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ABSTRACT

This paper offers a brief description of the Taiwanese elementary school system. It also outlines the current teacher training system, emphasizing the differences between the old "Normal Education Art" and the new "Teacher Education Art". One section describes the three major reforms that Taiwan's mathematics curriculum has undergone in the last three decades. Another section proposes two approaches aimed at assisting teachers in effectively dealing with reforms in mathematics education, and describes the effect of these reforms on teacher development. The paper states that developing cases of teaching was found to be a rich vehicle through which to facilitate teachers' reflective thinking. In addition, cases of teaching can serve as prototypes for developing essential knowledge about teaching events and can be used as precedents to provide occasions to practice analysis. Analyzing children's solution patterns contributes to a better understanding of their thinking. Furthermore, group discussion provides a forum for debate and reflections. Social interactions, cognitive conflicts, and reflections upon research are catalysts for developing teachers' knowledge. The sharing of beliefs and experiences among teachers on a collaborative team serves teaching practice and supports change in teachers' beliefs and conceptualization of mathematics teaching and learning. (Contains 13 references.) (ASK)

PROFESSIONAL DEVELOPMENT FOR ELEMENTARY MATHEMATICS TEACHERS IN TAIWAN

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INTRODUCTION

The success of curriculum relies heavily on teachers' professional knowledge and skills. In turn, the knowledge and skills teachers' require to implement curricular materials relies on the assistance of curriculum innovators and researchers. This paper describes two approaches taken to assist classroom teachers in implementing the standards-oriented curricular materials in Taiwan's 1993 mathematics curriculum reform. In addition, this paper illustrates the effects of these two approaches on teachers' professional growth and classroom teaching practice.

In response to societal pressures and drastic changes in the educational conditions, Taiwan's Ministry of Education completely overhauled the nearly twenty year-old "Normal Education Act" and enacted the new "Teacher Education Act" in 1994. The implementation of this new act represents an important milestone in Taiwan's teacher education system. The first section offers a brief description of the Taiwanese elementary school system. From here, the second section outlines the current teacher training system, emphasizing the differences between the old "Normal Education Act"and the new "Teacher Education Act".

The third section describes the three major reforms that Taiwan's mathematics

curriculum has undergone in the last three decades. These reforms include the Curriculum Standards for Elementary Mathematic issued in 1968, which was revised and re-issued in 1993, and the upcoming reform, called the Nine Year Curriculum Integration which was issued in 1998 and scheduled to be implemented in 2001. The two current stages of Taiwan's curricular reforms in mathematics and how these reforms translate into expectation for in-service teachers are discussed in detail.

Finally, the fourth section proposes two approaches aimed at assisting teachers in effectively dealing with reforms in mathematics education and describes the effect of these reforms on teacher development. An important characteristic of the first approach, termed the "curriculum investigation approach", is teachers were better able to understand the scope and the sequence by directly investigating curriculum in the year-by-year field testing of the standards-oriented curriculum materials. As a consequence, teachers who investigated the curriculum gained a better understanding of the contents of each grade's curriculum materials. With the support of the writing curriculum team, teachers became more familiar with the meaning of learner-centered approach and gained an advanced recognition of the philosophy, psychology, and education sociology underpinning the 1993 version.

The second approach, the school-based professional development approach, was investigated in terms of teacher development by the author of this paper. This teacher professional development program, which utilized a collaborative action-oriented approach was designed to promote the rethinking of teaching practices in light of the 1993 version of curriculum standards while, at the same time, fostering an understanding of children's learning (Lin, 1999). The philosophy behind this approach, the methodology, and the influences on teachers' conceptualizations are listed in the final section.

THE SCHOOL SYSTEM IN TAIWAN

With a population of more than 21 million, Taiwan has roughly 2 millions children aged from 6 to 12 in more than two thousands elementary schools. These schools are staffed by more than 90 thousand teachers and administrators. Taiwan's population is heavily concentrated in urban areas and, as a result, class sizes in city schools average around 50 students and those in suburban areas average around 35.

The school system in Taiwan is 6-3-3-4, as in the United States. Education is compulsory from elementary school through junior high school (from ages 6 to 15). Recently, however, the Ministry of Education has expanded this range to include 5 to 16.

Taiwan's highly centralized education system remained unchanged until the curriculum was revised in 1998. Prior to this version, the national curriculum standards outlined by the Ministry of Education dictates the names of courses to be offered from grades one to twelve, the contents of these courses, as well as the numbers of class sessions per week. The courses offered in Taiwan's elementary schools are Mandarin, mathematics, science, social study, ethic and health, music, art, and physical education. The proportions of class sessions per week in mathematics in grade 1-2, grade 3-4, and grade 5-6 are 3/26, 4/33, and 6/35 respectively. Class sessions are 40 minutes in length.

Since the re-enacted "Nine-Year Curriculum Integration" was outlined by the Ministry of Education in 1998, national curriculum standards have been decentralized. Currently, the "Nine-Year Curriculum Integration" headlines Taiwan's educational innovations, though it has yet to be implemented in schools. When implemented, courses offered in elementary and junior high schools will be shifted from

subject-oriented to area-oriented. The seven learning areas will include 1) language, consisting of Mandarin and English, 2) mathematics, 3) science and technology, 4) social study, 5) health and physical education, 6) art, and 7) combined activities.

Elementary school teachers average 25 teaching sessions per week. Two thirds of teachers are responsible for teaching all areas to their class. The other one third specialize in courses like art, music, or science, and teach their course to different classes. This means two thirds of elementary school teachers teach mathematics to her or his own class.

The school week in Taiwan is from Monday morning to Friday afternoon. On the even weekends of each month, the week continues through Saturday. Wednesday afternoons off while their teachers attend in-service training. Each day includes seven class sessions: four in the morning and three in the afternoon. Classes are in session from 7:30 to 4:00 and the first hour of each day functions as a morning pre-session time in which students are educated in ethics and assignments are checked.

THE TRAINING SYSTEM FOR PROSPECTIVE TEACHERS IN TAIWAN

In a reaction to societal pressures and drastic changes in the educational conditions in Taiwan, the Ministry of Education has completely overhauled the nearly twenty-year old "Normal Education Act" and enacted the new "Teacher Education Act" in 1994. The implementation of the "Teacher Education Act" has greatly impacted the examination and qualification process for prospective teachers, representing an important milestone for Taiwan's teacher education system.

Differences between the old "Normal Education Act" and the new "Teacher Education Act" include four major changes. The first change regards training. The old

"Normal Education Act" stipulates that prospective high school teachers must be trained only by normal universities while elementary school teachers must be trained only by teachers' college. However, under the new "Teacher Education Act", both high school and elementary school teachers can be trained by universities with teacher education programs. This is in addition to those programs already existing in Normal universities. The second change impacts tuition payment. The tuition fee for prospective teachers has changed from completely free to self-pay. Free tuition and scholarship are still, however, available to qualified students. The third change addresses teacher certification. To be a qualified teacher under the old "Normal Education Act", one must be a Normal university graduate with one-year teaching practicum. After graduation, teachers are only required to register with the local bureau of education without further examination. However, the new "Teacher Education Act" required two phases of certifications. For the First phase, to become eligible to be a student teacher, one must complete the courses required by university teacher education programs. For the second phase, after one year of student teaching, the prospective teacher must pass a qualifying examination. Finally, the new "Teacher Education Act" emphasizes teachers' processional development and educational studies, which were completely ignored by the old "Normal Education Act".

Currently, teachers' training programs for prospective elementary school and high school teachers remain separate. High school teachers are trained by three national Normal universities and universities with high school teacher education programs, while elementary school teachers are trained in ten national teachers' colleges and universities with elementary school teacher education programs. To qualify as a high school or elementary school teacher, one must complete at least 26 credits for high school and 40 credits for elementary educational program in professional education subjects. Of the 40 credits required for elementary education

are credits are compulsory and 20 are elective credits offered by individual university. The subjects of the 20 compulsory credits consist of 1) basic teaching courses such as music and calligraphy; 2) basic education courses such as educational philosophy and educational psychology; 3) educational methodology such as educational statistics and research methods and, 4) practice teaching courses, including the pedagogy of various subjects. A breakdown of the total credits according the subject for elementary and high school teachers is provided in Table 1.

Table 1 Credits and Subjects for Elementary and High School Teachers

Courses and Credits	**Elementary School Teachers**	**High School Teachers**
General Subjects	28	28
Teaching Subjects	80	80
Professional Education Subjects	40	26
Options	--	20
Total Credits required	148	154

EXPECTATIONS FOR TEACHERS UNDER VARIOUS MATHEMATICS CURRICULUM REFORMS

(1) Two Former significant Curriculum Reforms

The official unified mathematics textbook has been used by elementary schools all over Taiwan since the "Curriculum Standards for Elementary Mathematics" was issued by the Ministry of Education of Taiwan in 1968. The newly revised "Curriculum Standards for Elementary Mathematics", issued in 1993, privatized textbook publishing. The official unified textbook used for the nearly three preceding

decades was replaced by the newly "approved textbook", examined and approved by review committees from the Ministry of Education. The government of Taiwan has put considerable effort into the design of curriculum, textbooks, and editing and reviewing on the newly revised "Curriculum Standards for Elementary Mathematics".

The philosophy underpinning the 1993 version of the mathematics curriculum reflects a constructivists' perspective. This perspective posits that knowledge should be constructed actively rather than passively. As such, mathematics classrooms are expected to encourage an atmosphere of student problem solving in which the teachers' role switched from a problem solver to a problem poser and the students' role switched from replicating teacher's solutions to problem solving on their own. For teachers in Taiwan, this means they face a complete paradigm shift.

This paper describes two approaches used in Taiwan to assist teachers overcoming the difficulties associated with the curriculum reforms in 1993. In addition, it describes the rationale behind utilizing these approaches and the effects on teachers' professional growth.

Some of the basic educational problems in Taiwan throughout the last 50 years include educational rigidity and idleness, gap between school and society, educational inequality, excessive focus on examinations, lack of versatility in teacher education, and inefficiency in utilizing educational resources.

(2) Upcoming Curriculum Reform

Due to these persisting problems, the government desperately needs to reform its educational system. As a step in this process, teachers will face another upcoming curricular reform only seven years after the previous reform in 1993. The upcoming curriculum reform called "Nine-Year Curriculum Integration" is scheduled to be implemented in 2001. The new curriculum will focus on three major areas: stressing basic ability as opposed to subject knowledge, integration of learning fields, and

designing of school based curriculum. The "Nine-Year Curriculum Integration" represents one of the largest educational reforms to date. Moreover, it represents not only a reform of curriculum, but also a reform of school culture, completely alternating the expectations placed on teachers.

Reform of school culture is the primary focus of the "Nine-Year Curriculum Integration". In decades past, teachers lacked active exploration and research, collective learning when faced with problems in teaching, and professional dialogues because school meetings were the affairs of administration. Under the "Nine-Year Curriculum Integration", curriculum reform and school culture will be actively oriented in terms of research and professional development.

One new expectation placed on elementary and high school teachers under the "Nine-Year Curriculum Integration" is the change their role from executioner of the official unified textbook to designer of school-based curriculum. Using the official unified textbook left teachers unable to design and develop curriculum. Most teachers began teaching with the textbook and teacher's guide from the beginning of each semester, following it lesson by lesson. Their focus was helping students pass one examination after another and, as a result, teachers seldom took the educational needs of individual students into account.

To effectively deal with the school-based curriculum design and development outlined in the "Nine-Year Curriculum Integration", teachers must rethink the content of curriculum, its organization, and the basic instructional approach to enhancing students' abilities. Traditionally, the teacher has played a passive role in this process. teacher education programs commonly consisted of short-term workshops and institutes. Speakers in these workshops usually offered theoretically oriented teaching material and teaching demonstrations that, unfortunately, did not fully address the needs of day-to-day teaching practice. As a result, teachers often did not benefit from

what these workshops and institutes intended to provide. Consequently, the results are doubtful (Pink, 1992). Moreover, teachers' participation in workshops tended to serve the purpose of gaining credits for attending rather than truly reinforcing professional growth.

If the implementation of the "Nine-Year Curriculum Integration" is to be effective, the meaning and means of professional development should not be restricted to such narrow conceptualization. Activities for professional development must be more than workshops or institutes. Instead, teachers must be given to learn to transform their thinking into actions and, in turn, reflect on these actions. Thus, the roles of a teacher must be a professional, an individual in the process of developing, a learner, and a researcher.

TWO APPROACHES AIMED AT ASSISTING TEACHERS IN ADJUSTING TO CURRICULUM REFORM

(1) School-Based Collaborative Curricular investigation approach

The success of any curricular reform relies heavily on teachers' professional knowledge and skills. In turn, the knowledge and skills teachers' require to implement curricular materials relies on the assistance of curricular innovators of. The innovators of mathematics curriculum consist of educators working in the Ministry of Education and local bureau of education as well as classroom teachers. The current mathematics curriculum reform is a good example. The prime innovators are both the members of the Mathematics Curriculum Research and Development team from the Taiwan Provincial Institute for Elementary School Teachers' In-service Education and the members of the curriculum writing committee for private textbook-publishing. The

authors from the curriculum development teams introduce the philosophy, rationale, framework, and instructional approach. Besides, the disseminators of mathematics curriculum reforms are the professors of teachers college, educators in local bureaus of education, local mathematics consults, school administrators, and classroom teachers.

School-based collaborative curriculum investigation is an effective approach to support and help teachers move toward the vision espoused by the standards and promoting teachers growth. Curriculum investigation helps clarify impediments and provide supportive structures to standards-based mathematics curriculum reform. It also assists teachers in understanding the tendency and content outlined in the curriculum documentation. As a result, they are more likely to accept shot-term workshops and institutes. This is one of the approaches aimed at helping teachers gain a better awareness and understanding of the 1993 version of national curriculum standards.

In Taiwan, field testing of curricular materials is usually conducted in one or two classes in each school which is involved in testing curricular materials. The field test discussed in this paper, however, involved each class of a particular school, which had 36 classes with six classes for each grade. The school discussed in this paper was one of 13 schools involved in testing the 1993 version of the curricular materials. At the beginning of the field testing, all six first grade classes used the drafted curricular materials. At that time, only materials for the first graders had been developed completely. The development of materials for the second graders was ongoing. In the second year, the all six second grade classes and new first grade classes used the drafted curricular materials. This pattern was repeated as the years progressed.

All third and fifth grade students are commonly rearranged and assigned a new

teacher. Each teacher teaches a class for a two-year cycle. As part of this cycle of teaching, teachers are divided into three categories: low grade teachers, middle grade teachers, and high grade teachers. Offering the opportunity for professional discourse for same grade teachers is an essential part of this approach to enhance teachers' knowledge.

The principal of the school also played a part in the curriculum investigation, serving as researcher and discussion facilitator. In addition, each teacher assumed the role of an observer in addition to their existing role as an instructor. Teachers observed two classes in the same grade every Tuesday afternoon, and then took part in pedagogical discourse sessions after school. Initially, the first grade teachers investigating questions about teaching and student learning, the pedagogical discourse sessions became a dynamic interaction between the teachers and the principal. In sharing their experiences, the second grade teachers, who had an additional year of experience with the curricular materials, assisted the new first grade teachers. In her research, Chung (1999) found that the degree of teachers' growth depends how many years they had investigated the field testing materials. She found that teachers using curricular materials for one or two years were not readily convinced of the feasibility of the leaner-centered approach and that teachers who had been investigating curricular materials for three or four years were more likely to be convinced its advantages.

There are two conditions that foster success under the curriculum investigation approach. First, the teachers who investigated the 1993 version of the standards-oriented curriculum were in an elementary school that was one of the thirteen schools which were given the offer of investigating the experimental curriculum materials to be experimented. Because they were selected to do this investigation they were also given financial support for their effort. the school was

settings presents opportunities for more reflection and awareness of classroom practice. The emphasis of Taiwan's mathematics curriculum reform has shifted from teacher-centered to student-centered (Ministry of Education of Taiwan, 1993).

The second approach reported in this paper is part of the findings of author's research on teacher development project founded by the agency of National Science of Council. This teacher professional development program taking collaborative action-oriented as an approach was designed to promote the rethinking of teaching practices in light of the 1993 version of curriculum standards documentation while, at the same time, fostering an understanding of children's learning (Lin, 1999). This approach adopts a social constructivist view, positing teachers' knowledge of mathematics pedagogy and children's thinking is constructed via dialogue within the professional community. As part of this approach, a collaborative mathematics professional development team, consisting of a professor from a teachers college and six teachers, was set up in an elementary school. This team designed three learning activities--observing mathematics classrooms, developing cases of teaching, and analyzing children's solution patterns--and provided them to teachers.

The collaborative team met once per week for three hours. The regular weekly meetings provided a social forum for professional dialogues and reflection and exploring conflicts. These meetings proved crucial in enabling teachers to develop a common vision. Also in these meetings, teachers planned together and reflected on specific issues. They negotiated alternative solutions and provided support to one another. Teachers learned how to use each task provided by the collaborative team through reflecting on teaching practices. Discussions were initiated by the teachers' professional dialogues, and were not imposed by the researcher.

Each teacher participating in the research was both an observer and was observed in her or his implementation of the 1993 version of curricular materials.

Teacher's conceptualization of mathematics teaching and learning was reflected in their classroom observation. Initially, instructors' physical behaviors, including facial expressions, volume, pace of speech, and use of space, were frequently reported on observation forms. Immediately after each teaching observation, participants were invited to share what they had observed. The researcher, who also participated as a peer, deliberately reported on observations of children's learning patterns from a cognitive perspective. The researcher provided an opportunity for participants to express additional concerns about the observations process by showing a transparency which listed the dimensions of an observation at the following meeting. Group sharing of observations provided an opportunity for the participants to learn from one another's concerns.

By doing classroom observations, these teachers have expanded their perspective. Teachers whose orientation was teacher-centered gradually turned the focus of their observations to students' thinking and strategies. They learn to be more aware of children's thinking and more tolerate their mistakes. They noticed that the children intrinsically possessed the ability to engaging in meaningful discourse. As a result, they gained confidence in dealing with discussions with their students whey they strayed from the topic.

In sum, we found that developing cases of teaching is a rich vehicle in facilitating teachers' reflective thinking. In addition, cases of teaching can serve as prototypes in developing essential knowledge about teaching events and can be used as precedents to provide occasions to practice analysis. Analyzing children's solution patterns contribute to a better understanding of their thinking. Furthermore, group discussion provides a forum for debate and reflections. Social interactions, cognitive conflicts, and reflections over research are catalysts for developing teachers' knowledge. The sharing of beliefs and experiences among teachers on a collaborative

team serves teaching practice and supports change in teachers' beliefs and conceptualizations of mathematics teaching and learning.

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