

Perceptions of Change and Reform Efforts by Secondary School Mathematics Teachers in the People's Republic of China and the United States

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The present study extends previous research in this area by investigating perceptions of change and reactions to reform efforts by pre-service and practicing secondary school mathematics teachers in the People's Republic of China (PRC) and the United States of America.

Interviews were used to gather data about school experiences, teaching practices, and planned changes in mathematics programs. Analysis of the interview data supported earlier findings with respect to the well-planned nature of lessons by PRC teachers and the influence of mathematics contents and examination systems in the PRC. Findings also indicated a general agreement among teachers from both countries favoring less lecturing and more discussion and interactive activities.

There were contrasts by nationality in descriptions of future teaching, ideal lessons, sources of teaching ideas, and preferences about school mathematics programs.

1. INTRODUCTION

Education of secondary school mathematics teachers in the People's Republic of China (PRC) and in the United States of America (US) presents a number of contrasts as well as many similarities.

In China, there are more than 270 normal colleges and universities, at least one normal university and several normal colleges in every province, and a pre-service training of secondary school mathematics teaching specialty is available in everyone of

them (Tang, 1995; Wang, Bi & Sun, 1991). Over 1,200 US four-year institutions (more than 70% of American four-year colleges and universities) educate pre-service teachers. Public colleges and universities prepare about 80% of US schoolteachers (Hawley, 1992).

Recent research and expository reports (e. g., Wong, 1998) have accentuated the prominent role of mathematics education reform efforts in each country's system of education. Particular reform efforts in both countries have included:

- 1) Changes in contents, teaching and testing (Zhang, 1992; Romberg, 1995),
- 2) Assessments of program strength and weakness (Wang et al., 1991; CCSSO, 1995),
- 3) Improvement in lesson structure (Lietzel, 1991; Tang, 1994),
- 4) Use of models and manipulations (Ziqiang & Monroe, 1991; Li & Carter, 1998),
- 5) Identification of teaching difficulties (Chang & Paine, 1992; Holton & Goroff, 1995), and
- 6) The enhancement of extant sources for teaching ideas (Darling-Hammond, 1990; Lu, Sun & Wang, 1995).

2. PROCEDURES

This study investigated aspects of these common reform efforts from the perspective of the shared perceptions of change expressed by pre-service and practicing mathematics teachers in the PRC and the US. Since the current reform efforts are aimed at changing teachers' thinking about contents and methods of mathematics teaching, this study was particularly undertaken to recognize and record how national reform efforts have manifested themselves according to the types of changes pre-service and practicing teachers currently deem as necessary.

The participants in the study were either prospective teachers or practicing teachers of secondary school mathematics in China and in the United States, and the prospective teachers were students at five institutions, two in the US and three in the PRC.

The Chinese prospective teachers (four women and two men) were either third or fourth year students at teachers' colleges or a normal university where the typical program of study was four years in length. The institutions that these students attended were in Gansu, Guang Dong and Xing Jiang provinces of the PRC. The American prospective teachers (three women and three men) were all third year students at a college and a university where a typical program of study for a teaching credential was four or five years. The institutions that these students attended were in the states of California and New Hampshire.

The Chinese practicing teachers (six men) were all graduates of teachers' colleges or normal universities situated in both coastal and interior regions of China. Each of the

practicing teachers was teaching at a Chinese middle school situated in Gansu, Hunan, Yun Nan and Zhe Jiang provinces. The US practicing mathematics teachers (four women and two men) graduated from various colleges and universities in New England and the West Coast region of the US. All were employed as teachers at the time of the study in American junior or senior high schools located in the states of California or New Hampshire.

Data were collected in multiple phases in the US and in the PRC. A set of fourteen open-response, interview questions was designed to elicit answers from the subjects about their own schooling, their teaching practice, and their plans for changing their teaching. Questions were based on items developed by the Recognizing and Recording Reform in Mathematics Education Project in the US to assess the impact of mathematics education reform (Ferrini-Mundy & Ferrucci, 1996; Ferrini-Mundy & Schram, 1997). The inter-views took place in a faculty office and lasted for 1-2 hours. All interviews were audio-taped and transcribed and these response data were examined in order to identify themes across the questions.

3. RESULTS AND DISCUSSION

Interviewers asked comparable questions of the practicing and pre-service teachers from both countries. These questions dealt with future changes, positive and negative aspects of mathematics education program, ideal lessons, manipulations, difficult topics to teach, and sources for teaching ideas.

The first of these questions concerned what teaching changes were expected within the short term of five years, and the responses revealed differences between the practicing and preservice teachers and between the American and the Chinese practicing teachers. The pre-service teachers' responses indicated they expected change based on professional development and use of technology, but the US practicing teachers foresaw changes in their teaching resulting from student diversity or demographics. In contrast, the Chinese practicing teachers reported they anticipated few or no changes in their future teaching during the next five years.

One Chinese prospective teacher indicated how he expected his teaching of mathematics to be different from how he was taught by expressing sentiments that were common in the responses by pre-service teachers from the PRC and the US.

"In my classes I would like to emphasize students' ability to use both their hands and their brains, to more fully arouse students' interest, and to make the classes more activity-based."

The responses by the US practicing teachers typically referred to changes which they expected due to in-service education programs or new technology. For the most part,

Chinese practicing teachers indicated they expected few or no changes within the next five years. A practicing teacher from Hunan Province elaborated by saying that during the next five years he expected “to add to his teaching experience and to continue to work toward his goal of lightening his students’ workload.”

What the practicing and future teachers most liked about school mathematics programs was also described differently according to nationality. Both pre-service and practicing teachers of the PRC consistently indicated a favorite course of study (e.g., algebra, analytic geometry, complex variables, etc.) as what they most liked about mathematics programs. These preferences appeared to reflect the contents-dominated emphasis and the high regard in which mathematics coursework is held in Chinese mathematics education (Tang, 1994; Chang & Paine, 1992). American responses were markedly different. Pre-service US teachers consistently indicated that little or nothing was likable about school mathematics programs, while practicing US teachers gave various descriptions which related that problem solving, mathematical connections, or job-related benefits were the most likable aspects of their programs.

Contrasting responses between nationalities were also evident in the teacher’s answers to questions about what aspects of mathematics programs were least liked. Current and future teachers in China tended to give descriptions that stated a particular mathematical contents was what was least liked, whereas Americans gave a variety of responses about negative aspects of instructional, curricular, or testing issues. For example, one US practicing teacher related her dislike to the practice of “tracking” — the assignment of students to homogenous classrooms or groups within classrooms based on previous performance or achievement criteria.

“I resent tracking ... It is unfair to many students to be assigned to lower ability level classes when their low performance is really the fault of their teachers who fail to teach basic mathematics skills. Students’ placement levels too often mainly depend on these teachers’ recommendations.”

The Chinese practicing teachers and the future teachers from both countries expressed a willingness to use manipulations in their teaching and half the practicing US teachers concurred. Moreover, the prospective teachers from both countries expressed plans to use manipulations both to motivate and to match various learning styles. A fourth-year student and prospective teacher from Xing Jiang Providence said:

“I will use manipulations for exciting students’ interest in mathematics and for providing concrete illustrations of concepts.”

While a future teacher from California replied:

“I absolutely intend to use manipulations. They are helpful in emphasizing concepts you are explaining.”

Three-dimensional geometry was consistently mentioned as being the most difficult to teach by practicing teachers of both countries. An experienced teacher from Gansu Province further noted that:

“The contents most difficult to teach is that which I don’t understand deeply.”

Pre-service PRC and US teachers typically said that various topics (e.g., algebra, geometry, or calculus) were the most difficult to teach. An American future teacher from New England elaborated in this kind of reply.

“Calculus will be the most difficult for me because I have only taken four courses and never tried to tutor anyone or help in a classroom that was studying calculus. I have gotten A’s in all my work but I know I will have to develop a better understanding so I can help students learn.”

When asked where they got the teaching ideas used in their classes, PRC and US practicing teachers indicated that colleagues and professional publications were their major sources for teaching ideas. One experienced California teacher’s response exemplified the answers from practicing teachers in both countries.

“My teaching ideas come from many sources — my own years of teaching experience, observations of master teachers at work, reading mathematics education journals, conversations with other teachers, and even looking at TV shows related to education or mathematics.”

In answering similar questions, the future teachers who participated in the interviews revealed another contrast by nationality. All the Chinese but none of the American pre-service teachers stated that they expected their teaching practice to serve as a chief source of ideas about teaching.

In describing an ideal mathematics lesson, pre-service teachers from both countries recounted lessons in geometry, but the Americans were less specific in their descriptions. In a similar fashion, Chinese practicing teachers gave descriptions of their ideal lessons based on rather detailed multi-step plans. US practicing teachers were less definite in their descriptions of ideal lessons, but often referred to popular educational concerns such as cooperative learning and dealing with nontraditional students.

A third-year Chinese student detailed her ideal mathematics lesson as one in which she would:

- 1) Give students a problem (e.g., find the volume of a sphere.),
- 2) Guide students to retrieve relevant knowledge (e.g., area of a circle = $(1/2)(2\pi r)r$),
- 3) Guide students to guess conclusions by analogy,

- 4) Guide students to test conclusions experimentally and make needed modifications, and
- 5) Prove the result.

A third-year American student described her ideal lesson as follows:

“I would like to teach this ideal lesson on a geometric topic. I would separate the class into halves. Both halves would draw geometric figures, then each half would have an opportunity to talk about the other group’s figures and their properties.”

As the preceding examples illustrate, the American descriptions of ideal lessons lacked specificity but exhibited greater informality than those of their Chinese counterparts. The contrast here is similar to the observed differences between secondary school mathematics classrooms in Beijing and London, and this contrast points to the challenges faced by mathematics education reforms from an international perspective (Leung, 1995).

4. CONCLUSION

To accomplish the in-service and other reforms envisioned by mathematics educators worldwide, Siu, Siu & Wong (1993) have put forth a call for a new kind of mathematics teacher, the “scholar-teacher”, one who is truly prepared to address the wealth of issues that arise in these changing times. The areas are concerned with mathematical literacy, problem-solving strategies, communication skills, mathematical thinking, and cultural aspects of mathematics. From this vantage, current reform efforts of mathematics education may well be interpreted as fostering the development of more scholar-teachers. The present study has suggested how practicing and pre-service teachers may be responding to reform efforts in the PRC and the US. Such responses are apt to be key considerations in the development of future scholar-teachers in mathematics.

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