

The First Curriculum of Mathematics in Korea for the New Millennium

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In the Republic of Korea, mathematics has always been a major blame for huge private expenditures on so-called "private education," which consists of private tutoring and lessons at "private academies of extra curricula." The private spending on out-of-school education often exceeded public expenditures on schools.

In 1997, South Korean Ministry of Education reformed curriculum of mathematics along with other subjects to ease the burden of private education. The aim of this curriculum change was to put a boost on individual students' interests, affections and other attributes toward school mathematics. The essential distinctiveness of the new curriculum of mathematics compared with the previous one is as follows:

1. The implementation of so-called "differentiated curriculum" for grades 1-10.
2. 30% reduction of contents in mathematics and the reconciliation of contents.
3. Elective subjects for mathematics for grades 11 and 12.
4. More uses of technology in mathematics teaching.

Firstly, we examine the background of the curriculum reform and analyze the new curriculum according to awareness of educational administrators, teaching environments of schools and readiness of mathematics teachers. Then we find out what kinds of problems it has and look for some suggestions for remedies.

Keywords: private education, differentiated curriculum, professionalism.

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1. INTRODUCTION

The study of mathematics involves accumulating ideas and successively building deeper and more refined understanding of the subject (*cf.* National Council of Teachers of Mathematics [NCTM] 2000, p. 16). Teachers must be able to build on their students' earlier mathematics learning and develop a broad set of new understandings and skills to

help their students meet more complicated upcoming. Therefore a curriculum should provide a course of actions that help teachers increase students' level of sophistication and depths of knowledge. A curriculum should be such guidelines so that teachers at each level know what contents the students have studied at previous levels and what is to be studied at successive levels as well as what contents have to be learned at present level.

Even though South Korea has changed the national curriculum seven times since its first establishment, an adhering problem of mathematics education in the 20th century was that teaching in mathematics classes were carried out without much care of individual student's preparedness, capability, aptitudes, and other attributes.

In South Korea, mathematics has always been a major blame for enormous private spending on so-called "private education", which consists of private tutoring and lessons at "private academies of extra curricula". Private education mainly started in 1950s after the Korean War and expanded very rapidly during the 1990s. The private spending on out-of-school education often exceeded public expenditures of schools. In 1996, Koreans spent 25 billion U. S. dollars (fully 150% of the government's educational budget) on private education outside the school system (J. Lee 1999). A national survey of 1997 showed that the average student of middle school (grades 7-9) had received about 10.3 hours per week of lessons outside the regular school system (Kim, Yang, Kim & Lee 2001, p. 50).

In 1995, the National Committee on Educational Reform recommended drastic changes on various aspects of the national education system to cope with such problems. In 1997, the Ministry of Education made an announcement of new national curriculum (so called the seventh amendment of curriculum, *i.e.*, nation's first curriculum for the new millennium) to ease the burden of private education.

The aim of the new mathematics curriculum is to give attention to each student's achievement in mathematics through helping students get the followings:

1. To understand basic concepts, procedures, principles and rules of mathematics through solving problems of everyday life in a rational manner,
2. To observe and analyze the phenomena of matters mathematically, and
3. To acquire interests, abilities, knowledge and skills of mathematics needed to think and reason mathematically.

Firstly, we examine the background of the curriculum reform and analyze the new curriculum according to awareness of educational administrators, teaching environments of schools and readiness of mathematics teachers. Then we find out what kinds of problems it has and look for some suggestions for remedies.

2. BRIEF HISTORY OF MATHEMATICS CURRICULA IN KOREA

To get a closer look for the background of the curriculum changes, it is worthwhile to examine the history of mathematics curricula of South Korea in the 20th century (*cf.* Choe 1969; 1997; 2001; Han Shick Park 1991; 1993; Woo 1993).

Before World War II, the entire Korean Peninsula was a colony of Japan. During the Japanese rule of the peninsula, the Korean schools were merely for elites.

Around 1920, the “Perry Movement” was introduced to Japan (Ueda 2000, p. 108). The textbook that gave shape to the thought of German mathematician Klein was translated and published by the Japanese Ministry of Education. This textbook with other publications had much influence on mathematics teachers at secondary school level. Before 1930s in Japan, despite of increasing interest in innovation of mathematics curriculum, the practical side of mathematics education was extremely dull.

Japan had changed the national curriculum and textbooks (from so called the “Black Covers” to the “Green Covers”) for the primary school (grades 1–6) during 1935–1940 by a grade a year. As continuation of the change for the primary school, the curriculum for the secondary school mathematics was developed. However, the new textbooks for secondary school mathematics were not published until the end of World War II.

In 1946 after the liberation from Japan, educational forerunners of South Korea laid the foundation for the nation’s educational system including the national curriculum. However, the first national curriculum of mathematics was nothing but a copy of the old Japanese one, which was also influenced by American progressivism (*cf.* Han Shick Park 1991; 1993).

The national curriculum of mathematics has been revised seven times since then (see Table 1). Hence the current curriculum is actually the eighth one.

In 1952, 1953 and 1954 (for a ten-month period each year) the United States Missions of Education came to South Korea to train mathematics teachers of the nation. South Korean Ministry of Education also made mathematics curriculum reform¹ that was influenced by American pragmatism, Dewey’s educational philosophy. There was reduction of the mathematical contents, which caused a decline of students’ achievement in mathematics.

¹ The mathematics curriculum reform was also based on that of Japan, *i.e.*, a real-life-centered curriculum. In 1946, the U. S. Mission of Education to Japan submitted a report that had many policies such as extension of the compulsory education and textbook screening system. In response, the Japanese Ministry of Education published the national curriculum. The notable change of mathematics education in Japan was to adopt the system of “Life-Unit Learning” based on empiricism (Ueda 2000, p. 108).

Table 1. Periods of National Curricula of Mathematics

Amendment	Period	Main Focus
0	1946 – 1954	Progressivism
1	1955 – 1962	Real-life-centered
2	1963 – 1972	Systematic-learning
3	1973 – 1981	“New Math”
4	1982 – 1988	Back to basic
5	1989 – 1994	More back to basic
6	1995 – 1999	Problem solving
7	2000 – Now	Differentiated curriculum

In 1963, the Ministry of Education changed mathematics curriculum again. The focus of the second amendment of mathematics curriculum was systematic-learning, which was based on essentialism² of German philosopher J. F. Herbart (*cf.* Jahnke 1990). The curriculum placed great value on the logical and theoretical aspects of mathematics, and pursued the improvement of students’ mathematical abilities.

During 1960s the “New Math” movement, which was influenced by Bourbaki’s structuralism, occurred in the United States (*cf.* Sekiguchi 2000) and the third change of mathematics curriculum was influenced by it, which was the result of a discipline-centered curriculum and the “modernization movement” of mathematics education. The theory of “discovery learning” (*cf.* Bruner 1995) was also considered fundamental in mathematics education. The curriculum attempted to introduce abstract but fundamental concepts (for example, manipulations of sets, algebraic laws, etc.) in early periods of school and to review these concepts continually through subsequent learning by relating, elaborating and extending them.

Kim et al. (1969; 1971) visited Japan³ and the United States to undertake a research

² The important epistemological feature of this trend was the transformation of mathematics into a conceptual system and the derived ideal of ‘conceptual thinking’. This ideal had a strong basis in the post-Kantian philosophy. Within post-Kantian philosophy, Herbart took a realistic position, strongly influenced by mathematical and physical ideas. Herbart’s philosophy was very important because of its affinity to the working philosophy of many mathematicians and scientists.

³ When the “New Math” movement was spreading in the world, the Mathematical Society of Japan and the Japan Society of Mathematical Education hosted the “SMSG Study Seminars” in Tokyo (August 25–29, 1964) and in Kyoto (August 31–September 4, 1964), inviting E. E. Moise and D. E. Richmond from SMSG, which had been actively working for the “New Math” in the United States. The purpose of the seminar was for Japanese mathematics educators to deepen their understanding of the “New Math.”

on curriculum and proposed a new curriculum reflecting the “New Math” movement. The mathematics textbooks of secondary school were patterned after American experimental textbooks like SMSG (School Mathematics Study Group) and UICSM (University of Illinois Committee on School Mathematics). But the new movement was not so well implemented in Korea because the contents of the textbook were too diverse to be adapted by the teachers⁴. Many mathematics educators worried that students’ basic computation skills were weakened by the structural approach.

The “back to basics” movement in the United States ignited the fourth amendment of mathematics curriculum in Korea, in which educational administrators reduced contents, lowered the level of difficulty and emphasized on mathematical activities and on affective aspects of learning of mathematics.

The fifth and the sixth amendments maintained the basic frame of the fourth amendment. The sixth amendment placed emphasis upon mathematical thinking ability, problem solving ability and the ability to use computers in mathematics (*cf.* K. Park 1997). However, many mathematics teachers in South Korea could not understand the need for these changes and did not agree with new curricula.

3. CHARACTERISTICS OF THE NEW CURRICULUM

In 1997, South Korean Ministry of Education announced the first curriculum for the new millennium (so-called the seventh amendment). One of the most important issues in the seventh amendment was to encourage the students’ activity.

The “differentiated curriculum” is the basic characteristic of the seventh amendment. The essential distinctions of the new curriculum are as follows:

1. The implementation of a “differentiated curriculum” for grades 1–10.
2. 30% reduction of mathematical contents and the reconciliation of contents.
3. Elective subjects for mathematics for grades 11 and 12.
4. More uses of technology in mathematics teaching.

South Korean government implemented the new curriculum of mathematics according to the following schedule, which is very artificial (see Table 2).

3.1. Reduction of Mathematical Contents

In Korea, as mentioned in introduction, mathematics has been one of the main blames

⁴ Matrices and basic notions of linear algebra added, but synthetic geometry (plane and solid) had been replaced by more of analytic geometry.

for enormous private expenditures on education. Also, many education administrators thought the level of difficulty in school mathematics in Korea is relatively higher than that in western countries, thus they expected that reducing the contents of school mathematics might ease the suffering related to private spending on education outside school. But not all the mathematics educators agreed with this.

Table 2. Implementation Schedule for New Curriculum

Schools	Academic Year				
	2000	2001	2002	2003	2004
Primary School	Grades 1 and 2	Grades 3 and 4	Grades 5 and 6		
Middle School		Grade 7	Grade 8	Grade 9	
High School			Grade 10	Grade 11	Grade 12

However, educational administrators have determined to carry out 30% reduction of mathematical contents (25% reduction of time allocation) despite of opposing opinions from mathematics educators. To prevent overlapping of contents in the curriculum and to pursue the consistency of education, distinctions of school system and grades (see Table 3) have been abolished even though the distinctions in terms of administration remains.

Table 3. The Layout of Mathematics Courses in New Curriculum

Schools	Grades	Periods	Mathematics Curriculum		
High School	12	Selective Education Period	Subject Selection Differentiated Curriculum		
	11				
	10				
Middle School	9	National Common Basic Education Period	Level Based Differentiated Curriculum (10 steps, each step has 2 sub-steps)		
	8				
	7				
Primary School	6				
	5				
	4				
	3				
	2				
	1				Each sub-step comprises: Basic course, Enrichment course, and Supplemental remedial class.

3.2. “Differentiated Curriculum” for Grades 1–10

The curriculum of twelve-year education of the primary and secondary schools has been divided into two periods:

- National Common Basic Educational Period (grades 1–10): 10 steps and each step with 2 stages (or sub-steps), and
- Subject Selection Educational Period (grades 11–12).

The curriculum of the National Common Basic Education Period is carried out in a stage-by-stage manner according to students’ development of cognitive domain (ability of understanding and application). The curriculum has been divided into two types depending on subjects:

“Level Based Differentiated Curriculum” (LBDC), and
 “Enrichment and Supplement Differentiated Curriculum” (ESDC)⁵.

LBDC is applied to subjects (*i.e.*, mathematics and English)⁶ where the contents are hierarchically structured and which seem to create severe individual differences among pupils in learning process. The contents of each stage were selected according to learning hierarchy and levels of sophistication.

At grades 1–10 (National Common Basic Educational Period), however, there is no difference of class size between LBDC and ESDC. In Korea, almost all (if it is not all) schools divide the classes by years of schooling (*i.e.*, grade), not by the ability of students. There are 20 stages (each step with 2 stages for 10 steps) in mathematics courses including 1a, 1b, 2a, 2b, ... , 10a and 10b. However, the first stage of each step is given only at the first semester (the spring semester, March to August) of the academic year and the second stage only at the second semester (the autumn semester, September to February). Hence those students who are a little ahead or a little behind do not have any alternative class. This is not a real differentiated education. Even more serious problem in this situation is that education administrators are not aware of the point at this setback.

Up to now, the most serious problem of mathematics education is that the mathematics classrooms in schools had been conducted without much concerning of learners’ ability to understand the contents, affective domain (interest, aptitude and attitude) and other attributes of the individual students. Mathematics teachers have been stubbornly adhered to the curricula, which were set by the Ministry of Education. Therefore mathematics

⁵ ESDC is applied to the subjects, which are composed of various contents, and are not presumed to cause serious individual differences among students. Such subjects are Korean Language and Literature, Social Studies, and Science.

⁶ Ironically, mathematics and English received most blame for enormous private expenditures on private education.

teaching at school has been criticized as being monotonous.

According to Woo (2003, p. 2), mathematical abilities of students in a class are so widely spread that only about $2/3$ of the students in primary schools (grades 1–6), about $1/2$ in middle schools (grades 7–9) and about $1/3$ in high schools (grades 10–12) understand the explanation given by teachers. Hence, teachers cannot take care of all students in classes. This phenomenon reveals that student in mathematics class, the higher students' grade the more divergent in students' level of understanding and their deficiencies are being accumulating as they grow up in school. As a result, the private education market is growing even more.

3.3. Reconciliation of Contents

Also, there has been a reconciliation of mathematics contents⁷. Previously, the names of contents for each school level were heterogeneous. There is an integration of six fields' names of contents:

1. Numbers and Operations,
2. Figures,
3. Measurement,
4. Probability and Statistics,
5. Expressions and Equations, and
6. Patterns and Functions

3.4. Elective Subjects for Grades 11 and 12

The curriculum for the Selective Education Period (grades 11–12) is named as "Subject Selection Differentiated Curriculum" (SSDC). Students in this curriculum period can choose their subject by themselves according to their needs, capacity, preparation, interest and other attributes. These subjects are

Practical Mathematics,
 Mathematics I,
 Mathematics II,
 Calculus,
 Probability/Statistics, and
 Discrete Mathematics.

Compared to the previous curriculum, the last three subjects are newly added. Among

⁷ NCTM (1989) also influenced the reconciliation of contents of the new curriculum. In NCTM (2000), however, the fields' names are slightly different. They are 1) number and operations, 2) algebra, 3) geometry, 4) measurement, and 5) data analysis and probability.

six subjects, Mathematics I, Mathematics II and Calculus are hierarchically ordered and can be taken after finishing the tenth step of LBDC. Students in grades 11–12 may take Practical Mathematics, Probability/Statistics and Discrete Mathematics regardless of completion of the tenth step of LBDC.

4. MISLEADING STUDENTS' ACHIEVEMENT

To understand mathematics and to have interest in mathematics through the study of mathematics as well as acquiring the ability to apply mathematics to real life might be fundamental longing for most students, teachers and parents alike. The achievement of mathematics (*cf.* Senuma 2000) contains what students attained through the study of mathematics, such as performance (cognitive domain) and attitude (affective domain).

According to the Third International Mathematics and Science Study (TIMSS: 1994–1995)⁸ with participation of 46 countries, South Korean students' performance came in the second place for grade 4 students and the third place for grade 8 students (*cf.* Beaton et al. 1996; Zhang, Leung & Wong 1998; J. Lee 1999; Mullins et al. 2000; K. Park 2001). Also in the Third International Mathematics and Science Study – Repeat (TIMSS-R: 1999) with participation of 38 countries, South Korean 8th grader attained even higher levels of mathematical performance than in the previous TIMSS. Recent scores (*cf.* K. Park 2002) of mathematical literacy in the first round (2000) of the Program for International Student Assessment (PISA), an international comparative study organized by OECD, showed that Korean grade 10 students ranked the second among 32 countries (28 OECD members and 4 nonmembers).

However, these results are misleading education administrators as well as many mathematics teachers. On the contrary to high scores in mathematical performance, Korean students expressed an extremely low level of interest in mathematics compared with their counterparts from other countries. Korean students came in the second to the last in students' interest level of mathematics among 28 OECD members. Korean students had also difficulties in explaining their thoughts logically in answers to open realistic problems and in justifying the answers. Low level of interest in mathematics is not only a problem for an individual student but also a dilemma of the whole nation.

Mathematics teachers of secondary schools are very popular because mathematics is one of critical subjects in the university entrance examination. However, teachers are just

⁸ IEA (International Association for the Evaluation of Educational Achievement) conducted FIMS (First International Mathematics Study) in 1964, SIMS (Second International Mathematics Study) in 1980, TIMSS (Third International Mathematics and Science Study) in 1991–1995 and TIMSS-R (Third International Mathematics and Science Study – Repeat) in 1998–1999. South Korea has participated only TIMSS and TIMSS-R.

looking for strategies to increase the number of students who get higher scores in the examinations such as the qualifying examination for university entrance.

If the teachers challenge the curiosity of their students by setting problems appropriate to the learners' knowledge and help them to solve their problems with stimulating questions, the teachers are giving students a taste of (and some means for) independent thinking (Polya 1985). In Korea, mathematics teachers (including private tutors and instructors of private academies) misused their opportunities by looking for tactics and forcing students to memorize formulas to make their students to get high scores in various examinations. One example of strategy to get high scores in examinations is to throw away very complicated problems and to drill students with routine problems. This kind of teaching practice has increased students' mathematical scores in various examinations but ruined students' affection in mathematics.

5. SHADOWY PRIVATE EDUCATION OF MATHEMATICS

In South Korea, as mentioned in previous sections, many students are receiving so-called "private education" outside the regular school system. Mathematics has been one of the main blames for huge private expenditures on private education.

In 2000, the average student of Pre K–Grade 12 (*cf.* Kim, Yang, Kim & Lee 2001) spent 1,335,000 won (approximately 1,200 U. S. dollars) per year on private education⁹. According to the survey done by KEDI (*cf.* K. Park 2001, p. 129), there is some difference in the demand and provision of private education between the large cities and the small cities due to economic and other reasons (see Table 4).

Major causes of the overheated private education were considered to be the social values inducing overheated eagerness of learning and the university entrance examination system. The university entrance examination induced excessive competition in education. The private education is also caused by unsuccessful operation of the educational system in school.

The TIMSS-R (*cf.* Kim, Yoo, Seo, Lee & Imm 1999, p. 57) results indicated that there were significant discrepancies in the levels of student performance among different regions in Korea. Many factors may be used to explain the discrepancies in performance between different regions. Given the fact that school education is provided in more or

⁹ Kim, Yang, Kim & Lee (2001, p. 38) estimated 7.1 trillion won (approximately 6 billion U. S. dollars) for whole nation's expenditure for lessons out of the regular school system in year 2000. Before 1995 private tutoring was more popular than lessons from private academies of extra curricula. Now it has tendency of transition from private tutoring to lessons from private academies of extra curricula.

less the same manner regardless of region, the low performance among students in small cities may be due to relatively lower opportunities for private education in such areas (K. Park 2001, p. 129). This phenomenon reveals that those students who received more private education get higher scores so the situation becomes more severe resulting even bigger market for private education.

Table 4. TIMMS-R score vs. private education by regions in Korea

Regions	TIMMS-R (Mathematics) Converted average scores Maximum 100 pts	Percentages of students receiving private education
Seoul	77.68 pts	65.9%
6 metropolitan cities		59.9%
Mid-size cities	76.30 pts	57.3%
Small cities	70.08 pts	
Rural areas	N/A	46.4%

Source: S. Kim et al. (1999), p. 57 and Y. C. Kim et al. (2001), p. 46

Because private education just gives them a skill or technique to solve problems rather than helping students achieving more thorough understanding in mathematics, it has obstructed students' intellectual development in mathematics. Due to undesirable direction of students' development as reflected in their dependent learning attitudes, students are also building habits that are relying too much on teachers.

6. PROFESSIONALISM OF TEACHERS OF MATHEMATICS

Teachers stand at the center of any education system, since everything rests on their skills and energy. Knowledgeable teachers have adequate resources to support their work. Imagine that all mathematics teachers continue to learn new mathematics contents and stay current on education research.

The factors that have an effect on teaching performance vary widely. And it includes how teachers are affected by the system in which they operate, how they perceive the students they teach, how they plan for teaching, how they assess difficulties, how they view knowledge, how they relate to their professional community, and how they respond to curriculum change (Watson 2001)¹⁰.

¹⁰ Although it was reassuring to find a strong correspondence between teachers' assumptions about their students' responses and actual student responses, there is a need for professional development to increase not only teachers' knowledge of the content but also their appreciation of how their

Questions regarding teaching quality, teaching effectiveness, and teacher recruitment (and retention) have particularly significant importance in mathematics as we are in the century that is even more dependent on science and technology. However, a supply of qualified teachers is somewhat limited because the good students in mathematics do not want to take teaching professional for their future.

Regarding teaching quality and teaching effectiveness, Hart (1993) found that although children at the age of seven were not poor at mathematics, by the time of the children were nine years old they felt they had been poor at mathematics and they certainly did not like the subject. She thought teachers who had no discernible qualifications in mathematics caused this phenomenon.

Ma (1999) suggested that teachers' subject matter knowledge of mathematics might contribute to a classroom mathematics tradition and its alteration. A "taken-to-be-shared mathematical understanding" that marks a classroom tradition cannot be independent from the mathematical knowledge of people in the classroom, especially that of the teacher who is in charge of the teaching process.

Institutions of higher learning should work together with schools to do research on mathematics education and to improve teacher preparation and professional development. CBMS (2001, p. 8) recommended that mathematics courses for prospective teachers should develop the habits of mind of mathematical thinker and demonstrate flexible, interactive styles of teaching, along with building mathematical knowledge. Mathematics is not only about numbers and shapes, but also about patterns of all types. In searching for patterns, mathematical thinkers look for attributes like linearity, periodicity, continuity, randomness and symmetry. They take actions such as representing, experimenting, modeling, classifying, visualizing, computing and proving. Prospective teachers need to learn to ask good mathematical questions as well as to find solutions and to look at multiple points of view. Most of all, prospective teachers need to learn how to learn mathematics.

Middle grades (grades 5–8) curricula are even more demanding; for example the structure of rational numbers and the ideas of proportionality require even more knowledge of teachers. CBMS (2001, p. 11) recommended that, mathematics in middle grades (grades 5–8) should be taught by mathematics specialists. Middle grades mathematics teachers must know the foundation that is being laid for it in their instruction.

students learn that content. Efforts were made to establish teacher professionalism on the educational agenda as curriculum reform was increasing the complexity of the teacher's task. For mathematics this began in the United States with NCTM (1989), which was followed by similar document in other countries, including Australia (*e.g.*, Australian Education Council [AEC] 1991; 1994). These documents proposed changes in process as well as content and spawned several professional development projects to aid teachers in adapting to the new curriculum (*e.g.*, Watson, 1998).

Having mathematical specialists, beginning in the middle grades, both reduces the educational burden for those teaching mathematics in these grades and provides opportunities for prospective teachers of these grades who like mathematics to specialize in it.

Achieving the aim of mathematics education described in curricula requires competent and knowledgeable teachers who can integrate instruction with assessment, classrooms with ready access to technology, and a commitment to both educational equity¹¹ and excellence (*cf.* NCTM 2000, p. 3). The classroom environment must be equitable, challenging, and technologically equipped for the twenty-first century.

7. INFRASTRUCTURES FOR THE NEW CURRICULUM

Technology not only influences how mathematics is taught and learned but also affects what is taught and when a topic appears in the curriculum (*cf.* NCTM 200, p. 26). Technology also diminishes some of the artificial separations among topics in algebra, geometry, and data analysis by allowing students to use ideas from one area of mathematics to better understand another area of mathematics.

The infrastructure for mathematics teaching and learning is very inferior in Korea. In South Korea, secondary school mathematics teachers do not have their own teaching rooms with ready access to technology and other audio-visual equipments.

Jeong (2001) claimed that the “differentiated” curriculum of South Korea is very similar to the British curriculum. She introduced Chestnut Grove School in Britain as a model. However, there is big difference between the situation in Korea and that in Britain. In Britain, each school has classrooms especially designed for mathematics classes and thus many teachers have their own teaching rooms. In Britain, students have to move to the mathematics rooms just before mathematics classes begin, while in Korea the teacher has to move to the room, in which whole class will have the mathematics hour for the next session. In Korea, students do not change their home-base rooms and the teacher comes.

Jeong (2001) said the seventh graders in Chestnut Grove School were divided into six

¹¹ Equity does not mean that every student should receive identical instruction; instead, it demands that reasonable and appropriate accommodations be made as needed to promote access and attainment for all students. The vision of equity in mathematics education challenges a pervasive societal belief that only some students are capable of learning mathematics (NCTM 2000, p. 12). This belief leads to low expectations for too many students. Low expectations are especially problematic. Expectations must be raised and all students must learn mathematics. All students, regardless of their personal characteristics, backgrounds, or physical challenges, must have opportunities to study mathematics and support to learn mathematics.

different classes according to students' ability in mathematics. The two top classes had only 2–8 students each and next three classes had 18–23 students each. The class (class size unknown) of the lowest level also had mathematics classroom with ready access to technology so that each student could learn according to his or her own phase.

At the beginning of the year 2001, South Korean Ministry of Education announced the "Plan for Improvement of Educational Environment". According to this plan, the Korean government will spend about 9 trillion and 920 billion won (approximately 8.5 billion U. S. dollars) by the year 2004 to improve educational environment such as to build 14,494 new classrooms and to hire 23,600 new teachers (*cf.* Choe 2001). The core part of the plan is to reduce the numbers of students per class.

At the beginning of the academic year 2004, schools in South Korea will have classrooms with size of 35 students regardless of subjects. We hope that there will be smaller mathematics classes so that teachers can give more attention to each student as well as giving students individual advices for the problems that each student has in mathematics. However we cannot expect that there will be mathematics classrooms equipped with teaching and learning materials ready to use like British schools, because education administrators and policymakers are not aware of the character of mathematics education.

Kim, Joung & Son (2002) analyzed textbooks and other publications for the primary school mathematics, which were developed in accordance with the seventh amendment. They found that textbooks, practice books, and teacher's manuals do not reflect the aims of the seventh amendment of curriculum. And characteristics and roles of textbooks, practice books, and teacher's manuals were not clearly defined and therefore, they were not practical for understanding mathematics.

8. CONCLUSION

Making the vision of mathematics teaching and learning a reality requires a strong systematic support at both the local and the national levels. Education administrators and policymakers should be aware of the nature of mathematical thinking and learning, understand the importance of mathematics learning, help create professional and instructional climates that support students' and teachers' growth, and provide the time and resources on behalf of teachers to teach and students to learn mathematics well.

Even though the new curriculum is called "differentiated" one, the educational programs that are presently offered by most schools neglected differences of individual students in ability, interest, aptitude and other personal attributes. The mathematics curriculum for the National Common Basic Educational Period (grades 1–10) is operated

on a semester basis (a stage per semester) and each stage comprises of the basic common courses and of the enrichment courses to make it possible for each student to keep his or her own learning phase and to have creative learning experience.

Students of varied backgrounds and abilities must work together with their teachers to learn important mathematical ideas. Even though the curriculum says that special remedial courses are offered for underachieving students, in many educational situations, there are no rooms for such remedial courses. Senior mathematics teachers must be available in every school, serving as expert mentors to their colleagues, recommending resources, orchestrating interaction among teachers and advising administrators.

Professional mathematicians also have to take interests in mathematics education and contribute constructively to the field, setting the content goals for school mathematics and for developing teachers' mathematical knowledge. Professional organizations, such as the Korea Society of Mathematical Education, provide leadership, resources, and professional development opportunities to improve mathematics education.

The new curriculum reduced about 30% of the contents of mathematics. However more serious problem has arisen. As they have more time with fewer contents to teach, teachers just repeat the same contents and problems drilling students to memorize all the techniques for solving simple and routine mathematics problems, instead of touching extra contents to enhance each student's understanding in mathematics and to attract students with interest in mathematics according to their ability. This results in nothing but students with less interest in mathematics.

As fewer students major in mathematics, this will cause another serious problem in the future. And the problem already occurs. Less and less students enter the field of science and engineering.

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