

# New horizon to help the young scientists in Korea and international relationship

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**Abstract.** Mentorship programs for the young scientists in Korea have been begun since 2003. For four years 561 topics for mentorship program were selected and carried out under the guidance of 561 mentors. The procedure of applying and being selected research and education, R&E, programs as mentorship programs was introduced, and results of mentorship and responses of the participants were analyzed. From 2005 abroad research internship programs were offered to the teachers of Science High Schools and 38 teachers for two years had opportunities to do research experiences in the field of their majors. They are expected to guide students to prepare for mentorship programs.

**Keywords.** Mentorship, Research and Education program, gifted education

## Introduction

In Korea 2000 is the milestone of gifted education due to issuing a decree of the act on promoting the education of the gifted students and from 2002 a variety of policies and programs for the gifted have been in progress. [1], [2]. Especially mentorship program was offered to the students of Science High School (SHS) and Korean Science Academy (KSA) in order to foster the future leading scientists. 561 topics for mentorship program were selected and carried out under the guidance of 561 mentors from 2003 to 2006. [3], [4], [5]. A new program for the gifted is the research internship program for the lead teachers of SHS. This program is applied to develop the teachers' abilities of their major fields and to feed back their experiences to the SHS students. 23 teachers in 2005 and 15 teachers in 2006 accomplished their purposes in the research internship program in the States and Croatia. In order to activate and stimulate the young scientists it is necessary to make the best use of the facilities and the mentors in foreign countries as well as in home country. It is time to set up policies and programs for the gifted and to extend international network in order to help the young scientists. This article is one example in Korea and can be the new horizon to help the future scientists.

## 1. Overview of mentorship program

The Korean Government, the Ministry of Science and Technology(MOST) and the Korea Science and Korean and Engineering Foundation (KOSEF), has given support to the Scie

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nce Gifted Education Centers of universities from 1998 for the purpose of educating the gifted, elementary and middle school students, and now 25 Centers are supported by the Government.

Science mentorship programs in Korea were initiated by the Science Gifted Education Center of university from 2000 and the KSA and SHS from 2003 which was sponsored by MOST and KOSEF. In support of MOST and KOSEF, all the students of KSA have to complete personal research of science as the curriculum and some students of SHS could have a chance to execute mentorship programs as the extra activities.

### *1.1 Science Mentorship Program for KSA Students*

KSA, officially approved as the school for the gifted students in 2002 by the Ministry of Education and Human Resources (MOE), has the educational objectives to enhance the creativity and scientific research abilities of the students and to promote self-directed learning abilities that lead to the promotion of new knowledge and to teach the skills and ethical attitudes toward science, required of scientists of world stature. [6].

144 students who are in the 7th, 8th and 9th grade can enter KSA every year and they can graduate after completing the given course. The curriculum is composed of subjects (145 credits), Research and Education (R&E, science mentorship program, 30credits) and extra curricula activities. Research and Education is the other name of science mentorship program and which is composed of personal research and commit education.

All freshmen are introduced the synopsis of mentorship program and a list of topics offered by mentors. The students apply topics as R&E and some topics are approved by judging and other topics are approved by mediating. After completing the R&E they should present the results. For 4 years 237 topics were selected and explored. A list of topics for 4 years is in the table 1.

**Table 1.** A list of science mentorship programs in KSA from 2003 to 2006.

Year	Math	Physics	Chemistry	Biology	Earth Science	Information	Total
2003	6	7	5	8	5	4	35
2004	5	21	8	14	2	5	55
2005	7	20	15	18	5	8	73
2006	5	18	17	24	2	8	74
Total	23	66	45	64	14	25	237

### *2.1 Science Mentorship Program for SHS students*

The first Science High School, Kyunggi SHS, had opened in 1983 and there are 18 SHS in 2006. SHS selected about 1,500 students at the ratio 0.3% among 0.5 million students of the same grade.

Science mentorship programs for SHS students have been begun as after school program from 2003 in support of MOST and KOSEF.

The theme of science mentorship program is selected in two ways. One is that the professors as mentors suggest the themes and students select among them, the other is that students determine a theme they want to study and ask a professor to be a mentor. The characteristics of science mentorship program are followings.

- A period of science mentorship program is in one year
- The students have to submit documents recorded the activities regularly.
- A mentor has to submit his/her document recorded instructing regularly.
- A mentor or an academic advisor has to evaluate the students and submit the results regularly.
- After carrying out the program, the students have to submit and present the results of their research.

For 4 years 324 topics were selected and explored. A list of topics for 4 years is in the table 2.

**Table 2.** A list of science mentorship programs in SHS from 2003 to 2006.

Year	Math	Physics	Chemistry	Biology	Earth Science	Information	Total
2003	18	13	14	13	9	5	72
2004	20	14	14	14	10	7	79
2005	17	11	17	17	12	12	86
2006	16	14	20	15	10	12	87
Total	71	52	65	59	41	36	324

## 2. Results of science mentorship program

Every February the results of science mentorship program, R&E, are presented and evaluated by professional scientists and students. The guide and items were developed to evaluate the results of R&E by researcher. The items and the weights of each item are follows.

- Education evaluation : the process of educating
  - Faithfulness of R&E
  - Extent to participation of students (student's document)
  - Extent to evaluation of the mentor and the academic advisor (mentor's document and academic advisor's document)
- Research evaluation : result of R&E
  - Content and direction of R&E

- Completeness of R&E result
- Value and utilization of R&E result

A list of excellent results from evaluating R&E is in the table 3.

**Table 3.** A list of excellent results from evaluating R&E in SHS from 2003 to 2005.

Year	Math	Physics	Chemistry	Biology	Earth Science	Information	Total
2003	10/18	4/13	10/14	8/13	8/9	2/5	42/72
2004	7/20	4/14	5/14	4/14	3/10	3/7	26/79
2005	8/17	6/11	5/17	9/17	6/12	6/12	42/86
Total	25/55	14/38	20/45	21/44	17/31	11/24	110/237

I developed the questionnaire for the participants and 513 students answered the questions. The followings are the responses of them.

- They did R&E activities for 29 days, 112 hours, in a year.
- The ratio of mentor's education and students' experimental activities was 1 : 2
- 69% of the students thought the subjects were difficult to the abilities of the students.
- The proposal of the topic is determined by
  - Mentor (48%)
  - Mentor and teacher (28%)
  - Mentor, teacher and student (24%)
- The degree of the satisfaction about R&E was as follows.
 

(very satisfaction 5, satisfaction 4, neutral 3, dissatisfaction 2, very dissatisfaction 1)

  - Experiencing in the experiment facilities of university : 3.8(2003) → 4.3(2005)
  - Activities of science research at high level : 4.2(2003) → 4.3(2005)
  - Teaching of university professor : 4.4(2003) → 4.2(2005)
  - Helpful to university entrance : 4.2(2003) → 3.7(2005)
  - Having a chance of enrichment about science lessons at the school : 3.8(2003) → 3.7(2005)
  - Helpful to school science lessons : 3.3(2003) → 3.4(2005)
- They expressed that the followings remained in their memories.
  - Experimental experience and handling the high technical equipment.
  - Meeting the professors and/or Ph. D.
  - R&E helped his/her aptitude as the topic is in accord with his/her concern.
  - They learned the attitude of mentor's research and value of cooperation with others.
- They expressed the following roles of their mentors were satisfactory.
  - Detailed explanation about R&E and mentor's consideration.
  - Mentor's encouragement and kindness

- Extension to a new field through experience.
- Mentor's helping the student to find his/her aptitude and academic and career.

### **3. Who lead the students to do mentorship program?**

Teachers, especially of SHS, are the most important person due to their roles to guide the students to introduce them mentorship program and bridge the students with mentors. It is all so necessary of the teachers to experience research.

From 2005 KOSEF offered a variety of exciting internship opportunities for excellent lead teachers of SHS. Whether lead teachers are interested in studying or teaching their own subject areas, KOSEF encourage teachers to get involved with the internship programs and exciting research in advanced research laboratories.

Research is a "contact sport" and is best learned through practice. The Research Internship Program was held in seven laboratories of the Iowa University for three weeks during the summer 2005 and in 6 labs of three universities of the States and an institution in Croatia during the summer 2006. They offered internships in research settings to selected lead teachers who are working in SHS. The participants in the program had dedicated on and accomplished outstandingly a teaching career in one of disciplines of math, physics, chemistry, biology, geology, astronomy, and computer science. These teachers joined active research groups in those subject areas. Faculty members and their research staff served as mentors to the interns, providing the guidance and background needed for them to become active members of a research team. Each intern was assigned responsibility for part of an ongoing project in a mentor's laboratory. Although the content of projects may vary, all projects were designed to be carried out within the duration of the program and to provide students with a real-world research experience. At the conclusion of the program, interns submitted an abstract of their research experience to the program directors.

#### **The objectives for the Teacher Internships program were to:**

- provide Teacher Interns with opportunities to understand the nature of science and gain first-hand experience in scientific inquiry and to better understand and share their ideas about math, physics, chemistry, biology, geology, astronomy and computer science.
- provide Teacher Interns with opportunities to develop and share teaching materials related to math, physics, chemistry, biology, geology, astronomy and computer science.
- provide Teacher Interns with material and equipment support relevant to the development of their new math, physics, chemistry, biology, geology, astronomy and computer science lessons.
- provide scientist mentors with opportunities to learn about communicating and sharing their work with science teachers and the general public.
- provide high school students with information about opportunities and research at the university.

The topics of the Research Experience Program 2005 are summarized in Table 4. These activities included laboratory research, fieldtrips, cooperative small group learning.

Table 4. Seven Research Centers and the Topics for Korean Teachers Research Experience in 2005

Research Area	Topic
Mathematics	Wavelets and How they are used?
Informatics	Educational Technology and Instruction :GPS and Nagging Algorithm
Astronomy	Astronomical Observation with Using CCD
Physics	Plasma Physics
Chemistry	Research Experiences in Various Fields of Chemistry
Environmental Science	Hydro science and Engineering
Geo-Science	Various Techniques of Geo science Research

Teachers evaluated that the Research Experience Program 2005 was useful in respect that they got many ideas for the Research and Education (R&E) and the research topic which they may do with students. The ideas of teachers are summarized in Table 5.

Table 5. The plan of research that teachers do with students in 2005

Research Area	Plan
Math	The utility of Mathematics using matlab
Informatics	The program development with problem solving
Astronomy	The use of Robotic Telescope
Physics	The development of Problem solving with Plasma
Chemistry	The role of Oxygen in chemical reaction
Environmental Science	The program development about environmental issue
Geology	The isolation of mineral using electro magnetic

The teachers' beliefs became manifest when there was a particular goal shift during their classroom practices. In this study it was found changes in their beliefs before and after the research participation. Teachers working with research scientists and mathematicians and at their labs and fields would help them to have better perception on research and update academic content and teaching materials for classes for their own. In this way, teachers were asked to develop modules that can be implemented in their own classrooms.

The Research Experience Programs 2006 are summarized in Table 6.

Table 6. Six Research Centers for Korean Teachers Research Experience in 2006

Research Area	University/Institution
Mathematics	Department of Mathematical and computer Science in Colorado School of Mines (USA)
Physics	VIPP, Michigan State University (USA)
Chemistry	Department of Chemistry, STANFORD UNIVERSITY (USA)
Biology	CARNEGIE INSTITUTION OF WASHINGTON PLANT BIOLOGY IN STANFORD UNIVERSITY (USA)
Astronomy	SCIENCE EDUCATION CENTER VISNJAN, VISNJAN OBSERVATORY (CROATIA)
Computer Science	VIPP, Michigan State University (USA)

The participants, teachers in 2006, were satisfied with the contents of the Research Experience Program expressed that the program was helpful to teach the student and induce the students to research activities.

In conclusion the Research Experience Program was successful in improving the teachers' beliefs regarding science teaching and learning as well as the teachers' abilities.

#### 4. Closing

After finishing the mentorship program, some of the students published their result as a paper in international scientific journal every year and the number is increasing. And some students go abroad to research with foreign students and foreign students come to Korea too in the same purpose.

For several years we have learn the system and the programs for the gifted, especially in the field of science, from foreign countries. Now in Korea the system and the programs for the gifted in science become established and try to contact and communicate the foreign institution for the gifted. It is time to cooperate in helping the future scientists through international network. I hope we are to share the case of success and the lesson for helping the young scientists with each other.

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