School Mathematics and Popularization of Mathematics

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Abstract: *Mathematics is vital not only in ordinary person's everyday life but also in the cutting-edge technology of the information age. Mathematics is everywhere from counting objects to telecommunication and image processing. Unfortunately most of mathematics in everyday life is invisible to many people's eyes. This is partially because mathematics used in technology is usually deep results of ablest researchers of the field. The details of mathematics are even harder to mathematicians whose specialties are different from the materials used in the particular technology. The result is that mathematics is getting far and far away from general publics' 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 of university bound students should take mathematics. As a result, most of 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 the mathematics completely. Mathematics ranks the most hated subject for school children during their school years. In another words, mathematics is the most unpopular subject. People tend to think that mathematics is only needed for the university entrance examination which is a steep competition. Mathematics plays the most crucial and decisive role to determine who is a failure or successor in the university entrance examination.

In this talk, I will briefly discuss the curriculum of the plane geometry for middle school students (grade 7 through 9) in Korea. Then I will show you three apparatuses which are directly related to the middle school plane geometry. Two of them are published in the middle school supplementary text books. The remaining one was used for the gifted student class for investigating geometry. Of course, the reason for introducing these apparatuses in the middle school text book is manifolds. First of all, I 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, I would like to tell them that even middle school mathematics can be very helpful to our daily life. Thirdly, I would like to let them know that even school adolescents can invent useful items. Fourthly, I 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 the Curriculum and Time Allotment Standards

Korea employs the national centralized curriculum for the elementary, middle and high schools. The national curriculum has been written by the Ministry of Education. All schools must follow the guideline and text books which were approved by the Text Book Evaluation Committee are allowed to be used in the 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 the 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

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Extracurricular Activities	30	34	34	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
SUBJECTS	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(6), Spanish(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. 8 units is equivalent to 136 hours of annual instruction hours and 4 units to 68 hours.

3. Contents 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 in 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 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, Pythagoreans 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 Geometry of Middle School

Contents of geometry part are described below. Basically it covers most of Euclidean plane 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 polygon
Center of circle, central angle, sector, chord, arc,
Relative position of circle and line

④ Properties of solid figures
Polyhedra
Solid of revolution

⑤ Polygon and angles
Interior and exterior angles

⑥ Length, area, and volume of figure
Area of sector, length of arc
Surface area and volume of solid figure

(2) 8th Grade Geometry

Objectives:
To be able to prove simple properties of figures using congruence condition and similarity condition of triangle

Contents:
① Properties of triangle and quadrangle
To prove simple properties of triangle and quadrangle using congruence condition of triangle

② Similarity of figures
Similarity of figures
Simple properties of similar figures
Similarity condition of triangle

③ Application of similarity
Intercepted line segments between parallel lines and their ratios
Midpoint theorem of triangle and its application
Finding area and volume of similar figures using similarity ratios

(3) 9th Grade Geometry

Objectives:
To understand Pythagorean Theorem and to be able to apply it
To understand properties of circle and to be able to apply it
To understand basic concept of trigonometric ratio and to be able to use it

Contents:
① Pythagorean Theorem
Understanding Pythagorean Theorem and its proof
Applying Pythagorean Theorem to simple figure

② Circle
Properties of chord
Tangent line to circle and proof of the power point theorem
Inscribed angle and its properties
Properties of inscribed quadrangle
Ratio of intersecting chords

③ Trigonometric ratio
Understanding trigonometric ratio and finding trigonometric ratio of particular angles
Applying trigonometric ratio 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 good is very common in Korea. Wet clothes are hanged along the parallel lines in the arms. Especially in the winter time wet clothes will keep the moisture comfortable in the apartment. The slope of each arm can be adjusted using the supporter.

From this good, one can do the following mathematics:
SAS congruence of triangles
The bigger the angle, the longer length of the opposite side of the angle

4.2. Standing ironing table

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

1 삼각형과 평행선

• 삼각형에서 평행선과 선분의 길이의 비

생각열기 1 우리 주위에 있는 닮은 삼각형

우리 주위에서 쉽게 찾을 수 있는 닮은 삼각형은 어떤 것이 있을까?
다음 사진에서 닮은 삼각형을 찾아보자.

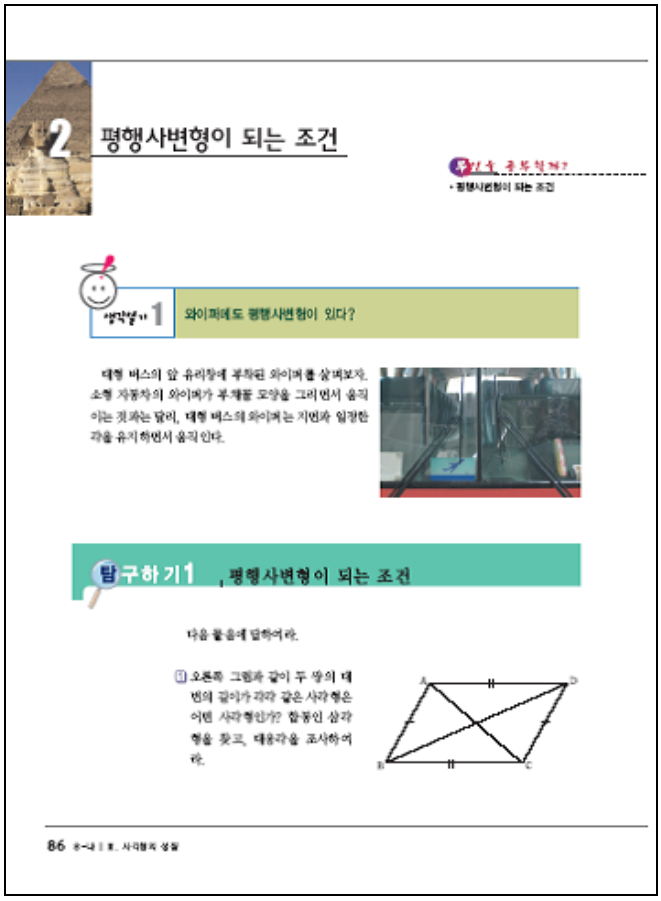
이 그림에 나타난 삼각형들은 왜 닮은 삼각형일까? 그리고 어떤 특징이 있을까?

132 8-나 | Ⅳ. 도형의 닮음

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

4.3. Windshield wiper

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



Mathematics used is a well-known property of a parallelogram. Namely, if the lengths of two pairs of opposite sides of a quadrilateral are equal, respectively, then this 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 another half of our communication means with another half being language. But people usually do not realize the importance of mathematics in our daily life. In the era of information age 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 general public do not appreciate the assets of mathematics. We have to arouse public interest toward mathematics. In many countries like Korea mathematics is regarded as a mean to enter a high educational institute and completely forgotten after public education. Hence the time is ripening for mathematicians to work together to raise public interests on mathematics. One way to do so is that we mathematicians find many every day household goods that contain 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 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/