

## Prospective Elementary Teachers' Lesson Plans and Teaching<sup>1</sup>

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In this paper we deal with two questions:

- 1) How have prospective teachers reflected mathematics curriculum reform in their planning of mathematics lessons?
- 2) To what extent were the pre-service teachers able to be reflective about their planning of mathematics lessons?

From analyses of videotapes, field notes, discussions among the college students, we found four features in the prospective teachers' lesson plans and their teaching.

### 1. INTRODUCTION

Currently, proponents of mathematics education reform (the 7th curriculum) in South Korea are proposing the restructuring of classroom mathematics content and pedagogy to provide challenging curriculum and instructional standards for all students. In order to prepare prospective teachers for the challenges of mathematics reform, teacher education programs need to change the content and pedagogy of their courses. The purpose of this study is to design and practice a reform-oriented mathematics teacher education course and examine how prospective teachers who managed the course planned and reflected elementary mathematics lessons.

One of the most fundamental problems in education in Korea so far is that teaching-learning in the classroom are being carried out without considering each student's capacity, aptitude, and interests. Thus, the core of the 7th curriculum revision is the implementation of a "differentiated curriculum". The second direction of the new

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curriculum is a 30% reduction of mathematical content. Finally, one of the main points of the new curriculum will be the use of calculators and computers (Ahn, 2001; Park, 1997).

The 7th curriculum emphasizes vastly different ways of teaching and learning mathematics from those that have typically been seen and experienced in most mathematics classrooms. Consequently, reform-based teacher education programs often strive to educate pre-service teachers to teach in significantly different ways from those in which they perceive they were taught. In order to prepare prospective teachers for the challenges of mathematics reform, this study addressed the following questions:

1. How have prospective teachers reflect mathematics reform in their planning of mathematics lessons?
2. To what extent were the pre-service teachers able to be reflective about their planning of mathematics lessons?

A literature review was undertaken to determine the best method to answer the research questions. An open-ended questionnaire and other qualitative techniques were used to identify how the pre-service teachers created meaning about the teaching and learning of mathematics. Data were collected through course artifacts (reports, examinations, class work), semi-structured interviews, surveys, video tapes of teaching and whole class discussion after seeing the videotapes.

## 2. LESSON PLANS AND REFLECTION

This course is taken usually in students' junior year. All students who managed the course have learned theories of mathematics education in their sophomore year. The general nature of the course is such that students spend some time discussing the recommendations of the mathematics reform, planning and practicing mathematics lessons, reflect on their work, and apply it during their field experiences. By having a better understanding of pre-service teachers' experiences during the course and concurrent field experience, we want to have a deeper impact on pre-service teachers' views on teaching and learning mathematics.

### *2.1 Initial Reflecting and Discussing*

There is a body of research suggesting that elementary pre-service teachers do not possess a rich understanding of the mathematics they will be teaching (McNerney, 1994). Often, but not always, elementary pre-service teachers express low interest in or even dislike of mathematics. This attitude was identified in the open-ended questionnaire that we presented to the pre-service teachers ( $N = 102$ ), who were asked to write about their

perceptions of mathematical learning and instruction, their knowledge of the mathematics education reform, their memories of their mathematics classes and teachers, their hopes for elementary mathematics education in the first lecture. 89% of the students wrote about their low understanding and low confidence in mathematics learning although I did not ask about their achievements or abilities in mathematics. Many of them worried that they would have problems with teaching mathematics because of their low abilities or low interest in mathematics. 71% of them had developed a negative image of the new curriculum because they had heard that there is little support by the government for teachers to practice reform in their mathematics classes.

96% of them thought that the most difficult thing in teaching the new curriculum is the size of class they have to control because interaction and communication between teacher and individual students is the most crucial element of teaching principles. 67% of the students thought that getting the one correct answer are more important in the mathematics classroom than the reasoning or predicting in the process of problem solving. 68% of them viewed the teacher's role as carrying out goals dictated by a textbook, presenting examples, demonstrating procedures, checking assignments, etc. Most of them (94%) confessed that although they were able to perform mathematical algorithms in elementary school mathematics, they did not know and could not explain the principles. They felt the gap between the recommendations of reform and real situations, especially the presence of about forty children in one classroom, to be too big to fill. Thus what they needed was to build connections or find a balance between the two, although this is not simple.

## *2.2 Curriculum Analysis*

The analysis of the curriculum occurred on several levels. Students evaluated how mathematical ideas were embedded in problem contexts, examined what were the most important mathematical ideas in the content area or in the chapter, and investigated the differences between new approaches and what they had been taught.

The new curriculum consists of six content areas: numbers and operations; geometric figures; measurement; letters and expressions; patterns and functions; and probability and statistics. Each week students were assigned to read a particular content area or contents of specific classroom grades. In small groups, students analyzed and discussed their investigation, and presented their conclusions. Our classroom discussions centered around how they could reorganize or reconstruct the contents to facilitate students' inquiry into and understanding of, essential concepts and procedures.

## *2.3 Planning and Teaching*

Students were assigned to select a specific topic, write a lesson plan, and discuss it in small groups. In class time, the student who was designated as a representative of his group at the beginning of the class taught his lesson to peers. These presentations were videotaped to be used as students examined and discussed their own teaching actions. Technology, other manipulatives, and teaching materials were actively integrated into their lesson plans. Students were talking and listening to each other like children as learners during the presentation. They sounded happy. Often unique patterns of behaviors and planning emerged in their work. I found four significant features in their lesson plans or teaching activities.

### *2.3.1 Feature 1: Connecting Mathematics and Everyday Life*

The prospective teachers emphasized connecting mathematics and everyday life in their lesson plans. It was one of the reform ideas they considered most important to be reflected on lesson plans. For example, one group designed the following context and questions to teach calculation of time:

**Problem:** Minsu's mother started preparing for dinner at 6 o'clock by using her microwave oven as follows:

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- Thawed the meat for 1 minute and 45 seconds
  - Cooked the meat and ingredients for 3 minutes and 50 seconds
  - Stewed the eggs for 1 minute and 40 seconds
  - Warmed food for 50 seconds
  - Extra time for preparing for dinner was 15 minutes and 17 seconds.
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- 1) How long did it take to cook the meat?
- 2) When was she finished her preparing for dinner?
- 3) How long did it take to cook?
- 4) How longer did it take to cook the meat than stew the eggs?

### *2.3.2 Feature 2: Development of Mathematics Game*

The prospective teachers were interested in attraction of students' attention. They believed it to be very important to involve students in class. They tried to develop many mathematics games such as the following example about time:

1. Students were shown the famous movie in which the actor ran for a time, and were then asked to guess how long it took to do it. The one who guessed closest to the correct time was the winner.
2. Students played this game in small groups. They were asked to make a sandglass to be used to guess the time presented by the teacher. The group that guessed closest to the correct time was the winner.

### 2.3.3 Feature 3: Integrating mathematics and literature

The pre-service teachers thought elementary students loved funny stories. Thus they made a great deal of effort to alter famous stories to be used in mathematics class as follows:

Cinderella went to the palace. There were 53,647 people, and 34,232 of them were men. How many women were there? Another princess arrived with 3,543 maidservants. Then how many people couldn't find partners when they began to dance?

### 2.3.4 Feature 4: Use of Technology

Mathematics reform strongly endorses the use of technological tools in instruction. The prospective teachers tried to use pictures or resources, and useful software acquired from the Internet such as the following:

아래 그림과 같이 원을 그려서 오린 다음, 접었다가 다시 펴 보세요.



Figure 1. A picture from the Internet

## 2.4 Presentation of Related Theories

The prospective teachers were asked to write questions with their own answers about planning mathematics lessons, teaching, applied theories, and submit them three weeks before the end of this course. The author could feel their need and enthusiasm towards learning about learning and teaching mathematics from their reports. After the analysis of their reports, the author summarized Hiebert (1986) since many of the pre-service teachers expressed lack of understanding of this subject.

Second, we presented Freudenthal's theory that considered the problem situation in mathematics textbooks, of which the essential part is as follows:

In the textbook context each problem has one and only one solution: There is no access for reality, with its unsolvable and multiply solvable problems. The pupil is supposed to discover the pseudo-isomorphisms envisaged by the textbook author and to solve problems, which look as though they were tied to reality, by means of these pseudo-isomorphisms. (Freudenthal, 1991, p. 70)

Third, a few concepts presented by Brousseau (1997, pp. 25–27) like “the Topaz effect”, “the Jordan effect”, “matacognitive shift”, “the improper use of analogy” were presented. The pre-service teachers wish to deepen their understanding of this theory, learning and teaching mathematics in class. Fourth, the findings of Annice (2000) about

the use of technology in mathematics class were presented. The essential part of the findings is as follows:

Children were engaged in low-level activities, and the purpose of the tasks was lost. Many of the children were engaged in “drill-and-skill” activities that had little relevance to their mathematics learning. The computers had taken on the role of an electronic work sheet to keep children busy once they had completed other assigned mathematics tasks (Annice, 2000, p. 71).

### *2.5 Later Reflection*

Students were shown videotapes of their peers’ teaching for the last 3 weeks of the course and were asked to write their thoughts on the teaching. Some of their reports were used as a basis for whole class discussion. Most students were able to connect their lesson plans or teaching activities with presented theories.

According to their reports and discussions, they paid great attention to conceptual learning rather than the mastery of algorithm when they wrote lesson plans for the curriculum reform. But because of this they often spent a large amount of time in playing games or doing activities to help students’ conceptualization of the content, and were forced to conclude with too brief explanation.

They concentrated their attention on the use of “why” and “how” questions rather than “what” questions but did not consider what kind of understanding their particular questions promoted or how they could keep asking children to explore. Most students concluded in their reports that they need to balance attention between mathematics and children, concepts and procedures, activities and reflecting, making contexts and formulating, etc. One of the students wrote as follows:

I was one of those students who never really had a complete grasp of mathematics. Nevertheless, I was able to earn above average grades in mathematics all through my schooling. I achieved successes but I didn’t like math. My initial impression of mathematics reform was that everything was changed and I would have to go to a lot of trouble to meet the change. In particular, I thought I need lots of knowledge of instructional tools, I could not even teach mathematics without technology or manipulatives. Yes, those are helpful, but I found that I needed to be a constant learner and researcher.

Some students were interested in analysis of mathematics textbooks after they were presented Freudenthal’s theory. They got many similar examples with Freudenthal’s theory in the current mathematics textbook. Some pre-service teachers collected and presented evidence that elementary students have no interest in word problems, especially regarding everyday life, because it is not real to them. They had a large number of research questions about mathematics problem situation and considering everyday life in mathematics textbook or class. Their reports and questions made final discussion exciting and meaningful. At the end of the course one student said as follows:

As I look back on the course and the work I have done, I have mixed emotions. I have learned about the critical issues and confrontations in adopting the new curriculum. I have learned about planning, analyzing, and modifying mathematics lessons. I have learned about the area and perimeter of polygons, calculation with fractions and decimals, and mathematics. I have also learned about myself, and teaching elementary mathematics. At the beginning of this course, I didn't expect this personal growth as a prospective teacher.

The most important result is that the pre-service teachers feel renewed energy for their understanding of the teacher's role and their professional development in mathematics education. Most students said that they didn't even consider that they could examine the problem, address it, and remedy it in mathematics teaching.

## FINAL COMMENTS

The prospective teachers had practice for two weeks right after this course. I heard some of them spontaneously videotaped their student teaching and reviewed it in order to provide each other feedback on their instruction. They attempted to do reform-oriented instruction and examined what had occurred in class during their instruction. These experiences impacted the prospective teachers' professional development as well as their practice in field experiences.

There is a noticeable lack of empirical research on mathematics teacher education in Korea. The course described in this paper has many defects but it could give a chance to activate empirical research on pre-service teacher training. Collaborative works like small and large group planning, peer evaluations, reflections, and discussions were extremely important in this lecture.

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