹此　　敬祝

如意愉快

愛荷華州大研究生

鍾貴兒　　謹上

78年11月

APPENDIX D: FIRST-GRADE TEACHER SURVEY

FIRST-GRADE TEACHER SURVEY

This research study is part of Iowa State University's continuing efforts to improve the education of teachers. All your answers for this questionnaire will be kept confidential. Please answer all of the questions. The questionnaire will take approximately 20 minutes to complete. If you wish to comment on any questions or qualify your answers, please feel free to use the space in the margins. Your comments will be read and taken into account.

Thank you for your help.

Department of Child Development

Iowa State University

Ames, Iowa 50011

First, we are interested in the learning of mathematics in your class. There are no right or wrong answers. Circle one number to represent your answer.

1. How many days per week do the students in your class do mathematics learning or mathematics-related activities at school?

   1 = 1 DAY

   2 = 2 DAYS

   3 = 3 DAYS

   4 = 4 DAYS

   5 = 5 DAYS OR MORE

2. How much time, on the average, does each child in your class spend learning mathematics or doing mathematics-related activities at school on the days you have mathematics class?

   1 = 10 MINUTES OR LESS

   2 = 11-20 MINUTES

   3 = 21-40 MINUTES

   4 = 41-60 MINUTES

   5 = MORE THAN 60 MINUTES

3. How often do you assign mathematics homework to your students?

   1 = LESS THAN ONCE A WEEK

   2 = ONCE A WEEK

   3 = TWICE A WEEK

   4 = THREE TIMES A WEEK

   5 = FOUR TIMES OR MORE A WEEK

4. How long do you think it usually takes the average student in your class to complete his/her mathematics homework for each assignment?

   1 = 10 MINUTES OR LESS

   2 = 11-20 MINUTES

   3 = 21-40 MINUTES

   4 = 41-60 MINUTES

   5 = MORE THAN 60 MINUTES

5. What is the total amount of time you spend each week checking mathematics assignments for your class?

   1 = 30 MINUTES OR LESS PER WEEK

   2 = 31-60 MINUTES

   3 = 61-90 MINUTES

   4 = 91-120 MINUTES

   5 = MORE THAN 120 MINUTES PER WEEK

6. Do you have an aid, helper or parent who also does checking mathematics assignments for your class? If so, how much time does she/he spend?

   0 = NOT APPLICABLE, NO HELPER

   1 = 30 MINUTES OR LESS

   2 = 31-60 MINUTES

   3 = 61-90 MINUTES

   4 = 91-120 MINUTES

   5 = MORE THAN 120 MINUTES

7. Teachers may evaluate their teaching progress and students' understanding of mathematics in many ways, such as tests or quizzes. How frequently do you evaluate students' mathematics learning?

   1 = LESS THAN ONCE A WEEK

   2 = ONCE A WEEK

   3 = TWICE A WEEK

   4 = THREE TIMES A WEEK

   5 = FOUR TIMES OR MORE A WEEK

8. After teaching a new mathematical concept or a skill, what percentile score that measures the mastery of the concept or skill taught (posttest) will satisfy you enough with your students' mathematics progress, so that you can move to another topic?

   1 = 50% OR LESS

   2 = 51-65%

   3 = 66-80%

   4 = 81-95%

   5 = MORE THAN 95%

9. To teach mathematics, teachers may use <u>direct-teaching</u>, such as explaining mathematics concepts, demonstrating procedural skills etc.; or they may use <u>seatwork</u> (worksheets or other individually assigned activities for students to complete in class).

   A. How often do you use <u>direct-teaching</u>?

   1 = LESS THAN ONCE A WEEK

   2 = ONCE A WEEK

   3 = TWICE A WEEK

   4 = THREE TIMES A WEEK

   5 = FOUR TIMES OR MORE A WEEK

B. How often do you use <u>seatwork</u>?

1 = LESS THAN ONCE A WEEK

2 = ONCE A WEEK

3 = TWICE A WEEK

4 = THREE TIMES A WEEK

5 = FOUR TIMES OR MORE A WEEK

C. During a 30-minute mathematics class, how much time do you spend on <u>direct-teaching</u>?

1 = 5 MINUTES OR LESS

2 = 6-10 MINUTES

3 = 11-15 MINUTES

4 = 16-20 MINUTES

5 = MORE THAN 20 MINUTES

D. During a 30-minute mathematics class, how much time do you spend on <u>seatwork</u>?

1 = 5MINUTES OR LESS

2 = 6-10 MINUTES

3 = 11-15 MINUTES

4 = 16-20 MINUTES

5 = MORE THAN 20 MINUTES

10. Some teachers use manipulatives (hands-on objects). For example, the teacher presents two groups of discrete objects and asks students to compare which group has more or fewer objects, etc..

A. How often do you use manipulatives?

1 = LESS THAN ONCE A WEEK

2 = ONCE A WEEK

3 = TWICE A WEEK

4 = THREE TIMES A WEEK

5 = FOUR TIMES OR MORE A WEEK

B. During a 30-minute mathematics class, how much time do you use for manipulatives?

1 = 5 MINUTES OR LESS

2 = 6-10 MINUTES

3 = 11-15 MINUTES

4 = 16-20 MINUTES

5 = MORE THAN 20 MINUTES

11. To teach mathematics, some teachers use real-world scenarios. For example, the teacher asks the students "I had 15 frogs in a box, 8 jumped out. How many did I have left in the box?"

A. How often do you use real-world scenarios?

1 = LESS THAN ONCE A WEEK

2 = ONCE A WEEK

3 = TWICE A WEEK

4 = THREE TIMES A WEEK

5 = FOUR TIMES OR MORE A WEEK

B. During a 30-minute mathematics class, how much time do you use for real-world scenarios?

1 = 5 MINUTES OR LESS

2 = 6-10 MINUTES

3 = 11-15 MINUTES

4 = 16-20 MINUTES

5 = MORE THAN 20 MINUTES

12. Some teachers combine the use of manipulatives and real-world scenarios when teaching mathematics. For example, the teacher gives 25 pennies to a student, tells him/her "You have 25 pennies. Now I give you 8 pennies. How many pennies do you have now?".

A. How often do you combine the use of manipulatives and real-world scenarios?

1 = LESS THAN ONCE A WEEK

2 = ONCE A WEEK

3 = TWICE A WEEK

4 = THREE TIMES A WEEK

5 = FOUR TIMES OR MORE A WEEK

B. How much time in a 30-minute class do you spend in combining manipulatives and real-world scenarios?

1 = 5 MINUTES OR LESS

2 = 6-10 MINUTES

3 = 11-15 MINUTES

4 = 16-20 MINUTES

5 = MORE THAN 20 MINUTES

13. How much time do you spend preparing to teach your mathematics lessons every week? Please include the time preparing materials, assembling manipulatives, and anything else you do, not including checking students' assignments.

    1 = 30 MINUTES OR LESS

    2 = 31-60 MINUTES

    3 = 61-90 MINUTES

    4 = 91-120 MINUTES

    5 = MORE THAN 120 MINUTES

Now we would like to learn your beliefs regarding children's learning.

Mrs. White and Mrs. Green have been teaching at the same grade at the same school for many years. The average IQ scores of the two classes they teach are very close, but the mathematics achievements of the classes are very different. Students in Mrs. White's class achieve much higher scores in mathematics than students in Mrs. Green's class.

Please indicate to what extent you agree with the statements below accounting for these differences in achievement (questions 14-19).

1 = STRONGLY AGREE

2 = MODERATELY AGREE

3 = UNSURE

4 = MODERATELY DISAGREE

5 = STRONGLY DISAGREE

14. Students in Mrs. White's class have greater mathematics learning abilities than do students in Mrs. Green's class.	1	2	3	4	5
15. Students in Mrs. Green's class do not work as hard as do students in Mrs. White's class.	1	2	3	4	5
16. Mrs. Green does not work as hard as Mrs. White does in helping her students learn mathematics.	1	2	3	4	5
17. Neither Mrs. Green nor her students work as hard as do Mrs. White and her students.	1	2	3	4	5
18. Mrs. Green does not expect her students to progress in mathematics as much as Mrs. White does.	1	2	3	4	5

19. Mrs. Green does not feel as confident about her own mathematics knowledge as Mrs. White does. 1 2 3 4 5

20. Mrs. Smith and Mrs. Jones are teaching at the same grade. The average scores of IQ tests in these two classes are almost the same, and both classes are working hard.

    Mrs. Smith likes to teach mathematics in one large group. She often explains the operational processes of mathematics skills and concepts to the whole class. After teaching, she likes to have her students do some sets of classwork or homework.

    Mrs. Jones prefers to divide her students into several groups and to use her mathematics time working with these small groups. She also assigns classwork or homework to the students based on their individual progress.

    Which class will most likely have higher mathematics scores?

    1 = MRS. SMITH'S CLASS

    2 = MRS. JONES' CLASS

    3 = NO DIFFERENCE IN THE MATHEMATICS SCORES BETWEEN THESE TWO CLASSES

    4 = IT DEPENDS ON THE STUDENTS' MATHEMATICS LEARNING ABILITIES

    5 = OTHER (please specify)______________________________

    ____

Finally, we would like to ask a few additional questions about your teaching style. Please think of all subjects, not just mathematics.

21. How many hours a week do you spend with your students, both inside and outside of the classroom?

    1 = 10 HOURS OR LESS EACH WEEK

    2 = 11-20 HOURS EACH WEEK

    3 = 21-30 HOURS EACH WEEK

    4 = 31-40 HOURS EACH WEEK

    5 = MORE THAN 40 HOURS EACH WEEK

22. In addition to the time you spend with students, how many hours each week do you spend in other school-related tasks, such as preparing lessons, checking students' work, doing administrative tasks, and talking with parents?

    1 = 5 HOURS OR LESS EACH WEEK

    2 = 6-10 HOURS EACH WEEK

    3 = 11-15 HOURS EACH WEEK

    4 = 16-20 HOURS EACH WEEK

    5 = MORE THAN 20 HOURS EACH WEEK

23. How many students do you have in your class?

    1 = 20 OR FEWER

    2 = 21-30

    3 = 31-40

    4 = 41-50

    5 = MORE THAN 50

24. What educational level have you attained? Please check all that apply.

1 = JUNIOR COLLEGE OR EQUIVALENT

2 = B.A./B.S. DEGREE OR EQUIVALENT

3 = M.A./M.S. DEGREE OR EQUIVALENT

4 = PH. D. DEGREE OR EQUIVALENT

5 = OTHER (please identify years and kind of school)____

____

25. What was your major?

1 = TEACHER EDUCATION IN ELEMENTARY EDUCATION

2 = TEACHER EDUCATION IN EARLY CHILDHOOD EDUCATION

3 = TEACHER EDUCATION IN OTHER (please specify)_________

____

4 = OTHER MAJOR (please specify)______________________

____

26. How adequately do you feel you have been prepared for teaching first-grade reading?

1 = VERY UNPREPARED

2 = FAIRLY UNPREPARED

3 = MODERATELY PREPARED

4 = FAIRLY WELL-PREPARED

5 = VERY WELL-PREPARED

27. How adequately do you feel you have been prepared for teaching first-grade mathematics.

    1 = VERY UNPREPARED

    2 = FAIRLY UNPREPARED

    3 = MODERATELY PREPARED

    4 = FAIRLY WELL-PREPARED

    5 = VERY WELL-PREPARED

28. How many years in total have you been teaching in the elementary school?

__________ YEARS

29. How many years in total have you been teaching in the first-grade?

__________ YEARS

If you would like, please tell us more about your mathematics teaching practices or your beliefs about mathematics learning in order to help us understand and interpret your answers. We would appreciate your insight, comments, and ideas. (Please write these comments here).

THANK YOU VERY MUCH!

APPENDIX E: FIRST-GRADE TEACHER SURVEY (CHINESE)

中美兩國小學一年級教師數學科教學意見調查問卷

本問卷致力於中美兩國小學數學教學之改進，您個人對這些問題的回答，僅供研究之用，我們有義務加以保密。請依照您的實際情況回答每一問題，如有任何疑問，意見或批評，請您寫在空白的地方，我們會慎重加以考慮。如果您想對自己的回答做更詳細的說明，也請在旁邊註明。答完此項問卷，請即利用所附回郵信封直接寄到國內的聯絡通訊處： 豐原市中興路136 號　林品玲老師

謝謝您的協助與合作

愛荷華州立大學兒童發展系
指導教授　Dr. Susan Hegland
研究生　鍾　貴　兒　敬啟

首先，我們想瞭解您班上數學教學的一般情況，請依照您目前的實際狀況回答。這些答案沒有所謂對或錯，每題的答案前面有一個代表的數字，請圈出您認為較適合的數字：

1. 一般說來，您班上的學生，在一星期裡有多少天有數學課或與數學相關的學習活動？
   1 = 1 天
   2 = 2 天
   3 = 3 天
   4 = 4 天
   5 = 5 天或5 天以上

2. 在有數學課的那幾天，您班上的學生，每天平均花多少時間在數學或與數學有關的活動上面？
   1 = 10 分鐘或10分鐘以下
   2 = 11-20分鐘
   3 = 21-40分鐘
   4 = 41-60分鐘
   5 = 60 分鐘以上

3. 您平均多久給學生一次數學家庭作業？
   1 = 少於一星期一次
   2 = 一星期一次
   3 = 一星期二次
   4 = 一星期三次
   5 = 一星期四次以上

4. 您每次出的數學家庭作業，程度普通的學生大約多少時間可以做完？
   1 = 10分鐘或10分鐘以下
   2 = 11-20 分鐘
   3 = 21-40 分鐘
   4 = 41-60 分鐘
   5 = 60分鐘以上

5. 您平均每星期總共花多少時間批改學生的數學作業（包括課堂習作及家庭作業）？
   1 = 30分鐘或30分鐘以下
   2 = 31-60 分鐘
   3 = 61-90 分鐘
   4 = 91-120分鐘
   5 = 120 分鐘以上

6. 您是否有助教、助手或家長幫忙批改學生的數學作業？如果有，他(她)平均每星期花多少時間在此項批改工作？

0 = 沒有助教、助手或家長幫忙

1 = 30 分鐘或30分鐘以下

2 = 31--60 分鐘

3 = 61--90 分鐘

4 = 91--120分鐘

5 = 120分鐘以上

7. 老師會以各種方式評量自己的教學效果，學生對於學習單元的瞭解程度，及進步情形(例如測驗)，請問您多久評量一次班上學生的數學學習效果？

1 = 少於一星期一次

2 = 一星期一次

3 = 一星期二次

4 = 一星期三次

5 = 一星期四次或四次以上

8. 在教過一個新的數學單元之後，要對學生的理解程度和熟練水準進行評量，測驗結果若以一百分計算，全班學生平均要幾分，您才滿意，並且繼續教下一個單元？

1 = 50分或50分以下

2 = 51-65 分

3 = 66-80 分

4 = 81-95 分

5 = 95分以上

9. 教數學時，有些老師用直接教學(如講解觀念，說明演算過程)，或使用課堂習作(如習作簿或個別指定在課堂完成的活動)。

(A) 您平均每星期使用直接教學的次數有多少？

1 = 少於一星期一次

2 = 一星期一次

3 = 一星期二次

4 = 一星期三次

5 = 一星期四次或四次以上

(B) 您平均每星期使用課堂習作的次數有多少？

1 = 少於一星期一次
2 = 一星期一次
3 = 一星期二次
4 = 一星期三次
5 = 一星期四次或四次以上

(C) 如果數學課一節是30分鐘，您用多少時間做直接教學？

1 = 5 分鐘或5 分鐘以下
2 = 6-10分鐘
3 = 11-15 分鐘
4 = 16-20 分鐘
5 = 20分鐘以上

(D) 如果數學課一節是30分鐘，您用多少時間做課堂習作？

1 = 5分鐘或5 分鐘以下
2 = 6-10 分鐘
3 = 11-15分鐘
4 = 16-20分鐘
5 = 20 分鐘以上

10. 有些老師使用可以操作的教具來教數學（譬如使用積木、火柴棒等）。

(A) 您平均每星期使用操作性教具的次數有多少？

1 = 少於一星期一次
2 = 一星期一次
3 = 一星期二次
4 = 一星期三次
5 = 一星期四次或四次以上

(B) 如果數學課一節是30分鐘，您通常花多少時間使用操作性教具？

1 = 5 分鐘或5 分鐘以下
2 = 6-10分鐘
3 = 11-15 分鐘
4 = 16-20 分鐘
5 = 20分鐘以上

11. 有些老師使用生活實例來教數學（如問學生"我現在有15顆糖，分給小明8 顆。請問我還有幾顆糖？"）。

(A) 您平均每星期混合使用生活實例的次數有多少？
- 1 = 少於一星期一次
- 2 = 一星期一次
- 3 = 一星期二次
- 4 = 一星期三次
- 5 = 一星期四次或四次以上

(B) 如果數學課是一節是30分鐘，請問您有多少時間用生活實例來教數學？
- 1 = 5 分鐘或5 分鐘以下
- 2 = 6-10分鐘
- 3 = 11-15 分鐘
- 4 = 16-20 分鐘
- 5 = 20分鐘以上

12. 有些老師混合使用操作性教具及生活實例兩種教學方法。

(A) 您平均每星期混合使用操作性教具及生活實例的次數有多少？
- 1 = 少於一星期一次
- 2 = 一星期一次
- 3 = 一星期二次
- 4 = 一星期三次
- 5 = 一星期四次或四次以上

(B) 如果數學課是一節30分鐘，請問您有多少時間混合使用這兩種教學方法？
- 1 = 5 分鐘或5 分鐘以下
- 2 = 6-10分鐘
- 3 = 11-15 分鐘
- 4 = 16-20 分鐘
- 5 = 20分鐘以上

13. 您每星期花多少時間準備數學教學（包括準備教材、製作教具等，但不包括批改學生的作業）？
- 1 = 30分鐘或30分鐘以下
- 2 = 31-60 分鐘
- 3 = 61-90 分鐘
- 4 = 91-120分鐘
- 5 = 120 分鐘以上

接著，我們想瞭解您對學童數學學習的看法和意見。請先看下面的兩則事例，再回答有關的問題。

事例一：張老師和李老師在同一所學校教同一個年級有好幾年了。他們兩班學生的智商相近，但數學成績却大不相同。張老師班上的學生數學平均成績比李老師班上的學生成績高。 以下14-19題是幾個可能用來解釋兩班差異的原因，請圈出您對該項解釋贊同的程度。

1 = 非常贊同

2 = 有點贊同

3 = 不確定

4 = 有點不贊同

5 = 非常不贊同

	非常贊同	有點贊同	不確定	有點不贊同	非常不贊同
14. 張老師班上的學生數學學習能力高於李老師班上的學生。	1	2	3	4	5
15. 李老師班上的學生不如張老師班上的學生用功。	1	2	3	4	5
16. 李老師在指導學生學習數學時，不如張老師認真賣力。	1	2	3	4	5
17. 李老師没有像張老師那麼認真教學，她的學生也不如張老師的學生努力學習。	1	2	3	4	5
18. 李老師對學生數學成就的期望，不如張老師對學生的期望高。	1	2	3	4	5
19. 張老師對自己的數學能力有信心，李老師對自己的數學能力没有信心。	1	2	3	4	5

事例二：台老師和藍老師教同一年級，兩班的學生智商相近，兩位老師都很認真教學，兩班的學生也都很努力學習。台老師喜歡用班級教學，她常向全班同時解說教學觀念及例題演算，在課堂上做相同的習作或出同樣的家庭作業。但藍老師則比較喜歡將學生分成幾個小組進行教學，並且到每一小組中去指導他們，她也依學生程度指定習作及家庭作業。

20. 請問，那一個班級的數學成績會比較高？

1 = 台老師的班級較高

2 = 藍老師的班級較高

3 = 兩班成績沒有差別

4 = 因學生天生的數學學習能力而有不同

5 = 其他（請具體說明）--

最後，我們再向您請教幾個教學問題(包含其他各科而不僅限於數學教學)。

21. 您每星期和學生一起上課的時間有多少(含各科教學及各項活動)？

1 = 10小時或10小時以下

2 = 11-20 小時

3 = 21-30 小時

4 = 31-40 小時

5 = 40小時以上

22. 您每星期工作時間多久（包括教學、批改作業、準備教材教具、處理學校行政業務及和家長聯繫等）？

1 = 10小時或10小時以下

2 = 11-20 小時

3 = 21-30 小時

4 = 31-40 小時

5 = 40小時以上

23. 您班上的學生人數有多少？

1 = 20人或20人以下

2 = 21-30 人

3 = 31-40 人

4 = 41-50 人

5 = 50人以上

24. 您本身的教育程度是：

1 = 專科學校畢業

2 = 大學院校畢業

3 = 研究所進修（含畢業獲有碩士學位暨四十學分進修班）

4 = 博士班進修或獲有博士學位

5 = 其他（請註明學校及肄業年級）------------------------------------

25. 您主修的科別是：

1 = 有關國民小學教育科系畢業

2 = 有關幼稚教育科系畢業

3 = 非教育科系而曾修習教育學分

4 = 其他（請說明）---

26. 在教一年級國語文時，您覺得自己所受的語文及有關語文教學的專業訓練，是否足以擔任該科教學？

1 = 非常勝任愉快

2 = 可以勝任愉快

3 = 能力適當

4 = 不太有把握

5 = 非常沒有把握

27. 在教一年級數學時，您覺得自己所受的數學及有關數學教學的專業訓練，是否足以擔任該科教學？

1 = 非常勝任愉快

2 = 可以勝任愉快

3 = 能力適當

4 = 不太有把握

5 = 非常沒有把握

28. 您在國民小學從事教學工作共有多久？

------------ 年

29. 您擔任一年級的教學共有幾年的經驗？

------------ 年

如果您願意，請再多談談您在班上的數學教學活動，及對兒童學習數學的看法，以幫助我們瞭解您對本問卷的看法，我們也非常歡迎您的建議和批評。

謝謝您！　敬祝教學愉快！

APPENDIX F: SECOND MAILING LETTER

Iowa State University of Science and Technology Ames, Iowa 50011-1030

College of Family and Consumer Sciences
Child Development Department
101 Child Development Building
Telephone 515-294-3040

January 22, 1990

Dear First-grade Teacher:

Recently a questionnaire seeking your beliefs and practices about mathematics learning and teaching was mailed to you. Your name was drawn in a random sample of first-grade teachers in Iowa.

If you have already completed and returned it to us, please accept our sincere thanks. If not, please do so today. Because it has been sent to only a small, but a representative sample of Iowa teachers, it is extremely important that yours also be included in the study if the results are to accurately represent the first-grade teachers in Iowa.

If by some chance you did not receive the questionnaire or it was misplaced, please call (515-294-4616) or write us right now, and we will get another one in the mail to you.

If you are not a first-grade teacher, please give the questionnaire to a teacher who is teaching first grade at your school. Thank you.

Sincerely,

Kuei-Er Chung
Graduate Student

Susan M. Hegland, Ph. D.
Associate Professor

APPENDIX G: SECOND MAILING LETTER (CHINESE)

親愛的　　　　老師：您好。

我們最近寄了一份一年級教師數學科教學意見調查問卷給您。您的名字是用電腦從台中縣一年級教師名單中抽選出來的。

我們誠懇的謝謝您答完這項問卷並寄還給我們。如果您還沒回答或寄回給我們，請能儘快寄回您的問卷。因為我們只寄給少數抽樣選出的台中一年級教師，我們需要您的意見以便能更準確的代表台中縣的一年級教師。

如果您沒收到問卷或者遺失了，請打電話或寫信給林品玲老師（地址：台中縣豐原市中興路136 號，電話：045-267342），林老師會立刻另外再寄一份問卷給您。謹此敬祝

教學愉快

愛荷華州立大學兒童發展系

指導教授 Dr. Susan M. Hegland

研究生　鍾　貴　兒　　謹上

79 年 1 月