LV SHIHU, YE BEIBEI & CAO CHUNYAN

7. IMPLEMENTATION OF THE NEW MATHEMATICS CURRICULUM FOR COMPULSORY EDUCATION IN MAINLAND CHINA

INTRODUCTION

In 1997, the Ministry of Education of the People's Republic of China evaluated the implementation of its compulsory education curriculum. A report on the nine-year implementation status of the compulsory education curriculum project (1997 Report) was submitted, which eventually became an important reference for developing the new compulsory education curriculum. This new mathematics curriculum has been in place for the past ten years. When *The Full-time Obligatory Education Mathematics Curriculum Standards (Experimental Version)* (also referred to as simply *The Standards*) were promulgated in 2001, mathematics education researchers in mainland China began a longitudinal study on the implementation of the new mathematics curriculum. These researchers initially focused on the interpretation of *The Standards* (Liu Jian & Sun Xiao-tian, 2002), the role of teachers (Liu Qian-fang, 2004), the existing problems in the teaching practice (Sun Xiao-tian, 2003; Dai Li-jun, Lv, & Ting-ting, 2003), and the implementation of exploratory teaching (Xu Yan-hui, 2002). As the new curriculum developed, researchers began to investigate and analyze key factors of *The Standards* (Yi Hong-ju & Li Zi-jian, 2004; Jing Min & Xie Hui, 2005) that could possibly affect its implementation. They studied the adaptation of teachers to the new mathematics curriculum in the teaching and learning aspects (Gong Zi-kun & Li Zhong-ru, 2005; Li Fu-jin, 2005), the challenges facing mathematics teachers (Chang, Guo-liang, 2005), and the changes that students had undergone in learning (Sun Mingfu & Wen Jianhong, 2004), among others.

Mainland China's mathematics curriculum reform began to draw international attention in 2005, when more studies were conducted by researchers from China and other countries. These researchers were interested in the development of, and changes in, student scores (Wang & Lin, 2009; Liu, Zhang, & Luo, 2010; Ni, Qiong, Li, & Zhang, 2011), as well as in the interactions and changes in teachers' teaching and students' learning (Li, 2007; Correa, Perry, Sims, Miller, & Fang, 2008; Cai, & Ni, 2011). In-depth studies of the changes brought about by the new mathematics curriculum were conducted using questionnaires, literature reviews, and other methods (Ma, Lam, & Wong, 2006; Zhou & Bao, 2009; Li, Zhang & Ma, 2009; Xu, 2010; Cai & Ni, 2011; Cai, Ni, Frank, 2011).

After 2008, researchers expressed concern over the status, effects, problems, and implementation strategies of the new curriculum. Investigations and reviews were

E.H.F. Law and C. Li (Eds.), Curriculum Innovations in Changing Societies, 123–140.

made from different angles (Lv & Guo, 2008; Gong, 2008; Yang & Yu, 2008; Huang & Long, 2008; Luo, Chang & Fan, 2008; Zhang, 2008; Xu, 2010).

Analysis of the new mathematics curriculum of compulsory education includes many perspectives that enable better understanding of the new mathematics curriculum. The current paper investigates the implementation of the new mathematics in mainland China.

In 2007, the current research team conducted a survey in Gansu province on the implementation of the new mathematics curriculum in Grades 7 to 9. This survey gauged the status implementation of the new mathematics curriculum based on the following criteria: (1) opinions of teachers regarding the new mathematics textbooks and curriculum, (2) teaching concepts and methods, (3) learning methods, (4) evaluation system, and (5) disadvantages of the new curriculum, among others. As of writing, three years have since passed since this survey.

What has changed in teaching and learning in the ten years that the new mathematics curriculum has been implemented? The author of the current study conducted a new survey to address this question. This survey involved 300 mathematics teachers and 1,360 students of compulsory education in Gansu province, and its findings were compared with those of the 1997 report and the 2007 survey reported in Lv & Guo, 2008. The author intends to collect (1) the opinions of teachers and students regarding the new mathematics curriculum, (2) their conceptions of mathematics teaching and learning, and (3) their opinions on the evaluation of the mathematics curriculum, so as to reflect the implementation of the new mathematics curriculum in mainland China.

RESEARCH PROCEDURES

The questionnaires used in this study were based on those of several previous studies. Only primary and middle schools in county towns in Gansu province, mainland China were investigated. Both teachers and students were surveyed via questionnaires and interviews. After the questionnaires were administered, teachers and students were interviewed individually to further discover their opinions.

Participants

The participants were randomly selected from county primary and middle schools. Researchers randomly selected the schools, picked a number of classes, and included all of the mathematics teachers in the selected schools. The participants in this survey are as follows:

- Mathematics teachers teaching Grades One to Nine in Gansu province (160 from primary schools and 140 from middle schools).
- A sample of 1,360 students from 20 secondary schools in Gansu province. All students were in Grades Seven to Nine.

Survey Tools and Methods

Survey tools This study used a self-made teacher questionnaire on the implementation of the new mathematics curriculum for compulsory education in Gansu province. This questionnaire adopted most of the questions in the 1997 report and 2007 survey to maintain consistency; a number of new questions were added. The questionnaire focused on the opinions of teachers regarding the mathematics curriculum, its current evaluation system, teachers' teaching behavior, students' learning styles, and so on. The questionnaire included 27 questions consisting of 16 single choice, 8 multiple choice, and 3 open questions. The survey tools referred to those that were used in the 2007 survey (Lv & Guo, 2008)**.**

A self-made student questionnaire and interview guideline were used to survey the implementation of the new mathematics curriculum in middle schools. This questionnaire covered the same topics as the first questionnaire, except for the part concerning teachers' understanding and application of *The Standards*. The questions concerned the students' perspective, including such topics as their emotions and attitudes toward mathematics and mathematics learning, their learning styles and study burdens, and their opinions and expectations regarding mathematics teaching. The questionnaire contained a total of 41 questions, consisting of 35 single choice questions, 5 multiple choice questions, and 1 open question.

After being administered to 30 teachers, 60 primary school students, and 60 secondary school students, the questionnaires were improved using feedback from the testers. The questionnaires were finalized after tests analysis and consultation with mathematics curriculum experts. The author and the consulted experts were satisfied with the credibility and effectiveness of the final questionnaires.

Methods

Questionnaires and interviews were both used in this survey. Three hundred questionnaires for teachers were sent out, and 287 valid ones were retrieved, which translates to an effective rate of 95.7%. One thousand three hundred sixty questionnaires for students were sent out, and 1,302 valid ones were retrieved, which translates to an effective rate of 95.7%. Forty-three students were selected for interview based on their answers to the questionnaires.

RESULTS AND ANALYSIS

Views of Teachers on the New Mathematics Curriculum

Understanding and application of The Standards by teachers. The survey results show that 74.2% of the teachers have been using the new mathematics curriculum for more than three years. By contrast, 6.6% of the teachers have never read *The Standards*, an improvement over the 43% recorded during the 2007 survey. The teachers' understanding and utilization of *The Standards* are shown in Table 1.

Table 1. Understanding and utilization of The Standards by teachers (%)

Understanding of The Standards	*Completely understand*	*Understand*	*Barely understand*	*Do not understand*
Percentage	8.6%	69.6%	19.5%	2.3%
Utilization of *The Standards*	Often	Sometimes	Occasionally	Never
Percentage	20.3%	60.2%	17.5%	2.0%

Among the teachers surveyed, 78.2% replied that they either "understood" or "completely understood" *The Standards*. Furthermore, 80.5% claimed to utilize *The Standards* "often" or "sometimes." These statistics have changed greatly since the 2007 survey**.** In the 2007 survey**,** the responses "completely understand," "understand," "barely understand," and "do not understand" garnered 2.5%, 57.3%, 33%, and 7.2%, respectively, and the replies "often," "sometimes," "occasionally," and "never" garnered 11.9%, 46.2%, 33%, and 89%, respectively. Comparing these numbers with those from the 2007 survey shows that utilization of *The Standard*s is increasing. Most of today's teachers understand *The Standard*s better and use it as a teaching guideline. Despite this, however, teachers that "completely understood" (8.6%) and "often" (20.3%) utilized *The Standards* were few, as shown in Table 1. Thus, the understanding and utilization of *The Standards* by teachers are fundamental and require focused guidance.

Teachers Approve of the Ideas of the New Mathematics Curriculum

As shown in Table 2, 99.6% of the teachers chose "full support" or "support," whereas only 0.4% of the teachers did not identify toward the conception of the new mathematics curriculum. In contrast, the 2007 survey showed that 23% of the teachers did not identify toward the conception of the new mathematics curriculum. Thus, more teachers have agreed with the new curriculum conception.

As to the question of whether the ideas and targets of the new curriculum can be realized, 7.8% of the teachers replied with "fully realized," 51.8% replied with "conditionally realized," and 38.5% replied with "partially realized." However, 1.9% of the teachers considered the new curriculum too idealistic to be realized. These numbers are similar to those obtained in the 2007 survey, whose corresponding percentages were 2.9%, 42.1%, 50.3%, and 4.7%. Thus, teachers generally supported the new curriculum's ideas but were not optimistic toward the full realization of its targets.

Emotional experiences of students of the new mathematics curriculum. Students' emotional experiences under the new mathematics curriculum can be shown by their feelings towards learning mathematics. How students felt about mathematics after experiencing the new mathematics curriculum is shown in Table 3.

Table 2. Teachers approve of the ideas of the new mathematics curriculum (%)

Item	*Full Support*	*Support*	*No Support*
Percentage	22.2%	77.4%	0.4%

Table 3. Experience of students learning mathematics (multiple choice) (%)

Experience	*Easy*	*Hard*	*Very interesting*	*Uninteresting*
Percentage	32.0%	44.0%	66.5%	13.5%

Table 4. Attitude of students toward mathematics (%)

Attitude	*Favorite*	*Like*	*Dislike*	*Hate*
Percentage	45.8%	45.2%	7.9%	1.1%

Table 3 shows that 32.0% of the students think mathematics is "easy" to learn, 44% consider it "hard," 66.5% think it is "very interesting," and 13.5% think it is "uninteresting."

Students' attitudes toward mathematics can also be shown by how much they like it.

As seen in Table 4, most students liked mathematics (91%), whereas 9% of the students disliked or hated it.

Regarding the students' confidence in learning mathematics well, 73.6% of them believed that they could get good marks if they exerted effort, 7.9% were confident in learning mathematics and believed that they could get good marks without difficulty, 13% believed that they could achieve only mediocre performance despite great effort, and 5.5% did not think would do well at all no matter how hard they tried.

The above findings indicate that most students experiencing the new mathematics curriculum like mathematics, find it interesting, and are confident in learning it. However, 44% of the students still consider mathematics "hard" to learn, and 13.5% find it "uninteresting." The goal of the new mathematics curriculum, "Everyone finds the value of mathematics, everyone finds mathematics necessary, and different people have different development in mathematics," is far from being fully realized.

Views of Teachers and Students Regarding Teaching Activities Used in the New Mathematics Curriculum

Teaching-related topics that teachers often discuss with colleagues. According to the data in Table 5, the topics that teachers discussed most often were "problem-solving skills" (83.3%) and "knowledge and skills" (65.4%). Other topics included "intellectual development" (47.9%), "creativity" (36.2%), "personality development" (32.7%), and "emotional attitude" (27.6%). In the 2007 survey, the percentages of these six topics were 70.1%, 67.3%, 41.8%, 34.7%, 27.4%, and 30.2%, respectively.

Table 5. Teaching-related topics that teachers often discuss with colleagues (%)

Topics	*Knowledge and skills*	*Problem-solving skills*	*Intelligence development*	*Creativity*	*Emotion and attitude*	*Personality development*
Percentage	65.4%	83.3%	47.9%	36.2%	27.6%	32.7%

Apparently, teaching-related topics often discussed among teachers have changed since the 2007 survey. The popularity of discussing "knowledge and skills" decreased to 4.7%, whereas that of discussing "problem-solving skills" increased to 16%, a much higher number than in the 1997 report. The most often-discussed topic changed from "knowledge and skills" to "problem-solving skills," which indicates that teachers care about examination marks most of all. Hardly any changes were observed in the popularity of "creativity," "emotion and attitude," and "personality development" compared with the 2007 survey. However, the percentages of the six topics in the 1997 report were 60% (knowledge and skills),50%(problem-solving skills), 33% (intelligencedevelopment), 22%(creativity), 15% (emotion and attitude), and 13%(personality development), which indicate that teachers are increasingly concerned with regard to emotion and attitude, creativity, and personality development.

Workload of Teachers

In answer to the question, "How have teachers' workloads changed after the new curriculum was implemented?" 77.5% of the teachers thought that their workloads "increased" or "increased substantially," 19.8% of teachers noted "no changes," and 2.7% thought that the workload was "reduced." Compared with the 2007 survey, those who replied with "increased" and" "increased substantially" decreased by 9.3%, while those who replied with "no changes" increased by 7.5%.

The data show that teachers need to spend time studying the new curriculum and creating teaching methods and classes accordingly. However, given increasing adaptation to the new curriculum, teachers may find their workload declining. Regarding the question, "What did you learn from the new curriculum," most teachers admitted that they had become learners and researchers of the new curriculum.

Teaching Methods and Student Participation in the Classroom

The teaching methods and student participation in the classroom are important indexes that reflect the classroom teaching activities. The survey of teaching methods is shown in Table 6 below.

Table 6 shows that 81.9% and 38.5% of teachers adopted "teacher-student Interaction" and "group cooperative learning" methods, respectively, 46.9% of students noted the use of the "lecture method," and 7.8% replied that teachers

Table 6. Classroom teaching methods pointed out by students (Multiple choice) (%)

Teaching methods	*Lecture method*	*Teacher-Student interaction*	*Group cooperative learning*	*Student self-study*
Percentage	46.9%	81.9%	38.5%	7.8%

adopted "student self-study." Those that replied with "group cooperative learning" increased by 12.7% compared with the 2007 survey, and no significant changes were noted regarding all other teaching methods.

In answer to the question, "Do you think students' active exploration and cooperation that are advocated by the new curriculum will be carried out in actual teaching?" 5.5% of the teachers answered "completely," and 70.6% agreed with "generally," while teachers who replied "not for now" and "never" made up 22.7% and 1.2%, respectively. Some changes can be found when the current findings are compared with those of the 2007 survey, which reported percentages of 2.2%, 57.5%, 37.1%, and 3.2%, respectively. The proportion of "completely" and "generally" increased by 16.4%, whereas those of "not for now" and "never" dropped by 16.4%. These changes show that teaching methods have changed toward the new curriculum and students have experienced these changes.

Student participation in the classroom can be reflected in three aspects: (1) whether students experience the learning activity of finding information and collective discussion, (2) whether the students have the opportunity to express their ideas, and (3) students' answers to teachers' questions.

The first question was, "Whether the students have experienced the learning activities of finding information and collective discussion," to which 77.2% of the students replied with "never" or "rarely," and 22.8% of the students replied with "often." Students who chose "often" increased by 12.8% compared with the 1997 survey (the percentages of "never," "seldom," and "often" were 56%, 34%, and 10%, respectively).

The second question was, "Whether students have the opportunity to bring out different ideas than teachers." Students who answered "rarely" and "no" constituted 54.5% and 22.3% respectively, while 23.2% of the students replied with "often." The percentage of "often" dropped by 19.8% compared with the 1997 report (the percentages of "no," "rarely," and "often" were 9%, 48%, and 43%, respectively).

The third question was, "What will you do when you are not sure to have correct answers to the teacher's questions?" 56.9% of the students chose "want to answer, but worry about mistakes," and 6.4% chose "never want to answer," while the responses "answer sometimes" and "answer all the time" garnered 28.1% and 8.6%, respectively. Compared with the 1997 report (wherein the percentages of "want to answer, but worry about mistakes" and "never want to answer" were 54% and 15%, respectively), those who replied with, "never want to answer" decreased by 8.6%.

Table 7. Teaching support in the new curriculum practice (%)

Support and Assistance	*Training in new curriculum text book*	*Training in "curriculum standard"*	*Teaching and researching activities*	*Expert guidance*
Percentage	68.5%	38.5%	77.4%	25.7%

The above numbers indicate that teaching methods have been changing from traditional "teaching only" to multiple methods like group cooperative study and exploration between teachers and students, among others. Teachers themselves have also been transforming from lecturers to motivators and guides to the students, and the change is taking place in daily teaching. However, no significant changes were observed in students' initiative and in the democratic atmosphere in the classroom. Students, despite being the most important component of the classroom, have not actively participated in class.

Support and Assistance to Teaching According to the New Curriculum Practice

Table 7 shows that the most teacher support and assistance is given through "teaching and researching activities," followed by "training in new curriculum text book." Teachers who chose "training in 'curriculum standard'" and "expert guidance" made up 38.5% and 25.7%, respectively. Remarkable changes are observed when compared with the 2007 survey, wherein "training in new curriculum text book," "training in 'curriculum standard'," "teaching and research activities," and "expert guidance" garnered 64.5%, 61.3%, 56.9%, and 16.0%, respectively. The percentage of "training in 'curriculum standard'" decreased dramatically, whereas that of "teaching and researching activities" increased significantly. The findings show that teachers initially relied heavily on training of curriculum standards. As the new curriculum was increasingly implemented, the training in curriculum standards gradually decreased, and teaching and research activities increased. Teachers then felt that the assistance they received regarding the two activities also changed. In the latest survey's open question item, most teachers expressed that they scarcely had any opportunities to meet with experts. They also expressed the hope that more experts will visit middle schools and offer guidance to rural schools on how to increase the interaction between teachers and experts. The findings show that teachers expect more support and assistance from professional experts.

Expectations of Students Regarding Teaching

The expectations of students regarding teaching can reflect their expectations regarding the teaching of the new mathematics curriculum. For the open question, "What would you like your teacher to do in mathematics class," 55.9% of the students wanted "more questions, less speaking and more practice so as to leave time for independent learning." 50.5% of the students expected the adoption of group

cooperative learning to increase communication between students and teachers. Furthermore, 28.3% of the students expected "teachers to motivate students' initiative and act as guides to help students express their own ideas before explanation," 23.1% expected teachers "to be sparkling in discourse, amiable, humorous, and smiling, and not to be irascible or to practice the physical punishment of students." The students also expected "the class to be pleasant, interesting and lively, and teachers to pique students' interest with stories, games and jokes" (17.7%), "teachers to treat every student equally, including problem students" (9.6%), and "to find more application of mathematics in real life" (8%).

These findings show that students expect teachers to act as organizers and guides in class, and that most students have adapted to independent learning and cooperative learning. However, students do not have much expectation regarding exploratory learning because they lack the relevant experience.

Views of Teachers and Students on Learning Activities in the New Mathematics Curriculum

Students' learning methods The learning methods of students are important bases for implementing the new mathematics curriculum. The learning methods espoused by the new curriculum are independent learning, cooperative learning, and explorative learning. Do students accept these learning methods? How well do students participate? The following are the findings gathered from both teachers and students.

Mathematics teachers rank students' learning methods as such: acceptance learning, followed by cooperative and exploratory learning, and lastly, mechanical learning. This order is similar to the one reported in the 2007 survey (the percentages of acceptance learning, cooperative and explorative learning, and mechanical learning were 69.5%, 24.5%, and 6.0%, respectively). However, teachers' identification of cooperative and exploratory learning in the latest survey was twice that of the 2007 survey.

Regarding student participation in class, 5.1% of teachers answered "very good," 90.2% chose "good" or "general," whereas 4.3% and 0.4% of teachers chose "bad" and "very bad," respectively. These findings are similar to those of the 2007 survey, wherein the percentages were 4.4%, 87.5%, 7.5%, and 0.6%, respectively.

The above numbers show that teachers think that cooperative and exploratory learning have been gradually accepted by students, and students participate more actively compared with three years ago. However, teachers still consider acceptance learning the students' main learning method. Moreover, teachers think that students could be better at exploratory and cooperative learning and need to engage in more interaction with teachers.

Overall, more than 75% of the students chose "listening carefully in class, making notes and doing exercises," "preparing before class and reviewing after class," and "discussing with classmates or asking teachers when having problems." Approximately 40% of the students chose "thinking independently when encountering

Table 8. Mathematical learning methods of students (Multiple choice) (%)

Learning methods	*Listening carefully in class, making notes and doing exercises*	*Preparing before class and reviewing after class*	*Discussing with classmates or asking teachers when having problems*	*Thinking independently when having problems*
Percentage	75.0%	78.9%	75.1%	42.6%

problems" as their learning method. Regarding preparation and review time, 87.6% of the students claimed to need half an hour to two hours, while 29.1% required less than half an hour, and 3.3% required more than two hours.

The above numbers show that students are becoming more adept at exploratory and cooperative learning. They are not restricted to traditional methods such as listening in class, making notes, and doing exercises, but have also adapted to preparing before class, reviewing after class, and independent thinking, which are the skills that the new mathematics curriculum intended to impart from the beginning (see table 8).

The students improved significantly in initiative learning, cooperative learning, and exploratory learning after implementation of the new curriculum, and teachers recognize this improvement. At the same time, teachers and students are positive toward acceptance learning. Mathematics teachers also think that the changing learning methods need to improve the students' ability to learn instead of merely following a certain structure.

Study Burdens of Students

When asked. "How do you feel about the burden in learning mathematics,?" 9.7% of the students replied with, "very heavy," 47.7% answered "heavy," 34.1% answered "OK," and 8.5% chose "easy." These findings show that more than half of the students consider mathematics is a heavy burden.

The survey uncovered a number of problems. Mathematics teachers often gave additional classes and exceeded the regular class schedule, with 45% of the students indicating that teachers continued teaching after class time was over or added an additional class if they did not finish the lesson in time. Students took a long time to finish mathematics homework, with 56.2% taking half an hour to one hour to finish homework and 9.9% taking more than one hour to do so. The weekly hours of mathematics classes are too many, with eight to nine or even more mathematics classes scheduled in a single week. Schools hold additional classes in the evening and on Saturday mornings. Grade 9 students sometimes had classes on Sundays.

These findings indicate that students think that mathematics schoolwork is very heavy, and that too much time is spent in mathematics class and on homework. Therefore, class schedule and time spent being taught in school are the main reasons that students consider mathematics a heavy burden.

Table 9. The types of mathematics homework teachers often assign (Multiple choice) (%)

Homework	*Written exercises*	*Reading the textbook*	*Hands-on activities*	*Reading extracurricular books*	*Social practice*
Percentage	95.7%	38.5%	62.6%	25.7%	22.2%

Views of Teachers and Students on Mathematics Homework

The types of mathematics homework that teachers often assign to students is illustrated in Table 9. "written exercises" is the first choice of teachers (95.7%), followed by "hands-on activities" (62.6%), "reading the textbook" (38.5%), "reading extracurricular books" (25.7%), and "social practice" (22.2%). Some changes were observed compared with the 2007 survey findings, wherein the percentages of "written exercises," "reading the textbook," "hands-on activities," "reading extracurricular books," and "social practice" were 92.1%, 43.7%, 36.0%, 24.2%, and 7.5%, respectively. "Written exercises" increased slightly, "reading the textbook" decreased slightly, "hands-on activities" increased 26.6%, and "social practice" increased 14.7%.

The survey given to students about the types of homework assigned by teachers show that 93.5% of the students selected "written exercises." The percentages for "reading the textbook," both "hands-on activities" and "social practice" are 27.7% and 39.9%, respectively. Compared with the findings of the 1997 report (wherein the percentages of "written exercises," "reading the textbook," both "hands-on activities" and " social practice" were 56%, 67%, and 18%, respectively), "written exercise" increased by 37.5%, both "hands-on activities" and "social practice" increased by 21.9%, and "reading the textbook" decreased by 39.3%.

The above numbers indicate that teachers have realized the importance of hands-on activities to students, and that social practice has also become widely acknowledged. However, teachers' preference for written exercises has increased significantly compared with the 1997 report (56%). This finding shows that the teachers' main concern remains students' ability to solve problems and tackle exams, which is consistent with earlier findings.

Views of Teachers and Students on Curriculum Evaluation

The basis for teaching evaluation When asked about "The primary criterion for schools to evaluate teachers' teaching," 96.1% of the teachers answered "students' exam marks" as the primary criterion, followed by "daily performance" (55.3%), "leader's assessment" (46.3%), "students' assessment" (28.8%), "parents' assessment" (18.3%), and "colleagues' assessment" (17.1%). In the 2007 survey, 66.8% of the teachers chose "students' exam marks" as the primary criterion. Thus, preference for "students' exam marks" as the main evaluation criterion increased by 30% from 2007.

Table 10. Student expectations of teachers' mathematics learning evaluation criteria (Multiple choice) (%)

Basis	*Exam marks*	*Learning enthusiasm and initiative*	*Diligence in study*	*Questions and thinking*	*Homework*
Percentage	54.9%	78.6%	52.7%	20.2%	41.2%

When asked about "the primary criterion for teachers to evaluate students," 89.1% of the teachers choose "exam marks," followed by "learning enthusiasm and initiative" (71.2%), "homework" (66.9%), "questions and thinking" (45.9%), and "diligence in study" (38.5%). In the 2007 survey, 43.2% of the teachers chose "exam marks" as the primary criterion. Therefore, the said finding increased by 45.9% from 2007.

The criteria by which students expected to be evaluated by teachers is shown in Table 10.

As seen above, 78.6% of the students expected teachers to evaluate their mathematics learning based on the former's "enthusiasm and initiative," followed by "exam marks," "diligence in study," "homework," and "questions and thinking."

In response to the question, "Whether teachers evaluate students' learning via practices such as observation, manufacturing, experiments, consulting data and social surveys," 75.6% of the students replied with "no," or "only one or two times."

The above findings show that the students' expectations of evaluation are very different from those of the teachers. Teachers are most concerned with exam marks, which relate closely to the basis of teachers' evaluations, and which explains why teachers pay so much attention to students' problem-solving abilities.

The Effects of the Existing Evaluation System on Teaching

When asked "Whether the conception of the new curriculum was reflected in the exams," 10.9% of the teachers chose "reflected," 68.0% chose "partially reflected," and 21.1% chose "does not reflect."

When asked "Whether the current county-, district-, and school-level evaluation systems for teachers and students are helpful to the implementation of the new mathematics curriculum," 15.2% of the teachers chose "helpful," 63.7% chose "not helpful," and 21.1% chose "not sure." These findings are similar to those of the 2007 survey, wherein the three percentages were 9.1%, 68.3%, and 22.6%, respectively. The current findings show that teachers do not agree with the current evaluation system.

When asked whether "High exam marks represent successful teaching," 2.4% of the teachers replied, "totally agree," 39.6% replied, "agree," and 58% replied with "disagree." In the 2007 survey, only 16.7% of the teachers replied with "agree." These findings once again indicate that more teachers tend to place great significance on exam marks.

When asked "Whether the multiple evaluation system of the new mathematics curriculum can be realized," only 3.9% of the teachers chose "totally realize," whereas 76.9% chose "partially realize," and 19.2% chose "too ideal to realize." These findings are similar to those of the 2007 survey, wherein the percentages were 3.4%, 75.5%, and 21.2%, respectively). The current findings show that most mathematics teachers are not optimistic of the multiple evaluation system.

In summary, teachers have realized that evaluating students' mathematics learning based on exam marks only is incorrect. They also clearly understand the malpractice of evaluating teachers' teaching and students' learning using only exam marks. Mathematics teachers think that no significant changes occurred in the evaluation system after the new mathematics curriculum was implemented, and that this non-progress has become a great obstacle to the realization of the multiple evaluation system proposed by the new mathematics curriculum.

Utilization of Evaluation by Teachers and Feelings of Students

This survey shows that 45% of the students claimed that "teachers often or always announce exam marks in class," and that 47.5% of the students believe that "teachers often or always rank students in order of exam marks." These numbers decreased slightly compared with the 1997 report (wherein these two percentages were 60% and over 50%, respectively). The current findings show that teachers have made changes in terms of announcing exam marks in class and ranking students in order of exam marks since the new mathematics curriculum was implemented. However, nearly 50% of the teachers did not change at all. This result may be related to the fact that teachers prefer exam marks as basis on which to evaluate students.

In addition, the current survey shows that 88.3% of the students were nervous about, afraid of, or hate teachers announcing exam marks in class and ranking them by exam marks; only 11.7% of the students agreed with the practice. Compared with the 1997 report (wherein 70% of the students felt nervous about, afraid of, or hated exam marks being announced in public, and only a few students liked it), the percentage of "nervous, afraid or hate" increased. This finding indicates that the negative influence on students exerted by announcing exam marks in public and ranking by exam marks has increased.

The above findings show that mathematics teachers have certain motives regarding evaluation, because their teaching is mostly evaluated based on their students' exam marks. A number of mathematics teachers often announce the exam marks of students in class and rank students based on these marks. This practice has created more negative effects on students than ever. Fortunately, given the implementation of the new mathematics curriculum, mathematics teachers have accepted the conception of multiple evaluation, and the practice of announcing students' exam marks in class and ranking students by exam marks decreased by 10% to 20%, respectively.

CONCLUSIONS AND SUGGESTIONS

After comparing the 1997 report and the 2007 survey, the following conclusions were reached.

There is an increase in teachers using *The Standards* as a guide to daily teaching. They generally adopt the concepts of the new curriculum. However, some teachers have not completely understood *The Standards* and require in-depth training. Most students with experience in the new curriculum show their interest and confidence in mathematics, although some still consider mathematics boring and difficult to learn. Therefore, teachers and students in general have a positive attitude towards the new mathematics curriculum. With the implementation of the new curriculum, teachers have begun to initiate changes in teaching concepts and activities. However, the experiences of teachers and students regarding the new curriculum show that there is still a long way to go before the goals of the new curriculum are realized.

The new curriculum created positive changes in teaching activities. Teachers have gradually adapted to the new curriculum. Teaching focuses on the capability of knowledge and on solving problems. Different teaching methods, particularly cooperative learning, exploratory learning, and independent learning, are being used by teachers and acknowledged by students. Students participate more actively in the class, consult data, study with cooperation and communication, and start discussions with teachers. Students expect the teaching and learning to be more independent and cooperative. Teachers receive the most support and assistance from new curriculum training and from teaching and researching activities. Teachers expect more professional guidance from experts. Teachers also hope to improve students' capabilities in independent and cooperative learning, and to eventually improve their learning methods.

Positive changes have taken place in learning activities based on the new curriculum. Both teachers and students agree with independent learning and cooperative learning. However, acceptance learning still plays a dominant role in teaching practice. Students can actively participate in classroom activities, but are also under heavy learning burdens due to long hours of mathematics classes and homework. Teachers believe students are capable of more independent exploration and cooperative communication. Teachers pay more attention to the hands-on capacity of students, which was the second choice of teachers when assigning homework, next to written exercises.

Students' marks remain the primary tool for teachers to evaluate students and for schools to evaluate teachers. Teachers' evaluation of students is not only based on their practice, but students expect teachers to also evaluate them based on other factors such as enthusiasm, initiative, diligence, homework, and thinking. More teachers agreed with the idea that high marks represent successful teaching. Teachers utilize the evaluation by announcing exam marks in class and ranking students based on those marks, a practice that students mostly fear, hate, or are nervous about. Because of the influence of exam marks, teachers are not optimistic about the effects of the multiple evaluating systems implemented by the new curriculum. Teachers

have recognized errors in the current evaluation system, which have had negative effects on students. However, both teachers and students are willing to continue using exam marks for evaluation. The evaluation system of the new curriculum has not been widely implemented.

Based on the above, the researchers have found that the teachers' professionalism improve as they use multiple teaching methods and pay attention to the individual differences and concerns of students in order to cultivate their confidence, indicating initiative in teacher professional development. Simultaneously, students have positive mathematic learning attitude and high learning interest; they accept independent and cooperative learning. Hence, they have become sure in their individuality and their creativity has begun to flourish. However, there is a lack of guidance for professional teacher development, the means of evaluation remains single and not multiple, students lack exploratory experiences, and there remains heavy learning pressure on students. These problems need to be addressed in the future.

First, the new curriculum should offer more training classes for teachers, and teaching can be improved through school-based teaching and research with professional guidance. Studies have shown that training classes in the new curriculum and school-based teaching and research can provide important support and assistance in teaching the new curriculum. A number of teachers lack in-depth understanding of the new curriculum. Thus, the author suggests increasing the number of training classes for the new curriculum so that teachers would have opportunity to be trained. Teaching and research activities with the guidance of experts are also necessary. Mathematics education experts need to carry out targeted training in daily teaching and research. Proper training would help teachers understand and use *The Standards* and the new curriculum, correctly comprehend their conception, increase their confidence in implementing them, and generally improve teaching practice.

Second, teachers should utilize different teaching methods to pique students' interest in actively participating in mathematics learning. This survey discovered that although teaching methods such as cooperation, communication, independence, and exploration are being used in teaching, teachers still believe that acceptance learning plays the dominant role in practice. Most of the students rarely or never had the opportunity to express personal opinions that differed from those of the teacher. Therefore, the author believes teaching in most mainland China mathematics classes is still done through lectures. Students are not considered the subjects in the class. There are too many students per class and they rarely have the opportunity to express their different ideas and communicate with teachers. It is necessary for teachers to allow students to express their understanding of mathematics and communicate with teachers by using multiple teaching methods such as lectures, discussions, dialogues, and group work. At the same time, it is also necessary for teachers to help students with different individualities experience a great number of mathematical activities through multiple teaching methods.

Third, a multi-resource curriculum platform should be built for students to facilitate cooperative communication, mathematics exploration, and individual development. The survey showed that students could be better at independent learning, cooperative communication, and exploratory learning, especially students that lack exploratory experiences. It is therefore necessary for schools to establish multi-resource curriculum platforms for students, particularly those involving communication of learning experience and informational resources.

The platform for communication of learning experience aims to improve students' capabilities for independent learning, cooperation, and communication, and to develop their individualities to learn mathematics. Opportunities need to be created for students to cooperate and communicate with each other during teaching or extracurricular activities. For example, group study should be encouraged to make independent learning, cooperation, and communication possible. In addition, different channels are needed to foster communication among students as well as between students and teachers. These channels can be established through free internet platforms such as email, QQ groups, and BLOGs, or via class and study group websites. Mathematics communication between schools would also help students communicate with peers in different schools in the community, city, and country, and help them to exchange and share experiences in learning mathematics.

The platform of informational resources aims to create opportunities for students to learn mathematics and develop individuality in learning mathematics. In mainland China, the limited application of information technology, as well as poor informational curriculum resources, have restricted most teachers to using multimedia devices to display only mathematics graphs and formulas. The exploratory and individual learning functions in mathematics for various informational devices and mathematics software such as Geometric Drawing Board and MATHEMATICS have yet to be developed. The development of this software would be of great help to the exploratory and individual experiences of students in learning mathematics, and needs to be considered as a very important factor in establishing platforms of informational resources.

Finally, it is necessary to develop a practical multiple evaluation system. The survey showed that students' exam marks are the schools' primary basis for evaluating teachers' teaching and teachers' primary basis for evaluating students' learning. The multiple evaluation system endorsed by the new curriculum has not been implemented. Teachers often announce exam marks in class, making students nervous, afraid, or even sick**.** There has yet been no decision on how to conduct multiple evaluations, such as oral tests, activity reports, and portfolios. *The Standards* for evaluation have not been prepared, causing difficulties for schools and teachers during its application. It has to be noted that evaluation by exam marks continues to grow and poses challenges to the new evaluation system. Therefore, education authorities in mainland China should develop a feasible multiple evaluation program for the new curriculum in order to assist its implementation.

In general, 10 years after the implementation of the new mathematics curriculum, mathematics teachers have become more professional, teaching methods have

become diversified, student individuality continues to grow, teachers continue to work toward building students' confidence in learning mathematics, and teachers have become more professional in their initiatives. For their part, students have become more active and more interested in mathematics. They are also gradually adapting to exploratory learning and cooperative learning. Students are considered the subjects in class and their creativity is encouraged. However, a number of problems have to be corrected. For instance, there is insufficient professional guidance regarding the professionalization of teachers. Evaluation methods for teaching and learning are too simple. Students lack experience in exploratory learning, and suffer heavy study burdens. Therefore, the authors propose that additional guidance from professional experts is needed to improve the professionalization of teachers. In teaching the new curriculum, closure problems need to be reduced and open problems need to be increased in order to transform learning and teaching methods into independent, cooperative, and exploratory methods, and also to make multiple evaluation possible.

REFERENCES

Basic Education Curriculum Panel of Chinese Ministry. (1997). Survey report on implementation status of 9 years compulsory education curriculum project. *Internal Data of Basic Education Ministry.*

Cai, J., Ni, Y., & Frank, K. L. (2011). Curricular effect on the teaching and learning of mathematics: Findings from two longitudinal studies in China and the United States. *International Journal of Educational Research*, *2*, 63–64

Cai, J., & Ni, Y. (2011). Investigating curricular effect on the teaching and learning of mathematics in a cultural context: Theoretical and methodological considerations. *International Journal of Educational Research*, *50*, 65–70

Chang, G. L. (2005). New mathematics curriculum reformation brings the realistic challenges which mathematics teachers have to confront. *Journal of Mathematics Education*, *2*, 41–43.

Correa, C. A., Perry, M., Linda, M. S., Kevin, F. M., & Ge, F. (2008). Connected and culturally embedded beliefs: Chinese and US teachers talk about how their students best learn mathematics. *Teaching and Teacher Education*, *24*, 140–153

Dai, L., & Lv, T. (2003). Considerations on the practise of mathematics curriculum reformation. *Journal of Mathematics Education*, *4*, 36–39.

Gong, Z., & Li, Z. (2005). Mathematics teachers' adaptability of the conception to the new curriculum. *Journal of Mathematics Education*, *36*, 7–71.

Gong, Y. (2008). On the implementation of the new junior high school math teaching material. *Journal of Mathematics Education*, *3*, 91–93.

Huang, M., & Long, W. (2008). On new curriculum adaptive problems and solutions of mathematics teachers. *Journal of Mathematics Education*, *3*, 95–97.

J, M., & Xie, H. (2005). Effect of attribution analysis on junior middle school teachers in teaching new mathematics courses. *Journal of Mathematics Education*, *2*, 64–67.

Liu, J., & Sun, X. (2002). *Mathematics curriculum standard interpretation (Experimental Version)*. Beijing: Beijing Normal University Press.

Liu, Q. (2004). According to the new math course standard — a talk on the roles of a teacher in teaching practice . *Journal of Mathematics Education*, *2*, 30–31.

Li, J. (2005). *Research on the adaptability of full-time obligatory education mathematics curriculum standards*. Chongqing: Southwest Normal University.

Lv,S., & Guo, X. (2008). Survey on the new mathematics curriculum implementation of 7–9 grade in Gansu province . *Journal of Mathematics Education*, *17*(5),31–35.

Luo, H., Chang, G., & Fan, L. (2008). Appreciation on education reform mathematics curriculum review. *Journal of Mathematics Education*, *3*, 23–26.

Li, Y. (2008). *Strategy*, *effect and problem of implementation of the mathematics curriculum at the stage of compulsory education*. Jilin: Northeast Normal University.
Li, Y., Zhang, J., & Ma, T. (2009). Approaches and practices in developing school mathematics textbooks in China. *ZDM*, *6*, 733–748
Li, Y. (2007). Examining and understanding mathematics classroom instruction and possible contributing factors through a cross-national lens. *School Science and Mathematics*, *8*, 308–310
Liu, C., Zhang, L., Luo, R., Rozelleb & Loyalka.(2010). The effect of primary school mergers on academic performance of students in rural China. *International Journal of Educational Development*, *30*, 570–585.
Ministry of Education of the People's Republic of China. (2001). *Full-time obligatory education mathematics curriculum standards (Experimental Version)*. Beijing: Beijing Normal University Press.
Ni, Y., Qiong L., Li, X., & Zhang, Z. (2011). Influence of curriculum reform: An analysis of student mathematics achievement in Mainland China. *International Journal of Educational Research*, *50*, 100–116.
Sun, X. (2003). Several issues of thinking on the implementation status of new mathematics curriculum. *Mathematics Bulletin*, *12*, 9–12.
Sun, M., & Wen, J.(2004). Problem and strategy on cooperative learning in implementation of new mathematical curriculum. *Journal of Mathematics Education*, *4*, 49–52.
Wang, J., & Lin, E. (2009). A meta-analysis of comparative studies on Chinese and US students' mathematics performance: Implications for mathematics education reform and research. *Educational Research Review*, *4*, 177–195
Xu, Y. (2002). *A study on the inquiring teaching in implication of new mathematical curriculum in Junior high school*. Chongqing: Southwest Normal University.
Xu, B. (2010). Research on mathematics education in china in the last decade: A review of journal articles. *Front. Educ China*, *5*(1), 130–155.
Xu, Z. (2010). The reality research on the students' development from grade 7 to 9 in countryside pro moted by the mathematics new curriculum. Lanzhou: Northwest Normal University.
Yi, H., & Li, Z. (2004). An analysis of factors influencing implementation of the basic education's new curriculum: A case study from Beibei District, Chongqing City. *Journal of Nanjing Normal University (Social Science Education)*, *2*, 62–70.
Yang, H., & Yu, P. (2008). Investigation on the secondary school new mathematics curriculum implementation—take Shanxi province as an example. *Educational Theory and Practice*, *8*, 25–27.
Yun, P., Ma, C., Lam, N., & Wong. (2006). Chinese primary school mathematics teachers working in a centralised curriculum system: a case study of two primary schools in North East China. *Compare*, *2*, 197–212.
Zhang, X. (2008). On reflection of adaptability in the implementation of new mathematics curriculum in rural area. Chongqing: Southwest University.
Zhou, C., Bao, J. (2009). A survey on mathematical proofs among teachers. *Frontiers of Education in China*, *4*, 490–505.

AFFILIATIONS

Lv Shihu
Ye Beibei
Cao Chunyan
Education Science College
Northwest Normal University
Mainland, *China*