

School Mathematics and Popularization of Mathematics

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Abstract: *Mathematics is vital not only in ordinary people's everyday lives but also in the cutting-edge technology of the information age. Mathematics is everywhere, from counting objects to telecommunication and image processing. Unfortunately most mathematics in everyday life is invisible to many people's eyes. This is partially because the mathematics used in technology is usually the deeper results of the ablest researchers in the field. The details of mathematics are even hard for mathematicians whose specialties are different from the materials used in the particular technology. The result is that mathematics is getting further and further away from the general public's attention and is confined to specialists. Eventually this will undermine the whole enterprise. We mathematicians need to act against the public ignorance of mathematics.*

1. Introduction

In Korea, mathematics is a compulsory subject up to the first year of high school (grade 10). For the last two years of high school, mathematics is an elective course but most university-bound students should take mathematics. As a result, most Koreans are well prepared for mathematics in theory. The reality is the opposite. After their graduation from high school the vast majority of graduates abandon mathematics completely. Mathematics ranks as the most hated subject for school children during their school years. In other words, mathematics is the most unpopular subject. People tend to think that mathematics is only needed for the university entrance examination which is a once-in-a-lifetime competition. Mathematics plays the most crucial and decisive role of determining who is a failure or success in the university entrance examination. In this article, we will briefly discuss the plane geometry curriculum for middle school students (grades 7 through 9) in Korea. Then we will show you three apparatuses which are directly related to middle school plane geometry. Two of them are published in middle school supplementary text books. The remaining one was used for gifted student classes for investigating geometry. Of course, the reasons for introducing these apparatuses in the middle school textbook are manifold. First of all, we would like to inform students that mathematics is not a foreign subject but it is always around us to be used somewhere in our daily life. Secondly, we would like to tell them that even middle school mathematics can be very helpful to our daily life. Thirdly, we would like to let them know that even school adolescents can invent useful items. Fourthly, we would like to motivate them to learn mathematics with their heart. Finally and most importantly with those apparatuses mathematics should get more popularity among students. This will in turn make mathematics popular among youngsters throughout the rest of their lives.

2. Overview of Korean Educational System

2.1. School Ladder System (6-3-3-4)

The school ladder system is the unified structure connecting the different school levels. Korea has a single-track 6-3-3-4 system which maintains a single line of school levels in order to insure that every citizen can receive elementary, secondary, and tertiary education without discrimination and according to his or her ability. Elementary and middle school education are free and compulsory.

2.2. Organization of Curriculum and Time Allotment Standards (2007 개정 기준)

Korea employs a national centralized curriculum for elementary, middle and high schools. The national curriculum was written by the Ministry of Education (now the Ministry of Education, Science and Technology). All schools must follow the guidelines, and only the textbooks approved by the Text Book Evaluation Committee may be used in classrooms.

Part (1) Organization of the Curriculum

- ① The curriculum comprises the national common basic curriculum and the high school elective-centered curriculum.
- ② The national common basic curriculum consists of subject matters, optional activities and extracurricular activities.
- ③ The national common basic curriculum is the curriculum up to the first year of high school.
- ④ The high school elective-centered curriculum is for the second and third year of high school.

Part (2) Time Allotment Standards

- ① The National Common Basic Curriculum

		Elementary School					Middle School			High School			
		1	2	3	4	5	6	7	8	9	10	11	12
Subjective Area	Korean Language	Korean Language		238	204	204	204	170	136	136	136	Elective Courses	
	Moral Education	210	238	34	34	34	34	68	68	34	34		
	Social Studies	Mathematics		102	102	102	102	102	102	136	170		
	Mathematics	Disciplined Life		136	136	136	136	136	136	102	136		
	Sciences	60	68	102	102	102	102	102	136	136	102		
	Practical Arts	Intelligent Life				68	68	68	102	102	102		

s	Physical Education			102	102	102	102	102	102	68	68
	Music			68	68	68	68	68	34	34	34
	Fine Arts	Pleasant Life		68	68	68	68	34	34	68	34
	English	180	204	34	34	68	68	102	102	136	136
Optional Activities	first 60	68	68	68	68	68	136	136	136	204	
Extracurricular Activities	30	34	34	68	68	68	68	68	68	68	68
Grand Total	830	850	986	986	1,088	1,088	1,156	1,156	1,156	1,224	

The numbers in the above table are the minimum numbers of total annual instruction hours by subject and grade level.

② High School Elective-Centered Curriculum

		Subjects	Elective Courses
S U B J E C T S		Korean Language Moral Education Social Studies	Speech Communication(6), Writing(6), Grammar(6),Literature(6),Media Language(6) Ethics in Modern Life(6)Ethics and Thoughts(6), Traditional Ethics(6) Korean Geography(6), Economic Geography(6), Korean Cultural History(6), Understanding World History(6), East Asian History(6), Law and Society(6),Politics(6), Economic(6),Society and Culture(6)
		Mathematics Science Technology and Home Economics	Applied Mathematics(6),Mathematics I (6), Pre-Calculus and Pre-Statistics(6), Mathematics II (6), Integration and Statistics(6), Geometry and Vector(6), Physics I (6), Chemistry I (6), Life Science I (6), Earth Science I (6), Physics II (6), Chemistry II (6), Life Science II (6), Earth Science II (6) Agricultural Life Science(6), Engineering Technology(6), Home Economics(6), Enterprise Management(6), Ocean Science(6),Information(6)
		Physical Education	Exercises and Healthy Life(4), Sports Culture(4), Sports Science(6)
		Music Fine Arts	Music Performance(4), Music and Society(4), Understanding Music(6), Art in Life(4), Art Appreciation(4), Art Production(6)

Foreign Language	English I (6), English II (6), Listening and Speaking(English) I (6), Listening and Speaking(English) II (6), Reading and Writing(English) I (6), Reading and Writing(English) II (6) German I (6), German II (6), French I (6), French II (6), Spanish I (6), Spanish II (6), Chinese I (6), Chinese II (6) Japanese I (6), Japanese II (6), Russian I (6), Russian II (6), Arabic I (6), Arabic II (6)
Chinese Characters and Classics Liberal Arts	Chinese Characters and Classics I (6), Chinese Characters and Classics II (6), Our Life and Philosophy(4), Life and Logic(4), Life and Psychology(4), Life and Education(4), Life and Religion(4), Life and Economics(4), Safety and Health(4), Career and Occupation(4), Environment(4)
Total Units	132
Extracurricular Activities	8
Grand Total Units	140

The figures in parentheses are the numbers of units to be completed. A unit is the amount of learning in a 50-minute period of instruction per week for one semester, equivalent to 17 weeks. Eight units are equivalent to 136 hours of annual instruction hours and 4 units to 68 hours.

3. Content of School Mathematics

3.1. Selected Topics to be covered in certain grades

(1) Elementary School

Elementary school education provides the general rudimentary education necessary for life. Mathematics in the final year of elementary school includes: Fractions and Decimals, Division of fractions and decimals, Pyramids and Solids, Circumference and Area of a Circle, Ratios, Rules and Correspondences.

(2) Middle school

Mathematics in the final year of middle school includes: Square Roots, Irrational Numbers, Factorization of Polynomials, Quadratic Equations, Graphs of Quadratic Functions, Pythagorean Theorem, Geometry of Circles, Trigonometric Ratios, Correlation.

(3) Mathematics of the first year in high school

Mathematics of the first year in high school includes: Sets, Real and Complex numbers, Discriminant, Cubic and Quartic Equations, Quadratic Inequality, Means, Distribution and Standard Deviation, Equation of Lines, Equation of Circles, Parallel Transformation, Composite Functions, Inverse Functions, Maxima and Minima of Quadratic Functions,

Rational Functions, Radians, Trigonometric Functions, Laws of Sine and Cosine, Area of Triangles.

(4) Mathematics I in Elective Course in the second year of high school

This course includes: Exponents and Logarithms, 2×2 Matrices, Mathematical Induction, Limit of Infinite Sequences, Infinite Series, Exponential Functions and Logarithmic Functions.

(5) Mathematics II in Elective Course in the third year of high school

Mathematics II includes: Fractional and Irrational Equations, Cubic and Quartic Inequalities, Trigonometric Functions, Limits and Continuity of Functions, Differentiation of Polynomials.

3.2. Contents of Middle School Geometry

The contents of the geometry part are described below. Basically it covers most of Euclidean plane and solid geometry.

(1) 7th Grade Geometry

Objectives:

To understand basic figures and to know simple properties of plane and solid figures

To be able to find angles of polygonal, surface areas and volumes of simple solid figures

Contents:

① Basic Figures:

Simple properties of point, line, surface, and angle

Relative position of point, line, and plane

Properties of parallel lines

② Construction and Congruence

Construction of Simple figures

Simple properties of congruent figures

Congruence condition of triangles

③ Properties of plane figures

Properties of polygons

Center of circle, central angle, sector, chord, arc

Relative position of circle and line

④ Properties of solid figures

Polyhedra

Solids of revolution

⑤ Polygons and angles

Interior and exterior angles

⑥ Length, area, and volume of figures

Area of sector, length of arc

Surface area and volume of solid figures

(2) 8th Grade Geometry

Objectives:

To be able to prove simple properties of figures using the congruence and similarity conditions of triangles

Contents:

① Properties of triangles and quadrangles

To prove simple properties of triangles and quadrangles using the congruence condition of triangle

② Similarity of figures

Similarity of figures

Simple properties of similar figures

Similarity condition of triangles

③ Application of similarity

Intercepted line segments between parallel lines, and their ratios

Midpoint theorem of triangles and its application

Finding area and volume of similar figures using similarity ratios

(3) 9th Grade Geometry

Objectives:

To understand the Pythagorean Theorem and to be able to apply it

To understand the properties of circles and to be able to apply them

To understand basic concepts of trigonometric ratios and to be able to use them

Contents:

① Pythagorean Theorem

Understanding the Pythagorean Theorem and its proof

Applying the Pythagorean Theorem to simple figures

② Circle

Properties of chords

Tangent lines to circles and proof of the power point theorem

Inscribed angles and their properties

Properties of inscribed quadrangles

Ratio of intersecting chords

③ Trigonometric ratios

Understanding trigonometric ratios and finding trigonometric ratios of particular angles

Applying trigonometric ratios to real world problems

4. Three Apparatuses

We will show you two common household goods and windshield wiper. These items are directly related to middle school geometry.

4.1. Hanger for wet clothes

The following household item is very common in Korea. Wet clothes are hung along the parallel lines in the arms. Especially in the winter, wet clothes will keep an apartment's moisture level comfortable. The slope of each arm can be adjusted using the supporter.



From this item, one can do the following mathematics:

SAS congruence of triangles

The bigger the angle, the longer the length of the opposite side of the angle

4.2. Standing ironing table

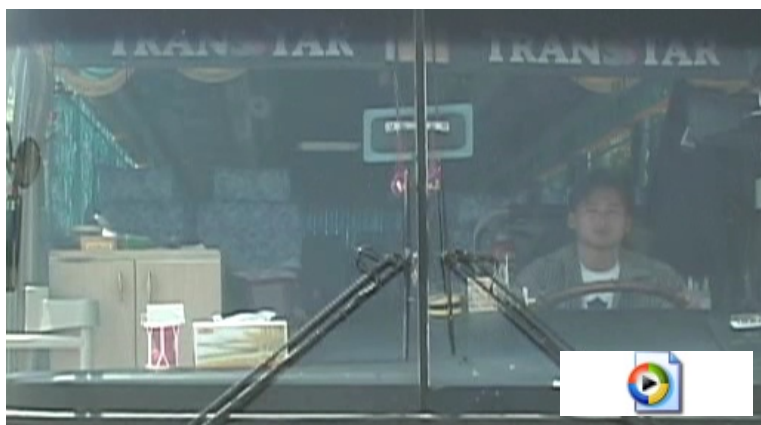
The height of the following ironing table can be adjusted. Also the table must be parallel to the floor. Both can be done.



The mathematics involved in the standing ironing table is a SAS similarity condition for two triangles. Namely, if the ratios of two corresponding sides are equal and the angles formed by two sides are equal, then the two triangles are similar. If this happens, then the remaining third sides are parallel.

4.3. Windshield wiper

On a rainy day the windshield wiper is very important. If the windshield wiper does not adequately brush water off the windshield, the driver will not be able to see out of the front. It will make driving very hazardous. The conventional wiper moves in the shape of a sector. As one can see, in the following device the wiper moves horizontally. This new device wipes off more water and gives a better front view to the driver. This simple device illustrates the usefulness of even middle school mathematics.



The mathematics used is a well-known property of parallelograms. Namely, if the lengths of two pairs of opposite sides of a quadrilateral are equal, respectively, then the quadrilateral is a parallelogram. Then opposite sides are parallel. This in turn says that the blades keep the same angle with the base line.

5. Concluding Remarks

Mathematics constitutes one half of our communication means, the other half being language. But people usually do not realize the importance of mathematics in our daily life. In the era of information the role of mathematics ever increases, as our society gets more sophisticated. The advancement of information technology is possible mainly with the aid of mathematics. Again, the general public does not appreciate the assets of mathematics. We have to arouse public interest toward mathematics. In many countries like Korea mathematics is regarded as a means to enter a higher education institute and is completely forgotten after public education. Hence the time is ripening for mathematicians to work together to raise public interest in mathematics. One way to do so is for us mathematicians to find many everyday household goods that embody considerable mathematical ideas suitable for school children. Then let them be familiar with mathematical ideas and realize that mathematics is always around us to help us to a better life.

References

- [1] Ministry of Education, Science and Technology. Available: <http://english.mest.go.kr/>
- [2] The Korea Institute of Curriculum and Evaluation. Available: <http://www.kice.re.kr/en/>