

Chapter 6

Gifted Education in Korea

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Abstract

Gifted education appears to be gaining much popularity lately as it has become a hot issue in the Korean education circle. Consequently, the issue relating to gifted education has been gaining momentum, and interest and support by Korean government have been increasing.

In Korea, gifted education in mathematics is designated to be implemented in three ways: in gifted high schools, in gifted education centers as a pull-out program, and in gifted classes as a pull-out program in regular schools. Currently, 16 gifted science high schools and the Busan Science Academy, 15 gifted education centers affiliated with universities, and gifted education centers run by 93 school boards and 206 schools are providing gifted education programs for about 13,000 elementary and secondary students in total.

I. Introduction

The needs for gifted education can be considered from two perspectives, the personal perspective and the national perspective. On the personal perspective, gifted education helps develop individual's potentials and interest to the fullest. On the national perspective, developing students' aptitude in mathematics and science to become exceptional by means of a compatible curriculum would have a significant impact in the fields of mathematics and science and would decisively contribute to the nation's competitive edge. Especially, as the societal needs of creative human resources are increased in this era of rapidly developing science and technology, all nations around the world strive to make efforts towards building their education systems to develop top-rank creative human resources. Korea, as a nation mostly depending on advanced development of science and technology for its growth and economic competitiveness, has to inevitably invest in gifted education. Fortunately, enthusiasm by Korean parents for education has induced an enormous increase in the demand for gifted education. In this section, the historical development of gifted education in Korea will be briefly reviewed, and then the overview of gifted education in mathematics will be presented.

II. Historical development of Gifted Education in Korea

Gifted education in Korea did not draw much attention until a science high school was established in 1983. The establishment of a science high school was considered as the first effort under the Ministry of Education. In 1995, the government introduced acceleration systems including early entrance into elementary school, grades skipping and early graduation. In 1997, special admission to universities for prizewinners from international competitions has also been set up. This policy tended to induce students, parents and teachers to put their efforts to acceleration rather than enrichment.

Recently, Korean gifted education has been rapidly developing with the new Gifted Education Law, which was proclaimed in 2000, and became effective since March 2002. The Law and Act of Gifted Education provided a legal foundation for gifted education. According to the Law, gifted education is implemented in three ways: *gifted high schools*, *gifted education centers* as a pull-out program operated by universities and school boards, and *gifted classes* as a pull-out program in regular schools.

After the first establishment of a science high school in 1983, more science high schools have been instituted in consecutive years and currently there are 16 science high schools. In addition, the Busan Science Academy was established as an official gifted school in 2001. With the financial support by the Ministry of Science and Technology, 15 gifted education centers affiliated with universities have established and are currently providing enrichment programs of mathematics and science. Currently more than 3,000 students attend enrichment classes during weekends as well as summer and winter vacation at gifted education centers affiliated with universities. Pull-out classes of mathematics gifted education have also been implemented as after-school or extracurricular activities by 16 provincial offices of education. About 7,000 students ranging grade 4-9 are enrolled in gifted classes.

III. Overview of Gifted Education in Mathematics

Gifted education is mainly implemented following three processes: student selection, education, and evaluation for reselection. In this section, student selection and educational program at science high school, the Busan Science Academy, and gifted education center affiliated with universities will be presented.

1. Science High School

Students Selection

To recruit students with great potential in mathematics and science, science high schools administer the interview and oral test as well as the written test to diagnose students' problem solving ability in mathematics and science. The qualification of application to science high school is given to the students who rank high in mathematics, science or information technology olympiad or nationwide contests. In addition, high achievers in all subject areas from junior high schools also have opportunity to apply. As a result, science high schools are composed of a very homogeneous group of students by limiting the qualification. This admission policy resulted in that the exceptionally talented in one particular subject of either mathematics or other science who are not the prizewinners do not get a chance to be admitted (Seo, *et al.*, 2004).

Educational Programs

When the first science high school was established in Korea, the need for a differential curriculum was recognized. Major characteristics of curriculum at science high school include: more advanced levels of mathematics and science; more science laboratory and inquiry activities; and many elective courses.

However the curriculum provided at the science high school is not much different from that of ordinary high schools. The most prevailing reason for the similarity is the fact that no special privileges are given to the science school graduates in college entrance. In addition, students in science high schools have to be tailored to the curriculum rather than the curriculum is planned to meet individual students' unique characteristics such as ability, achievement, and interest areas at various levels. Even if many elective courses have been included in the national curriculum for science high schools, the schools cannot open all elective courses that students may select due to lack of teachers for specific subject areas as well as limitation in the number of teachers employed at one school.

Moreover, the priority policy for university entrance given to graduates from science high schools was abolished in 1999. Consequently, graduates of science high schools do not take much advantage for university entrance. Their GPA, which is one of the most significant factors in getting admitted into prestigious universities, is assessed as the same as that of the graduates from regular high schools. As a result, students usually spend more time and effort in getting

higher GPAs in courses rather than taking challenges for creative independent research.

2. Busan Science Academy

Recently, more criticisms raised from deviated implementation of curriculum in science high schools urgently called for reform. With the Gifted Education Law, the reform efforts for science high schools became a reality, and Busan Science High School was established in 2001.

Students Selection

Lessons and reflections upon the science high school admission policy, BSA introduced a new set of admission policies to recruit students. Instead of employing the old policy of selecting students out of high achievers in all subject areas in junior high schools, the new admission policies require applicants to demonstrate high potentials in mathematics and science achievement, creativity, and task commitment.

The selection process of new entrants to BSA consists of three phases. In the first phase, applicants have to submit their GPA scores in all subjects as well as mathematics and science areas and/or winner's records in math and science contests at local, national, and international levels. For the second phase, the tests of creative problem solving abilities in mathematics and sciences are administered to students who have passed the first phase. The main emphasis of this test is placed on how they approach and solve problems. The test does not attempt to evaluate how much students memorize concepts and facts. The third phase of the selection process is designed as a four-day long camp. Students have to demonstrate their abilities in identifying problems, designing experiments, collecting data, drawing conclusions, and presenting and communicating results in front of audience.

The new admission policies to BSA make attempts to select students who possess high potentials and achievement in mathematics and science knowledge and skills, creativity and problem solving abilities, and task commitment.

Educational Programs

The goals of the curriculum for gifted students in BSA are as follows: 1) to help students develop a well-harmonized character along with a sound body and mind and a mature sense of self-identity; 2) to help students enhance their leadership skills and sense of responsibilities, and develop abilities which can lead the stream of social changes; 3) to help students endeavor to

build and develop the national community and to develop an awareness and attitude as global citizens.

Under the above goals of BSA, the directions of curriculum development were set up. First, the curriculum reinforces mathematics and science in order to help the students grow to become creative scientists in the future. Second, it focuses on enhancement of creativity and higher-order thinking through enrichment rather than acceleration. Third, contents of curriculum and methods of instruction are designed in various ways in consideration of each students' ability and aptitude. Fourth, extracurricular and community service activities are emphasized for student's affective and social development.

Characteristics of the curriculum for BSA are summarized as follows:

- The curriculum has minimum graduation requirements, 175 credits in 3 year so that the students can control the schedule of courses by themselves.
- One of the up-to-date science technology courses (BT, NT, ST) must be taken.
- Extracurricular and community service activities are reinforced.
- Advanced Placement courses as acceleration are offered
- Foreign languages and computer skills are emphasized during specialized courses taught by textbooks written in English.
- The independent study is imposed to enhance the student's self-learning and research abilities.
- Mentorship is offered to develop creative problem-solving abilities, research skills, refinement of thinking processes, and commitment needed to extend the limits of existing knowledge.
- The entrusted education programs offered by university professors are introduced to gain valuable knowledge and experiences applicable to their future advanced education and careers.

The curriculum for BSA is composed of *subject matters*, *independent studies*, and *extracurricular activities*. Subject matters consist of general courses for developing a well-rounded personality and major courses in mathematics and sciences. General and major courses are consisted of required and elective courses. Students are encouraged to conduct independent research projects, where they can choose their research topics depending on their own interests.

Entrusted education program at local/international universities or institutions during the vacation period are encouraged for highly exceptional students. Extracurricular activities include participating in the student body, adjustment training, club activity, development programs, various events, and voluntary community service.

<Table 1> Minimum number of units for courses in subject area for 3 years at BSA

Subject area		Required courses	Elective courses		Sub-total
			General	Intensive	
General subjects	Korean	8	4		12
	Social studies/History	5	12		17
	Foreign language	8	12(4 for second foreign language)		20(4)
	Art and physical Ed	9	2		11
Specialized subjects	Mathematics	10	6	32	85
	Sciences	24	6		
	Computer sciences	4			
	Up-to-date science technology	0	3		
Independent study		20	0	0	30
Entrusted education program		10	0	0	
Extracurricular activities (club, etc)		More than 40 hours per year			
Extracurricular activities (community service)		More than 40 hours per year			
Grand total					175

* An academic year in BSA is composed of two semesters and each semester includes 16 weeks. One unit implies that a course in subject area offers a 50 minutes period per week for one semester.

* For mathematics, 14 courses are offered: 2 AP courses, linear algebra, differential equation, etc.

The curriculum for BSA was designed to bridge in-depth studies and interdisciplinary studies, to facilitate wholesome development of students, to maintain a balance between

acceleration and enrichment, to diversify the instructional materials and methods considering different aptitudes, abilities and interests of students, to expose students to trendy mathematics and science and self-directed research, and to foster the responsibility of students for society by recognizing their potential roles as leaders.

3. Gifted Education Centers Affiliated with Universities

Students Selection

Whom and how to select is the first issue that we encounter when we implement gifted education programs. As a matter of fact, there is no agreed definition about a gifted student and there have been many different opinions presented regarding how to distinguish gifted students. Although different studies suggest different criteria, two common criteria they share are ‘multiple-step evaluation processes’ and ‘evaluation based on mathematical creativity or advanced mathematical thinking capability.’

The Gifted Education Centers(GEC) affiliated with Chongju National University of Education adopts such criteria as their basic principles to select gifted students and implement them in its three-step selection process: application screening that include recommendations from teachers and parents, problem solving tests that assess students’ mathematical creativity and advanced task-solving tests in high difficulty level. Among the three-step selection process, recommendations do not serve as an important criterion for selection. Thus, only a mathematically meaningful set of problems can be a reliable tool to select truly outstanding students with mathematical talent. In this regard, it is most important to develop problems different from those practiced at numerous private institutions that are attracting many students preparing for selection examinations for gifted students. If the students studying at these kinds of institutions are selected and enter GEC, the general public will think that anyone can be trained to become a gifted student, which might trigger competition to spend exorbitant amounts of time and tuition for private education (Lee *et al.*, 2003).

What follows is an example from a selection test of GEC administer for elementary school students. The following problem asks to see if a student knows the meaning of multiplication algorithm and is able to explain it.

It is said that ancient Egyptians calculated the multiplication of 46×78 using the following method. Please explain briefly why they added only the underlined part in the following calculation.

$$\begin{aligned} 46 \times 78 &\Rightarrow 46 \times 1 = 46 \\ &\quad \times 2 = \underline{92} \\ &\quad \times 4 = \underline{184} \\ &\quad \times 8 = \underline{368} \\ &\quad \times 16 = 736 \\ &\quad \times 32 = 1472 \\ &\quad \times 64 = \underline{2944} \end{aligned}$$

If you add up the underlined parts
 $92 + 184 + 368 + 2944 = 3588$,
then the answer is 3588

Among the students who aspire to enter and study at GEC, hardly any of them are unable to multiply two double-digit numbers. Therefore, the above problem does not ask how to perform the multiplication but leads a student to think about the main ideas of multiplication algorithm and compare it with the ancient Egyptian method. Some students who had correctly answered all the problems according to the ‘competition style’ were unable to understand this basic problem and answered in a completely wrong way. The algorithm of the vertical multiplication of two numbers is based on the understanding of the decimal system and the distributive law.

This problem was novel to the students because none of them had been exposed to the questions prior. The structure of this problem is not complicated and the problem solving process is not lengthy. Accordingly, the process of solving this problem can be considered an appropriate criterion of a student’s mathematical ability.

Educational Programs

The enrichment programs for elementary students developed by GEC can be divided into four types: experimental, group discussion, open-ended problem solving, and exposition (Kim, 2001). In the secondary level, what follows is the general features of study topics in enrichment programs (Shin, 2000).

- *The study topics that would inspire the motivation to solve the problem*

ex) What is the strategy to get a car in the Monty Hall dilemma?

- *The study topics that are conducive to developing the factors of initiative (A-E)*

A. sensitivity toward the task

ex) Explain, in mathematical expression, the principle of ladder climbing game.

B. fluency in thinking

ex) To produce the numbers between 1 to 100 with four numbers 1, 9, 9, 8 and four arithmetical operations, square root, square, factorial, and exponent.

C. flexibility in thinking

ex) Discuss the differences between two-, three- and ten-dimensional spaces.

D. originality of thinking

ex) A probabilistic proof (A bag contains two pebbles. There are three possibilities: two whites, one white and one black, or two blacks. I have a bag with two whites. How can I prove that my bag has two whites without showing the contents?)

E. perseverance

ex) Try to find a continuous curve filling in a box.

- *Exercises for self-motivated study*

ex) Find the counterfeit coin using the balance scale. "Of the three coins, two are genuine and one is the counterfeit, which is lighter than the real coin, but is impossible to visually tell apart. Can you isolate the counterfeit coin, using the balance scale only once?"

- *Diversification of study tools*

ex) Write two programs (using BASIC and LOGO) for factoring and for expressing the input natural number in the binary system.

- *Study tools to stimulate cooperation and competition*

A gifted education program that emphasizes the aforementioned topics helps students develop a thinking ability that processes a deeper understanding of basic mathematical concepts, ultimately nurturing them to become creative problem solvers, and enables students to attain an integrative and interdisciplinary understanding of knowledge and skills in diverse fields so as to become knowledge creators.

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