School Mathematics Curriculum in Korea

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Now in Korea, the 7th curriculum reform is underway. The main difference of the seventh curriculum compared with former curricula is that it puts much emphasis on individual difference. It is a "differentiated" curriculum.
The basic directions of the 7th mathematics curriculum are as follows:

1. Offer various mathematical subjects for "Selective Educational Period" (Grades 11 and 12).
2. 30% reduction of mathematical contents.
3. The reconciliation of domain names of school mathematics.
4. The use of computers and calculators in mathematics classrooms.

I. BRIEF HISTORY OF MATHEMATICS CURRICULUM IN KOREA

School mathematics curriculum of modern Korea has been revised six times since the establishment of its government in 1945.

The 1st mathematics curriculum can be characterized as a real-life-experience-centered-curriculum which was influenced by progressivism in the United States. Thus, the curriculum valued students' experience in their real life.

Looseness of the 1st mathematics curriculum caused a decline of students' achievement in mathematics, which necessitated the second curriculum revision. The focus of the 2nd curriculum was systematic-learning, which was based on Herbart's essentialism. The 2nd curriculum placed great value on the logical and theoretical aspects of mathematics, and pursued the improvement of students' mathematical abilities.

The 3rd mathematics curriculum was influenced by the "New Math" which was the result of a discipline-centered-curriculum and mathematics modernization movement. The 3rd curriculum attempted to introduce abstract but fundamental ideas (for example, the concepts of sets, algebraic laws, etc.) early in the school period and to review continually these ideas in subsequent lessons, relating, elaborating, and extending them. Bruner's discovery learning was also considered crucial in the 3rd

curriculum.

The 4th mathematics curriculum began from the failure of the new math and the emergence of the back to basics movement in the United States. Many people think students' basic computation skill was weakened by the structural approach to mathematics of the third curriculum. Thus the 4th curriculum reduced the content, lowered the level of difficulty, and emphasized obtaining minimal competencies in school mathematics.

The 5th mathematics curriculum basically maintained the frame of the 4th curriculum. The main direction of revision was the emphasis on mathematical activities and affective aspects of students' learning of mathematics.

The 6th mathematics curriculum is not much different from the previous one. The 6th curriculum especially stresses fostering mathematical thinking abilities and mathematical problem solving abilities.

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Table 1. Periods of Mathematics Curriculum Revision

Phase	Period	Main Focus
1st Mathematics Curriculum	1955 – 1962	real-life-centered
2st Mathematics Curriculum	1963 – 1972	systematic-learning
3st Mathematics Curriculum	1973 – 1981	new math
4st Mathematics Curriculum	1982 – 1988	1st revision, back to basics
5st Mathematics Curriculum	1989 – 1994	2nd revision
6st Mathematics Curriculum	1995 – 1999	problem-solving
7st Mathematics Curriculum	2000 –	differentiated curriculum

II. THE 6TH MATHEMATICS CURRICULUM IN KOREA

1. The Structure of the Mathematics Curriculum

For each of the three school levels, i.e. primary, middle, and high, the corresponding mathematics curriculum was developed. The documents of mathematics curriculum for each level deal with 5 aspects: characteristics, objectives, contents, methods, and evaluation comments (Figure 1).

From grade 1 to grade 10, mathematics is compulsory, which means all the

students should take the same mathematics courses. But, during grades 11 and 12, tracking in mathematics courses is available (Figure 2).
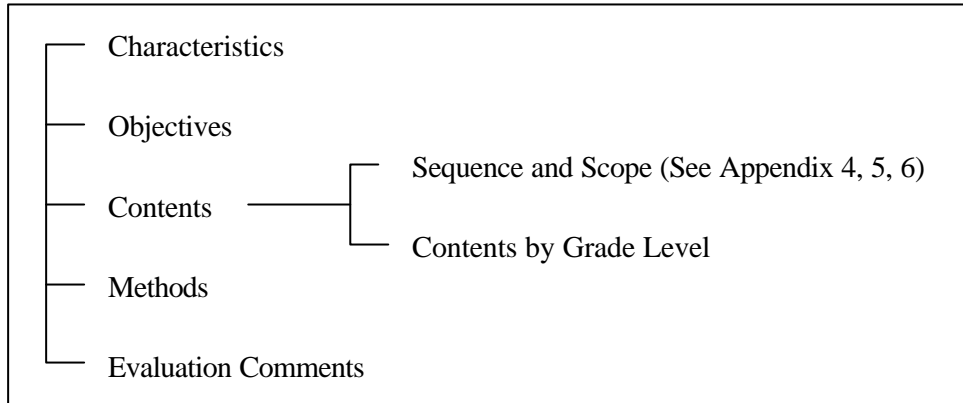

Figure 1. The Structure of Mathematics Curriculum for Each Level
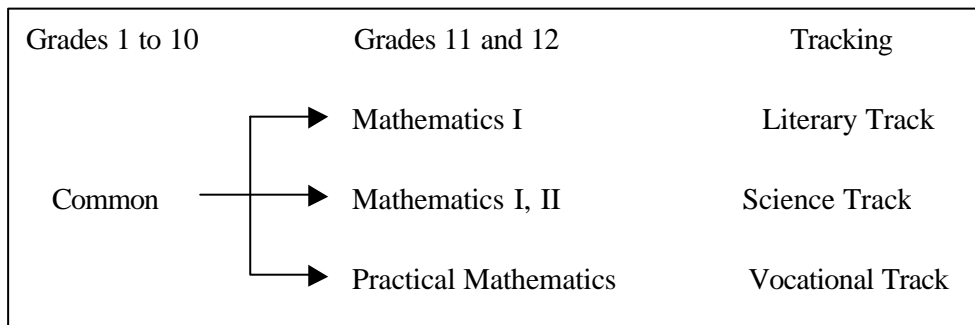(Primary School/Middle School/High School)

Figure 2. Tracking in Mathematics Courses in Grades 11 and 12

The domains of the mathematics curriculum are different according to each school level.

Table 2. The Domains in Each Mathematics Curriculum

School Level	Primary School	Middle School	High School
Number of Domains	5	5	4
Domains	number operation geometric figures measurement relation	number and expression equation and inequality function statistics geometric figures	algebra analysis geometry statistics

2. Mathematics Textbooks

Mathematics textbooks should be written based on the mathematics curriculum as in any other country. Thus, the mathematics curriculum plays the role of "bible" in developing new mathematics textbooks. What follows is a summary of the basic features of the mathematics textbooks for the 6th curriculum.

Table 3. Mathematics Textbooks (6th Curriculum)

School Level	Title	Number of Textbooks	Number of Workbooks	Policy of Publication
Primary School	Primary School Mathematics (2 semesters per year) 1–1, 1–2, · · · , 6–1, 6–2	12	12	First type*
Middle School	Middle School Mathematics 1, 2, 3	3	×	Second type**
High School	Common Mathematics Mathematics I Mathematics II Practical Mathematics	4	×	Second type**

* The textbooks of the first type are uniquely developed and published by the central government, the Ministry of Education.

** The textbooks of the second type are developed and published by private publishing companies, and the Ministry of Education approved the textbooks.

III. The 7th Mathematics Curriculum in Korea

1. General Features of the 7th Curriculum

Korea is presently in the middle of curriculum revision, and the draft of the 7th mathematics curriculum is going to be completed at the end of this year. The new curriculum will be gradually implemented in the schools from the year 2000.

One of the most fundamental problems in education in Korea so far is that teaching-and-learning in the classroom is being carried out without considering each student' capacity, aptitude, and interests. Thus, the core of the 7th curriculum revision is the implementation of a "Differentiated Curriculum"(DC), which can alleviate such problems. The main features of the DC are as follows.

First, the educational period consists of two: National Common Basic Educational Period (10 years from grade 1 to grade 10) and Selective Educational Period (2 years from grade 11 to grade 12). To prevent redundancy and inefficiency in dealing with the mathematical contents in curriculum, and to pursue the consistency of mathematics education, previous school distinctions will be abolished (even though the distinction in terms of administration still will exist).

Second, DC is divided into "Level Based Differentiated Curriculum" (LBDC), "Enrichment and Supplement Differentiated Curriculum" (ESDC), and "Subject Selection Differentiated Curriculum" (SSDC).

LBDC is applied to the subjects whose contents are presumed to be hierarchically structured, and which seem to create severe individual differences among pupils in the instructional process. Those subjects have been determined to be Mathematics and English. Mathematics is organized and implemented by LBDC from grade 1 to grade 10 (10 levels and each level with 2 sub-levels), and English is organized and implemented by LBDC from grade 7 to grade 10 (4 levels and each level with 2 sub-levels).

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 as Korean Language, Social Studies, and Science are organized and implemented by ESDC.

SSDC is the curriculum in which students can select their own subjects based on their needs and capacities. Therefore, various types and levels of subjects shall be provided. SSDC is applied to all the subjects in grades 11 and 12.

Third, LBDC is operated on a semester basis, and each level in LBDC comprises three sub-courses:

Basic-common course, Enrichment course, and Supplement course.

For underachieving students taking the subjects from LBDC, special remedial courses shall be offered.

2. Focus of the 7th Mathematics Curriculum Revision

The basic directions of the 7th mathematics curriculum revision are as follow.

First, the 7th curriculum shall offer various mathematical subjects for the Selective Educational Period in grades 11 and 12. The tentative subjects are

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

Compared to the 6th curriculum, the last three subjects are added to fill a variety of students' needs.

Second is a 30% reduction of mathematical content. Many administrators in government seem to think the level of difficulty in school mathematics in Korea is relatively higher than western countries. And mathematics has been being blamed as a main factor in the huge private lesson problems in Korean society. Thus everybody expects that the lowering of school mathematics difficulty level will reduce the suffering related to private tutoring. Not all the mathematics educators in Korea agree with that. However the 30% reduction is already determined by administrators despite mathematics educators' opinions.

Third, there shall be reconciliation of the domain names of school mathematics. As mentioned before, the domain names for each school level are heterogeneous. Thus there shall be an integration of domain names. The only issue still under discussion is whether "problem solving" will be established as a separate domain.

Fourth is how to implement the use of computers and calculators in mathematics curriculum and in each classroom. The 6th curriculum already mentioned and encouraged the utilization of calculators for some specific mathematics content. However, the reality of schools does not allow active use of such technologies. Thus, one of the main points of the 7th curriculum shall be the combination of the use of calculators and computers with the mathematics curriculum.

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APPENDIX 1

Primary School Time Allotment* by Subject and Extracurricular Activity (6th Curriculum)

Subject \ Grade		1	2	3	4	5	6
Subject Area	Moral Education	Disciplined Life 60(2)/68(2)		34(1)	34(1)	34(1)	34(1)
	Korean Language	210(7)	238(7)	238(7)	204(6)	204(6)	204(6)
	Mathematics	**120(4)**	**136(4)**	**136(4)**	**136(4)**	**170(5)**	**170(5)**
	Social Studies	Intelligent Life 120(4)/136(4)		102(3)	102(3)	136(4)	136(4)
	Science			102(3)	136(4)	136(4)	136(4)
	Physical Education	Pleasant Life 180(6)/238(7)		102(3)	102(3)	102(3)	102(3)
	Music			68(2)	68(2)	68(2)	68(2)
	Fine Arts			68(2)	68(2)	68(2)	68(2)
	Practical Arts	·	·	34(1)	34(1)	34(1)	34(1)
Extracurricular Activities		30(1)	34(1)	34(1)	68(2)	68(2)	68(2)
Optional Courses		·	·	34(1)	34(1)	34(1)	34(1)
Grand Total		790(24)	850(25)	952(28)	986(29)	1,054(31)	1,054(31)

* The minimum numbers of total instructional hours per year (per week)

・ The standard number of school weeks a year is 30 in grade 1, and 34 in grades 2–6.
・ One instructional hour covers 40 minutes.
・ In case of grade 1, 70 hours among the total 790 instructional hours should be allocated to an orientation program in March.

APPENDIX 2

Middle School Time Allotment* by Subject and Extracurricular Activity (6th Curriculum)

Subject \ Grade		1	2	3
Compulsory Subject	Moral Education	68(2)	68(2)	68(2)
	Korean Language	136(4)	170(5)	170(5)
	Mathematics	**136(4)**	**136(4)**	**136(4)**
	Social Studies	102(3)	136(4)	136(4)
	Science	136(4)	136(4)	136(4)
	Physical Education	102(3)	102(3)	102(3)
	Music	68(2)	34–68(1–2)	34–68(1–2)
	Fine Arts	68(2)	34–68(1–2)	34–68(1–2)
	Home Economics	68(2)	34(1)	34(1)
	Technology and Industry	34(1)	68(2)	68(2)
	English	136(4)	136(4)	136(4)
Elective Subject	Chinese Characters and Classics	34-68(1–2)	34-68(1–2)	34–68(1–2)
	Computer Science			
	Environmental Studies			
	Others			
Extracurricular Activities		34-68(1–2)	34-68(1–2)	34–68(1–2)
Grand Total		1,156(34)	1,156(34)	1,156(34)

* The minimum numbers of total instructional hours per year (per week)

· The standard number of school weeks a year is 34.
· One instructional hour covers 45 minutes.

APPENDIX 3

High School Time Allotment* by Subject and Extracurricular Activity (6th Curriculum)

Subject Area	Common Compulsory Courses	Compulsory Courses for from each Subject Area(Track)	Elective Courses
Ethics	Ethics(6)		
Korean Language	Korean Language(10)	Speech(4), Reading(4), Composition(6), Grammar(4), Literature(8)	
Chinese Characters and Classics		Chinese Characters and Classics I(6), II(4)	
Mathematics	**Common Mathematics(8)**	**Mathematics I(10), II(10), Practical Mathematics(8)**	
Social Studies	Common Social Studies(8), Korean History(6)	Five subjects including Politics(4)	Subjects excluded from the compulsory courses(8)
Science	Common Science(8)	Eight subjects including Physics I(4), II(8)	
Physical Education	Physical Education I(8)	Physical Education II(6)	
Military Training		Military Training(6)	
Music	Music I(4)	Music II(4)	
Fine Arts	Fine Arts I(4)	Fine Arts II(4)	
Vocational Education and Home Economics		Nine subjects including Technology(8)	
Foreign Languages	Common English(8)	Seventeen subjects including English I(8), II(8)	
Free Optionals			Seven subjects including Philosophy
Total Units	70	126	12

* (The minimum numbers of total instructional hours per week)

・ The standard number of school weeks a year is 34.

・ One instructional hour covers 50 minutes.

APPENDIX   4

Synopsis of Primary School Mathematics Curriculum (6th Curriculum)

Domain \ Grade	1	2	3
Number	· 0–99	· 0–999 · introduction of fraction	· 0–9999 · proper fraction · introduction of decimal
Operation	· addition and subtraction of basic numbers · addition and subtraction of two-digit natural numbers	· addition and subtraction on the range of three-digit natural numbers · introduction of multiplication, multiplication table, and division	· addition and subtraction on the range of four-digit natural numbers · multiplication whose multi-plier is two-digit numbers · division whose divisor is one-digit numbers · addition and subtraction of proper fractions with equivalent denominator · addition and subtraction of decimals
Geometric Figures	· recognizing shape and character of fundamental geometric figures (plane figure and solid figure)	· segment, straight line · components of construction of triangle and quadrangle · components of construction of right hexahedron	· angle, right angle · right triangle, isosceles triangle, regular triangle · rectangle, square · circle · constructing figures

4	5	6
· ten thousand- · improper fraction, mixed fraction, equivalent fraction · principle of · position of decimals	· divisor, multiple · set, element · reduction of a fraction · union, intersection	· integer · power
· addition, subtraction, multiplication, and division of natural numbers · addition and subtraction of fractions with equivalent denominator · addition and subtraction of decimals	· addition and subtraction of fractions with different denominator · multiplication and division of fractions · multiplication and division of decimals	· addition of integers · abacus · division of fractions and decimals · mixed calculation on the range of positive rational numbers
· perpendicular, parallel · properties of parallel line · acute angle, obtuse angle · acute triangle, obtuse triangle · sum of interior angles of triangle and quadrangle · trapezoids, parallelogram, rhombus, polygon	· congruence of figures, symmetry and drawing a figure · development figures of right hexahedron and cube	· regular polygon · circumference, sector, arc similarity · prisms, cylinders · pyramid, circular cone · development figures · solid of revolution

APPENDIX 4 (CONT.)

Grade / Domain	1	2	3
Measurement	· comparison of quantities · reading a clock	length (cm, m) clock, times minutes, day, week, month, year more than, less than	· length (mm, km) · weight (g, kg) · capacity (　,　) · comparison of angle size · calculation of times · about
Relation	· comparison of cardinality · making expression	· record table · graph · recognition of corresponding · patterns · finding unknowns · making expression · application problem	· bar graph · making expression · corresponding patterns · finding unknowns · application problem

4	5	6
· using degree · reading a clock · area of rectangle and of square · area of right triangle and of triangle · rounding off, counting fraction as one, emission of fraction	· capacity (,) · weight (t) · areas of trapezoid, parallelogram, rhombus, and triangle · surface area and volume of right hexahedron · true value, approximate value, error	· circumference · length of an arc · using a reduced scale · area of circle and sector · surface area and volume of prism and cylinder · estimation · round number
· broken line graph · making expression · corresponding patterns · true, false · process problem · game, puzzle	· pictogram · mean · coordinate, relation expression graph · finding unknowns · ratio, rate · problem solving strategy	· histogram · rate graph · number of outcome in an event · probability · direct proportion, inverse proportion · properties of equality · simple equation · proportional expression · continued ratio · proportional distribution · speed, concentration

APPENDIX 5

Synopsis of Middle School Mathematics Curriculum (6th Curriculum)

Domain	Contents	1	2	3
Number and Expression	Set	· meaning and representation of sets · inclusion relation among sets · operation of sets		
	Number	· divisor, multiple · prime factorization · common divisor, common multiple · numeration system (decimal, quinary, binary) · concepts of integers and rational numbers and their calculations	· decimal representation of rational numbers · approximate values and error · representation of approximate value · mixed calculation of approximate values	· square root and its properties · irrational number · order relation of real number and number line · computing expression involving square root
	Expression	· using letters and algebraic expressions · numerical value of an expression · calculation of the first degree expression	· addition and subtraction of polynomials · laws of exponents · (monomial) × (polynomial) · (polynomial) × (polynomial) · transformation of simple equality	· multiplication of polynomials · multiplication formulas · factorization
Equation and Inequality	Equation	· equation and its solution · properties of equality · linear equation	· simultaneous linear equation with two unknowns	· quadratic equation
	Inequality		· properties of inequality · linear inequality	

Domain	Contents	1	2	3
Function	Function	· correspondence · meaning of · function · ordered pair and coordinate · graph of function	· linear function and its graph · application of linear function	· quadratic function and its graph · relation between quadratic equation and quadratic function
Statistics	Statistics	· frequency distribution table, histogram · relative frequency, cumulative frequency		representative value, mean measure of dispersion, standard deviation scattergram correlation
	Probability		· number of case of an event · meaning and properties and probability · calculation of probabilities · expectation value	
Geometric Figures	Basic Figures	· point, line, plane, angle · positional relation · properties of parallel lines		
	Plane Figures	· construction of figures · congruence of figures · conditions for congruence of triangles · circle, polygon · area of sector, length of arc	· properties of triangle and of quadrilateral · similarity of figures · conditions for similarity of triangles · application of similarity	· Pythagorean theorem and its application · relation between two circles · angle of circumference · trigonometric ratio
	Solid Figures	· polyhedron · solid of revolution · surface area and volume of solid figures		
	Investigation of Geometric Figures	· simple closed curve · linear system · Euler's formula		

APPENDIX 6

Synopsis of High School Mathematics Curriculum (6th Curriculum)

Common Mathematics

Domain	Contents
Algebra	• set and statement • number systems (real number, complex number) • polynomial (remainder theorem, factorization, divisor and multiple) • rational expression and irrational expression • equation (quadratic equation, high order equation, simultaneous equation) • inequality (quadratic inequality, simultaneous quadratic inequality, proof of inequality) • exponent and logarithm
Analysis	• function (function, composite function, inverse function) • rational function and irrational function • exponential function (exponential function, equation, and inequality) • logarithmic function (logarithmic function, equation, and inequality) • trigonometric function (properties and graphs of trigonometric function)
Geometry	• coordinate in the plane (internal division point and external division point of a line segment, distance between two points, distance between a point and a straight line) • equation of a straight line (parallel and perpendicularity) • equation of a circle (circle and straight line) • displacement of figures (parallel translation, symmetric translation) • regions of inequalities (maximum and minimum)

Mathematics I

Domain	Contents
Algebra	• matrix and its operation (simultaneous linear equation and matrix) • sequence (arithmetic sequence and geometric sequence, mathematical induction, algorithm and flow chart)
Analysis	• limit of sequences (limit of infinite sequences, infinite series) • limit and continuity of a function • differentiation of a polynomial function (derivative, application of derivative) • integration of a polynomial function (indefinite integral, definite integral, application of definite integral)
Geometry	• permutation and combination (number of cases, binomial theorem) • probability (meaning of probability, computation of probability) • statistics (frequency distribution, probability distribution, estimation and testing)

Mathematics II

Domain	Contents
Algebra	• equation (rational equation, irrational equation) • inequality (high order inequality, rational inequality) • simple linear transformation and matrix (symmetric, similar, and rotation transformation, composite of transformation, inverse transformation)
Analysis	• trigonometric function and complex number (addition formula for trigonometric function, trigonometric equation, polar form of complex numbers) • limit of a function (limit of a trigonometric function, an exponential function, and a logarithmic function) • differentiation (differentiation of various functions, application of derivatives) • integration (indefinite integral, integration by substitution, integration by parts, definite integral, application of definite integral)
Geometry	• quadratic curve (parabola, ellipse, hyperbola) • space figure (position relation of straight line and plane, parallel and perpendicular, orthogonal projection) • coordinate in the space (coordinate of a point, distance between two points, internal division point and external division point of a line segment, equation of a sphere) • vector (addition, subtraction, scalar multiple, and inner product of vectors, application of vectors)

Practical Mathematics

Domain	Contents
Algebra	• statement and true-false table (composite of statements, conditional statement) • matrices (arrangement of collected data, inverse matrix) • sequence (arithmetic sequence, geometric sequence)
Analysis	• limit (limit of sequences, infinite series, limit of functions) • differentiation and integration (derivative, indefinite integral, definite integral) • trigonometric function and complex number
Geometry	• vector (addition, subtraction, and scalar multiple of vectors, application of vectors)
Probability and Statistics	• permutation and combination • probability • statistics
Others	• utilization of calculators and computers • management of living (management of incomes and outgoes)