



Gifted Education in Korea:

Three Korean High Schools for the Mathematically Gifted

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Introduction

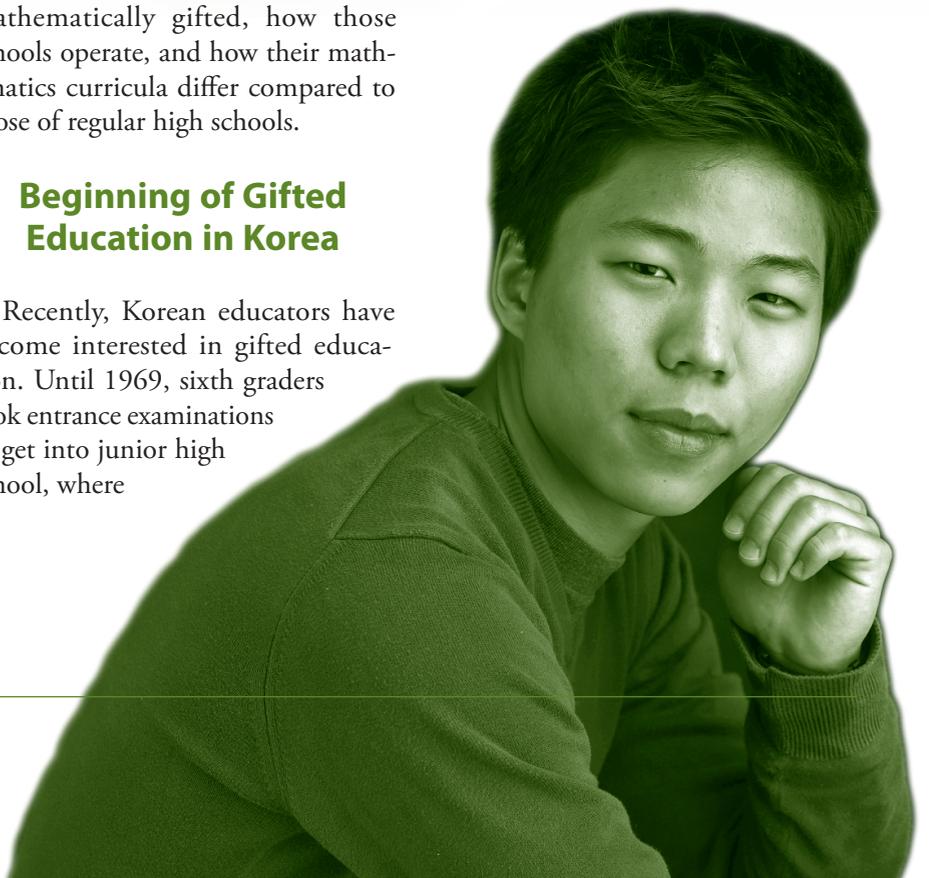
Korea is one of a few countries known for its mathematics achievement. Findings from studies such as the Trends in International Mathematics and Science Study (TIMSS) 1999 and 2003 and the Programme for International Assessment (PISA) 2000 and 2003 have consistently shown that Korean students do well in mathematics. As a result of such comparative studies, there has been a growing interest in mathematics achievement at the international level. Participants in TIMSS and PISA are elementary, junior high, and high school students, including gifted students. Although educators in other countries have developed schools and programs for gifted students (Donoghue & Vogeli,

1998; Holton, 1995; Vogeli, 1997), this paper will present a brief history of three Korean high schools for the mathematically gifted, how those schools operate, and how their mathematics curricula differ compared to those of regular high schools.

Beginning of Gifted Education in Korea

Recently, Korean educators have become interested in gifted education. Until 1969, sixth graders took entrance examinations to get into junior high school, where

mathematically and scientifically talented students could attend specialized



junior high schools along with equally talented peers (Cho, 2003). With the implementation of the Equalization Policy in 1969, entrance examinations into junior high school were abolished to reduce the competitiveness among elementary school students. In 1974, the highly controversial High School Equalization Policy (HSEP) was placed into effect, where students were assigned to high schools in their districts by a lottery system. Critics argued that the HSEP was not equitable or efficient because many potentially gifted students were assigned to high schools in their districts without sufficient academic consideration. This concern was very similar to what educators in New Zealand went through before founding the New Zealand Mathematical Olympiad Committee (NZMOC; Holton, 1995). In 1983, 9 years after the introduction of the HSEP, the first Korean high school for gifted students in science and mathematics, the Gyeonggi Science High School was founded (H. Kim, 2006; Kwon, 2007). This was considered the beginning of gifted education in Korea.

Korean Specialized High Schools for Mathematics and Science

Currently, 17 public mathematics/science high schools exist in Korea. They are distributed equally throughout the southern part of the Korean peninsula with one in each province, one in each metropolitan city, and two in the city of Seoul and are operated by the Ministry of Education and Human Resources Department. Students can only apply to the school that is located in their province/city. However, considering the commute time, some schools offer boarding for students who choose this option. In addition,

Table 1
Major Differences Between Science High Schools and the Korean Science Academy

	Science High Schools	Korean Science Academy
Admissions Qualifications	Middle school graduates	Middle school graduates and current high school students
Area Restriction	Corresponding area within the province or city of residence	From all parts of the country
Curriculum	Nationalized curriculum (216 credits required)	In-depth curriculum in mathematics and science
Teachers	License required	Professionals in the area without a license are encouraged

the Ministry of Education and the Ministry of Science and Technology operate the Korean Science Academy (KSA), although it is not considered a specialized high school. The KSA selects students from all parts of the country. The KSA can modify its courses as needed because there is no curriculum regulation, whereas the other science high schools are required to use the national curriculum (Cho, 2003). Table 1 shows the major differences between science high schools and the KSA. Another school, the Korean Minjok Leadership Academy (KMLA) is an independent private high school, not considered specialized, but its outstanding achievements are evidence of its significance as an institution for the gifted. Among these 19 schools, this article will review one of the specialized public high schools, the Seoul Science High School (SSHS); the Korean Science Academy (KSA); and the Korean Minjok Leadership Academy (KMLA).

The KSA and KMLA are not specialized high schools under Korean educational regulations. Korean private high schools, despite being called “private,” receive financial support from the government as long as they follow

regulations regarding things such as tuition, curriculum, and admission of students. On the other hand, for a school to be autonomous, it must support itself financially without any funding from the government. This kind of school is classified as an independent private school where selection of students is free from governmental control and whose tuition should not be more than three times that of public high schools.

Mathematics/Science Public High Schools—Seoul Science High School (SSHS)

Among the 17 public specialized mathematics and science high schools, one of the best-known schools in terms of accomplishments of its graduates is the Seoul Science High School located in Seoul, the capital of South Korea. The Seoul Science High School opened in March 1989. Its main purpose was to serve mathematically and scientifically gifted students in the Seoul area because ordinary high schools were not able to meet their special needs. Until this time, there was no significant movement in Korea to educate gifted

students for their unusual interests and needs in regular public schools. The second science high school, the Hansung Science High School, opened in 1992, and joined the Seoul Science High School in serving gifted students in the metropolitan area of Seoul.

The SSHS was the first school to implement an acceleration system, which allowed students to complete their high school education in 2 years and enter the Korea Advanced Institute of Science and Technology (KAIST), considered one of the best higher education institutions in Korea specializing in science and engineering, to pursue their specific interests in mathematics and science. Many Korean educators did not welcome this action because there was no general acceleration system in place. However, this program continues to be very successful with around half of the SSHS students going on to the KAIST after early graduation. Since then, a large portion of its graduates continue to enter the KAIST after 2 years of high school study.

Admissions

SSHS selects about 140 (seven classes of 20 students each) middle school graduates every year. Currently, students can be screened in several ways. With “special screening,” priority is given to winners of various national Olympiads. A maximum of 36 students who have won medals in the Korean Mathematics, Science, or Information Olympiads are admitted by this method. Additionally, those who have been chosen to participate in International Olympiads are accepted without further processing. Up to 20 students who are within the top 2% in their science and mathematics classes at their school and recommended by their middle school principals also can

be selected through special screening (Jeon, 2004).

The second route for screening is through “standard selection” via a series of evaluations of transcripts and recommendations, oral tests to assess students’ creative thinking, and interviews.

The third method of screening is limited to an additional 15% of the student pool for participants of government certified gifted centers, those returning from foreign countries, or children of a person of merit.

After screening, the standard selection process begins. A small number of top-ranked students in Mathematics or Science Olympiads and those recommended by school principals are automatically accepted through special screening. The remaining students who have a grade point average in the top 10% in mathematics and science classes from their middle school are orally tested and interviewed on site. From this, 140 students are selected from the special and standard selection processes. In addition, as many as 21 students, or 15% of the pool, from underprivileged areas can be selected according to the revised 2006 Gifted Education Promotion Law.

This current admission process has only recently been developed. Until the 1990s, there was a standardized entrance exam for specialized high schools, including foreign language high schools.

Curriculum

Although SSHS is a public school, it has partial autonomy in choosing courses to offer its students. According to the school’s 2005–2006 curriculum plans, students are required to take a certain number of accelerated and enriched mathematics and sciences courses in addition to regular courses that the Ministry of

Education (MOE) offers to all Korean high school students.

Enrichment courses include one semester on an individual research project, nature explorations and investigations, and various lab classes. Individual research projects are required for all 10th- and 11-grade students. Students select one topic in mathematics, physics, chemistry, biology, or Earth science at the beginning of the school year, plan their research, record their activities, and present the results of one of their research studies to the class at the end of the school year. Visitations and collaborative studies are recommended for further experience in the field. In nature, explorations, and investigations, groups of students visit specific sites to investigate geological features and biological aspects or to perform outdoor experiments. Throughout the explorations and research, students are expected to understand the process of research, set up hypotheses and carry out experiments, analyze results, and derive conclusions.

Accelerated instruction occurs when students complete the regular 3-year mathematics curriculum in a year. The accelerated courses include college-level mathematics with topics in discrete mathematics, linear algebra, differential equations, and possibly more advanced courses for qualified students. Close association with universities and institutes yields distinct opportunities, such as lectures on current topics by famous scholars and professors, to stimulate student interest in the fields and trends of high-level mathematics and science.

Preparation in the Mathematics and Science Olympiads is an important part of what special programs provide. Students are selected based on achievement on preassessments and individual interest. For Olympiad preparation courses, teachers at the SSHS continu-

ally develop mathematics and science materials in accordance to Olympiad preparations. Selected students are offered enrichment courses. Textbook content in these courses are more advanced than those of Korean college freshmen courses, such as probability and statistics, discrete mathematics, and advanced mathematics and calculus. If necessary, mathematicians and scientists from higher educational or research institutions are invited to give lectures in advanced topics. The main goals of the courses are to develop students' scientific research abilities and creative problem solving. Students also may find areas of interest while taking theoretical and experimental courses.

Although this school specializes in mathematics and science, courses in foreign languages, literature, economics, and social science also are emphasized as much as they are in the regular secondary school curriculum. Considering the intelligence of its students, the school provides many elective courses such as advanced foreign languages and international history. Foreign language courses are taught by native speakers of the language, which is not usual in Korea. In fact, the school has an "English Only Zone" where only English must be spoken in this area. In addition, events such as drawing or essay-writing competitions take place every year for students to present and develop their abilities in these areas.

Students

Every year, the SSHS sends students to the International Mathematics Olympiad (IMO) and other science Olympiads with astounding results. At the 2007 IMO, the six-member Korean team comprised of four SSHS students was awarded a total of six gold and silver medals. Three students from the school made the International Physics

Olympiad team with two peers from other schools and received two gold medals and one silver. In 2006, three participants of the IMO were SSHS students and two were awarded gold and one was awarded silver medals. For the Physics Olympiad that year, the three students who participated all won gold medals. Three students participated in the Chemistry Olympiad, with one winning silver and two being awarded gold.

The true value of students' abilities, however, is seen after graduation. About half of the students graduate in 2 years and enter the KAIST majoring in science or engineering. Most students who graduate after the third year enter prestigious Korean universities and some go abroad, mostly to the U.S. A large proportion continues their studies in various graduate schools, including medical or law schools. According to the principal of the SSHS (H. Kim, 2006), within the 17-year history of the school, the SSHS has produced 2,331 graduates. Among them almost half (47.6%) entered Seoul National University and close to one third (29.6%) entered KAIST. Moreover, 217 graduates have earned doctoral degrees and more than 300 are in doctoral programs.

Teachers

Teachers are hired at the discretion of the principal. A number of teachers hold master's degrees in related fields and some hold doctoral degrees. In addition to these full-time teachers, lectures about recent developments in the science fields are provided once a month by outside speakers, mostly professors or doctors in related fields. With such highly qualified teachers, students can access more advanced knowledge and pedagogical methods. Teachers in the SSHS continue to research one topic a year even though

they are already knowledgeable in their subject areas. In this way, teachers do not lose their academic focus and remain engaged as scholars. Observing their teachers' learning and studying is one way students are able to find role models.

Independent Private High School—Korean Minjok Leadership Academy (KMLA)

In 1996, philanthropist Myung-Jae Choi started KMLA with his long-term educational philosophy to cultivate young gifted and talented students to be future leaders of the world. The school he built was radically different from any existing Korean high school. The school was built in a rural area far from Seoul so that the environment would not be disturbed. Because of its location, it was uncertain if many students would want to attend. Mr. Choi's principal ideology of the school seemed too ambitious to fit the public's common understanding of schooling. Despite these issues, he opened the school in 1996 using his own financial backing.

In its first year, 30 students entered the KMLA and about half continued. The dropout rate may be explained by distinctive Korean educational characteristics, which relate to college entrance exams. College entrance examinations are highly competitive in Korea and generally almost all high school seniors, not counting high school seniors in vocational high schools, want to enter certain universities. Most colleges and universities have similar criteria, which include high school grades in terms of ranking of students, not just grades themselves (30%), a once-a-year standardized entrance exam called Su-Nung-Shi-Hum (the Scholastic Aptitude Test

for College Entrance; 40%), and an essay and interview (30%). Most likely, KMLA students worried about their high school ranking. It is possible that all of them would be top-ranked if they attended any other high school, but at KMLA, a student could be ranked at the bottom and lose 30% of the standard criteria, which would be guaranteed if they attended any other school. This was a critical consideration for the KMLA administration. In partial response to maintain its student population, the school began study-abroad classes. These classes have been considered successful because of the continual increase in the number of students attending prestigious colleges abroad. In 1999, among the first graduate class of the KMLA, two students entered schools abroad after completing high school in 2 years, with one entering Cornell University. In 2001, three students entered MIT, Columbia University, and Amherst College. By 2006, 138 of its 341 graduates continued further studies in prestigious universities around the world.

There are several unique and interesting characteristics about the KMLA. First, students wear traditional Korean clothing called Hanbok in observance of their national spirit despite their pursuit of accelerated modern learning. The second interesting fact is the “English Only” policy in classes aside from Korean literature and Korean history. This policy is based on Mr. Choi’s conviction that speaking perfect English is essential for students to be global leaders, as the name of the school reveals.

Admission

The KMLA is not considered a specialized gifted high school like the Seoul Science High School by the Korean educational system. Despite this, the KMLA has been able to

select highly gifted students who are attracted to its English-only policy, its highly qualified teachers, tuition-free system, and its educational philosophy. Today, the KMLA accepts 15 classes of 10 students each, 150 students, through a very competitive admission procedure.

In the initial documentation screening of the admissions process, students have to provide their GPA, records of awards such as Olympiads, and certificates. Although there is no specific GPA requirement, admission is extremely competitive with students in the top 3% considered eligible. Winners of various Olympiads are desirable as well. Because the policy of the school is to use English, students are required to show basic ability in English, through the Test of English as a Foreign Language (TOEFL).

Those who successfully pass the document screening go on to a written examination that measures logical, creative, and rational thinking abilities and problem-solving skills. For those who pass this step, oral tests on academic knowledge and humanity, as well as an examination of physical strength, are given. If a student’s family is not able to pay the tuition, which is no longer free, the school offers scholarships to cover tuition and boarding expenses.

Curriculum

A slogan at the KMLA is a “3-step education,” which includes (1) Teaching/Lecture, (2) Discussion/Debate, and (3) Writing/Tutoring. During Teaching/Lecture, highly dedicated and well-prepared teachers prepare gifted students for advanced-level learning by lecturing and discussing basic concepts for concrete understanding. Students can always approach teachers to ask questions and polish their ideas after school hours. During

the Discussion/Debate step, students discuss and exchange ideas with peers and develop deeper and critical thinking abilities. From this step, students build logical thinking, the power of persuasion, and an effective way to present their own thinking. Through Writing/Tutoring, students make sure there are no deficiencies in their knowledge and understanding in one-on-one sessions with their teachers.

In addition to offering courses within the curriculum guidelines of the Ministry of Education, the KMLA has a distinctive innovative curriculum. Accelerated and enriched courses are offered throughout all mathematics and science classes. Inviting outside lecturers in science courses allow students to stay current in the field. One example is inviting a distinguished scientist to explain the contribution of the Nobel Prize of the year. During vacation, students visit institutions and universities to research and learn about topics not covered in the school curriculum. Many elective courses are available, especially for those who have interest in the Olympiads. Invention competitions and exhibitions of students’ projects also broaden students’ avenues to explore.

In 2006, the College Board recognized the KMLA as having the strongest AP courses in the world (College Board, 2006). Because students of the school often plan to enter universities in the U.S., Advanced Placement (AP) courses undoubtedly help students in their preparation.

The school develops nonacademic abilities in leadership. Students are encouraged to participate and earn certificates in foreign languages, including French, Chinese, German, Spanish, and English; Tae Kwon Do or other Korean sports; artistic performances; and reading classical literature. These are certainly areas that the academically intelligent could care less about

than academics, but at the KMLA, students are encouraged to be a part of these programs.

Students

The KMLA student body is well-known for its out-of-school activities. Their volunteer activities often are shown in Korean media. Some examples include teaching children from poor and rural families and offering interpretation services for international events (Kim, 2007). KMLA students' generosity has been featured in a major newspaper in recognition of their volunteer activities and community service (S. H. Kim, 2006; Lee, 2008). While students earn many awards in singing, sports, recitation of poetry, and plays, their peers at other schools spend time preparing for the college entrance exam, which is considered the most important aspect in Korean high school students' lives.

In terms of academic achievement, the KMLA's Web site lists students who have received awards from various Olympiads and academic competitions (KMLA, 2007). The KMLA proudly reports that more than 3,000 of its students have earned recognition from national and international competitions during its 10-year history. In 2007, KMLA students participated in the American Invitational Mathematics Examinations (AIME). The KMLA was awarded the AMC 12 School Honor Roll where three of its students advanced to the United States of America Mathematics Olympiad (USAMO). In 2006, one student won gold at the IMO and one won at the International Chemistry Olympiad; another student won a gold medal at the International Biology Olympiad in 2005. Two students presented their work at international conferences and were published in a SCI-expanded magazine. In 2004, two KMLA stu-

dents advanced to the International Biology Olympiad with one gold and one silver awarded while another brought home a gold medal from the International Physics Olympiad.

Most graduates of the KMLA enter prestigious universities in Korea, the U.S., England, Japan, and China. It was big news when a first-year graduate of the KMLA entered an Ivy League college because the preparation process is completely different from that of Korean colleges. So far, about one third of its graduates have entered well-known universities in the U.S. *The Wall Street Journal* (Gamerman, 2007) reported that the KMLA is one of two foreign high schools ranked in the top 50 high schools with the best record of graduates attending the top eight colleges in the U.S.

Teachers

Hiring qualified teachers, especially for gifted students in a rural area, is especially difficult. The school also wants teachers who are able to lead classes in English and native-speaking teachers to teach foreign languages. Thus, the founder of the school offers at least 1.5 times more salary than what public schools offer. In addition to the higher salary, the school also provides teachers' housing.

From the principal to its faculty, the staff at the KMLA is well-qualified. The principal is a former secretary of the Ministry of Education and a former dean of the education department at Seoul National University. Teachers at the KMLA hold at least a master's degree in relevant subjects.

Lecturers from universities and other institutions are an important part of the KMLA. Also, students have opportunities to visit institutions and universities to research areas of interest. For instance, two students in 2005 published their work after

being instructed by a professor at Pusan University. This kind of opportunity allows students and teachers to stay up-to-date. Being around famous mathematicians and scientists offers an abundance of role models for students to emulate.

One of the benefits of residential school is cooperative learning outside of the classroom. Because all students live in the dormitory, they spend most of their time with peers. During classes or after school, students discuss what they have learned and exchange their thoughts.

Korean Science Academy (KSA)

In 2000, the Ministry of Education and the Ministry of Science and Technology proposed the law for the advancement of gifted education. After studying exemplary specialized schools in Russia, lawmakers decided to adopt the bill and found such a school. Among existing science high schools, the Pusan Science High School was evaluated to be most suitable to convert. Thus, in 2003, the Pusan Science High School was reorganized and renamed the Korean Science Academy (KSA). The KSA has a unique system in which students graduate as soon as they complete the required credits, similar to what college students do.

The committee studied Russian, American, and Israeli special schools before designing the KSA. To learn from their systems and promote student collaboration, the KSA has associations with other famous international specialized schools, such as the Kolmogorov Mathematics and Science School, 239 Physical-Mathematical School in St. Petersburg, the Illinois Mathematics and Science Academy (IMSA), and the Israel Art and Science Academy. For example, as

a result of collaborative work, one KSA student and a Russian student recently published together in a chemistry journal. Interchanges with such schools encourage teachers to make more of an effort to guide and stimulate talented students to broaden their perspectives.

The Pusan Science High School opened in 1991, and its students have shown enormous abilities in mathematics and science. Students have received awards from various competitions and recognitions and have entered prestigious universities and science institutions in Korea and the U.S. After the Pusan Science High School reorganized to be the first science academy, the city of Pusan opened a new science high school to serve the area.

Students who graduate from the KSA can enter highly ranked universities such as Seoul National University, KAIST, and Pohang University of Science and Technology (PUST) without any screening process. In the current Korean college entrance competition, this guaranteed special admission demonstrates the merit of specialized education for the gifted.

Admissions

Unlike science high schools, students from any part of the country can apply to the KSA. The KSA has a three-step admission process. First, students are recommended by teachers and submit portfolios, which clearly show the individual's achievement and talent, personal statements, and records of awards. For those who pass the first round, applicants' creativity and problem-solving abilities in mathematics and science are assessed by oral and written tests. At this stage, the admission committee selects 216 students and invites them to a science camp. During the 5-day camp, staff members observe and evaluate stu-

dents and interview each to make a final determination.

Curriculum

The academy is a 3-year program; however, students who are eligible to accelerate can graduate as soon as they successfully complete 135 credit hours of courses. Students with a 3.7 or above GPA the previous semester can take as many as 28 credit courses the next semester. During summer and winter breaks, students may take courses as well. In this way, students are able to graduate early and enter KAIST, SNU (other Korean universities do not accept early graduates), or universities overseas.

The KSA curriculum requires 170 credits to graduate including 135 credits of subject courses and 35 credits of research activity. Korea has a national curriculum that requires all educational institutions to teach its students the same basic knowledge. Subject courses consist of basic courses and professional courses. Basic courses set forth by the Korean national curriculum require the teaching of subjects such as Korean history, art and physical education, moral education, and social sciences and are offered every semester with a requirement of at least 27 credits. Professional courses include accelerated and enrichment courses in mathematics, sciences, and technology. The proportion of professional courses is about 60% of total courses offered.

In addition to the two types of traditional courses, students work on individual research and extracurricular activities. Each student chooses a topic of research at the beginning of the school year in the area of mathematics or science. The research is carried out throughout the school year. Students work on their individual projects on Saturdays and are encouraged to visit universities or research institutions

during vacation to participate in experiments or in-depth studies. At the end of the year, participants write a paper on what they have studied and present the results. Seniors perform another type of research called a "graduate thesis" for a semester under an advisor. To maintain the quality of the study, each advisor is only allowed to work with up to six students per semester.

Students

The KSA began in 2003 and graduated one class of 144 students in the spring of 2007. However, their achievement in terms of continuing study is impressive. Only seven students, who decided to study in nonscience areas, dropped out of the KSA; 17 went to schools abroad such as MIT and Columbia University; 24 were accepted to Seoul National University; 89 to KAIST; 16 to PUST; and 5 entered other universities. Many of the graduates were awarded scholarships from different institutions and from private sectors as well. In 2005, two students participated in the International Physics Olympiad and International Astronomy Olympiad, which resulted in two gold medals.

Teachers

As of 2007, the ratio of students to teachers in KSA is approximately 7:1. Out of 88 teachers in 2007, more than half (53.4%) have doctoral degrees in relevant fields. Because the KSA is supported by the Ministry of Science and Technology, it maintains a close relationship with the Korea Advanced Institute of Science and Technology, with some KSA faculty members being professors at the KAIST. Also, students frequently go to SNU and PUST to get assistance for their research courses, and professors of those universities

come and visit the school to support students' learning.

In addition to the high qualifications of its teachers, the teachers participate in continuous training in gifted education and pedagogical methods. The school sends its teachers to internationally famous special schools for the gifted and talented, such as the Illinois Mathematics and Science Academy (IMSA) in the U.S. and the Kolmogorov Math and Science School in Russia. Thus, the faculty is academically and pedagogically well-supported.

Summary

This paper introduced three specialized Korean high schools for gifted students. It presents some insights on gifted education in Korea in terms of admissions criteria, curriculum offered, and the student and teacher population at these three different types of schools. The review of specialized, science, and private schools offers a glimpse at their similarities and differences and clear distinctions when compared to regular high schools. By attending schools where their peers are equally talented in mathematics and science, taking advanced classes, and having chances to attend schools abroad, gifted students have better support than students who attend other high schools. Administrators and educators still need to develop equitable admissions standards and suitable curriculum and experiences to further enhance the gifted students' high school experience. **GCT**

Author Note

Information about the three schools in the paper was obtained from the schools' Web sites:

- Seoul Science High School: <http://www.sshs.hs.kr/doum/index.jsp>
- Korean Minjok Leadership Academy: <http://www.minjok.hs.kr>
- Korean Science Academy <http://www.ksa.hs.kr>

Additional Resources

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