Recent Activities of Engineering Education in Korea

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Abstract

Engineering colleges in Korea have struggled with recruiting and retaining top students. At the same time, a large enrollment quota has resulted in a high influx of students who are not adequately prepared for engineering classes. Despite heavy teaching loads, a research-emphasized faculty evaluation system does not motivate the faculty members to pay much attention to education. Accreditation of engineering education, which started in 2001, brought much-needed reform in engineering education. Since then, several projects have been funded by the government and the industry, such as Innovation Centers for Engineering Education (ICEE) and the Women in Engineering (WIE) program. Undergraduate education is expected to be more rigorous in future, and more faculty training on education pedagogies and educational tools are anticipated.

Keywords: Recent Activities, Engineering Education, Korea

1. Introduction

Korea is known for its remarkable industrial developments over the last 30 years and has several global companies, such as Samsung, Hyundai, LG, POSCO, etc. Korea is also blessed with an “educational zeal” from parents, resulting in over 70% of high school graduates enrolling in college. Engineering, with the largest enrollment quota, accounts for approximately 23% of university students. Korea is not suffering from a lack of engineers, but providing high-quality engineers to rapidly changing and developing industries has been a challenge. This paper updates the status of engineering education in Korea and provides future directions. The recent activities of Korean Society for Engineering Education (KSEE) are also briefly described.

2. Key Issues in Engineering and Engineering Education [1]

2.1. Recruiting and retaining top students

Engineering colleges have been struggling to compete with law, medical, and business schools for top students. At the same time, a large enrollment quota has resulted in a high influx of students who are not adequately prepared for engineering classes. The industry is having a tougher time recruiting top engineers. Immediately after graduation, top engineering students move on to other fields such as medicine, law, business, and investments. Those with doctorate degrees prefer teaching positions and research organizations over industry. These trends worsened after massive engineering lay-offs during national financial crises in 1998.

A decrease in population will make the situation even more difficult. As shown Figure 1, the college-eligible population peaked in 2011 and is expected to decrease by roughly 40% by 2030. Korea can suffer from a lack of engineers to support its industry in the near future.

Figure 1. Changes in College-Eligible Population in Korea
2.2. High school science curriculum and teaching pedagogy

The current high school curriculum was structured in 1996, when the Korean government led a major educational reform. It was an ambitious and comprehensive plan to restructure the entire education system, suitable for an industrialized Korea. Under the new paradigm, a well-educated Korean is a person who
- seeks to develop his/her own individuality on the basis of well-rounded and wholesome development
- demonstrates creative ability based on a solid grounding in basic knowledge and skills
- explores career paths on the basis of broad intellectual knowledge and skills in diverse academic disciplines
- creates new values on the basis of understanding both national and foreign cultures

The new high school curriculum, which was called the seventh national curriculum, was implemented in March 2000. It was the seventh curriculum since 1954 and aimed to prepare students for the knowledge-based, globalized 21st century by emphasizing individuality, creativity, and knowledge of Korean culture, as well as awareness of other cultures. Under the new curriculum, students were allowed to choose their own courses in their final two years of high school. Foreign language education was emphasized: English instruction began in primary school, and additional foreign language classes were offered in high school. However, the new curriculum was not very effective in preparing students for engineering as it did not offer enough science subjects. In addition, chemistry and physics became electives, and the majority of students avoided them. Teaching pedagogy for math and science has not changed: rote learning is commonly practiced in preparation for college entrance exams, and experimental classes that are necessary to keep up the student’s interests in science are rarely offered.

2.3. Engineering curriculum and research-emphasized faculty evaluation system

The 1996 educational reform affected the university education as well. Under the vision of "obtaining broad intellectual knowledge and skills in diverse academic disciplines," the consolidation of similar disciplines (e.g., Chemical Engineering and Industrial Chemistry) was mandated. Students were admitted to a school with units in more than two academic departments. The required engineering credits for the major were lowered to 35 credits out of 130-140 total, meaning students could obtain an engineering degree without taking any classes from their major after the second semester of their junior year. Many engineering colleges are now back to requiring over 50 major credits to graduate, but some still maintain the 1996 system.

Engineering curriculum is often criticized by the industry out-dated industrial examples in course materials. Students criticism on fast-paced lectures and heavy assignment loads has not ceased.

Research is emphasized regardless of each college’s research infrastructure and capability. And yet, the teaching loads in most universities are heavy. Faculty members commonly have over 10 lecture hours per week, and class size is often over 50. Teaching is taken lightly, and there is lack of motivation to develop better lecture content and teaching pedagogy. A research-emphasized faculty evaluation system, despite heavy teaching loads, does not motivate the faculty members to pay much attention to education.

3. Status of Engineering Education Programs

One of the long-term goals of the 1996 education reform was to raise the quality of education to a world-standard level of excellence. Funding for quality enhancement of higher education began. This paper lists a few ongoing programs related to engineering education.

3.1. Brain Korea 21

The goal of the Brain Korea 21 project is to foster academic research by providing graduate students with stipends and opportunities for international exposure. The first 6-year phase of the program started in 1999, and the second 6-year phase ended in 2012. One of the outcomes of the Brain Korea 21 project was the emergence of large research universities, while other universities suffered from diminishing graduate programs. A secondary outcome was increased inbound mobility of students. The universities which had difficulties of recruiting quality graduate students reached out to China and Southeast Asia to recruit graduate students. The third phase of Brain Korea 21 starts this year, and the proposals are being reviewed now.

3.2. Accreditation Board for Engineering Education of Korea (ABEEK)

KSEE played a key role in bringing an engineering accreditation program to Korea. The Accreditation Board for Engineering Education of Korea (ABEEK) was established in 1998, and accreditation began in 2001. Since then, ABEEK has become a full signatory of the Washington Accord and a provisional member of the Sydney Accord and the Dublin Accord. ABEEK provided leadership in establishing the Seoul Accord for the computing and IT-related education at the tertiary level. As of May, 2013, 605 programs in 101 universities (EAC: 506, CAC: 51, TAC: 48) have been accredited. [2]

The introduction of accreditation programs strengthened engineering education and provided much-needed globalization to engineering education. Even though ABEEK started as a non-governmental organization, now it has become an accreditation agency supported by the Ministry of Education. ABEEK is preparing for the accreditation criteria for 2015 with emphasis on course-imbedded outcome assessment.
3.3. Innovation Center for Engineering Education (ICEE)

Another major program which significantly has affected engineering education is the Innovation Center for Engineering Education (ICEE) program. ICEE was launched in 2007. About 60 centers were selected and have completed the first 5-years program. The second stage of the ICEE project started in 2012 with 65 newly selected centers nationwide.

The main objectives of the ICEE program are to enhance engineering educational programs to meet the needs of the industries in the region and to seek a continuing collaboration with the industry on the development of relevant educational contents. Key agendas are:

- Developing need-based programs
- Improving education/teaching methods
- Improving assessment/evaluation systems
- Enhancing industry collaboration

Through ICEE, several company-tailored tracks were installed. Faculty workshops on teaching pedagogies and educational tools are offered, as are design camps for students. Design projects are included at various stages of the curriculum. Students are now able to foster their design capability and skills through capstone design projects. ICEE also helps the ABEEEK by providing necessary support for accreditation programs. [3]

Additionally, ICEE contributed to creating a new network between engineering colleges. Engineering colleges began cooperation in developing design projects and started to disseminate teaching tools and methods. Cooperation between engineering colleges minimized the trial-and-error that each college would have otherwise had to experience individually. ICEE also brought in the experts with backgrounds in education engineering, planting seeds for engineering education research. Korea has yet to see a large number of faculties involved in engineering education research. However, the papers submitted by engineering faculties have increased, as well as the total number of papers submitted to a KSEE journal (Engineering Education Research).

ABEEK and ICEE programs definitely increased the interest in engineering education. As shown in Figure 2, the number of attendees and papers presented in the KSEE annual conferences drastically increased since 2002.

![Figure 2. Accreditation and ICEE Outcome on KSEE Annual Conference](image)

3.4. Women in Engineering Program

The percentage of women in Korean four-year engineering colleges has been at about 18% for the last 15 years. Kim et al. [4,5] investigated the psychological characteristics of almost 2000 female and male engineering students in 8 universities nationwide, including the measures for self-career aspiration, self-efficacy, satisfaction, and expectation in engineering careers. The results revealed that female students scored significantly lower than male students for all of these variables. It was concluded that, in order to improve the retention rate, the program for women in engineering must start with improving psychological correlates of career development.

The Women in Engineering Program in Korea was started in 2006; the first of its kind in Korea that targeted female engineering students. Five universities in different regions in Korea were funded for 6 years to develop programs in three sub-target areas: (1) Promote an inclusive educational environment for female engineering students, (2) Develop specialized programs to enhance competency in various hard and soft skills, and (3) Increase the employment rate in the field related to one's major. At the second stage, starting 2012, the WIE program was expanded to 16 universities, covering different regions of Korea.

3.5. Industry Sponsored Program

There are several industry-sponsored programs. This paper introduced two such programs, the first of which is the Samsung Talent Program. The first phase of the program started in 2006 as the Samsung Electronics
Information and Communications track, and the second phase started in 2011. Samsung Talent Programs are running in Electrical Engineering, Computer Science, Materials Science and Engineering, and Mechanical Engineering Departments at 14 universities. Program details vary. For example, the Electrical Engineering Department at Hongik University runs two tracks: one in semi-conductors and the other in communications. Students must complete 10 required subjects and three subjects out of 10 electives. Students are afforded internship opportunities and preference in employment. Some receive scholarships.

The display track was co-sponsored by display industries and the government. It was an interdisciplinary program involving Electrical Engineering, Materials Sciences & Engineering, and Chemical Engineering. Students were required to take 16 credits (5-6 subjects) of display-related subjects.

4. Future Directions
In order to stay globally competitive, engineering education is expected to be more rigorous in future, and other anticipated changes are as follows:
- Merging and consolidating schools are expected to prepare for the decrease in student population
- More rigorous undergraduate education
- Universities specializing in different fields and developing unique programs
- Enhanced industry-university collaboration in education
- Enhanced faculty training on education pedagogies and educational tools
- Increased inbound student mobility
- Increase in public funds/support and more financial aid for students

5. KSEE Updates
KSEE has been playing a crucial role in disseminating new developments in engineering education since its founding in 1993. With 1800 members from academia and industry, KSEE publishes a journal of engineering education research, a quarterly magazine, proceedings, and reports. KSEE holds its annual conference in November and hosts workshops throughout the year. It maintains close ties with the Korean Engineering Deans Committee, the Accreditation Board of Engineering Education in Korea (ABEEK), and the National Academy of Engineering of Korea (NAEK). KSEE is a member of the Association of Engineering Education of Southeast and East Asia and Pacific (AEESEAP) and the International Federation of Engineering Education Societies (IFeES). KSEE will be a secretariat for AEESEAP in 2014-5.


References
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Biography
Myongsook Oh is a professor of Chemical Engineering Department at Hongik University in Seoul. She obtained a B.S degree in chemical engineering from the University of California at Berkeley, and Sc. D. from Massachusetts Institute of Technology (MIT). Before joining Hongik University, Dr. Oh was associated with Lawrence Livermore National Laboratory (LLNL) and Texaco, Inc. in the U. S. Starting from her Sc. D. thesis on softening coal pyrolysis, she worked on the conversion of fossil fuels for over 30 years. The other area that Dr. Oh devotes her effort is to develop women in engineering program and educational contents. She authored several articles and research papers. Dr. Oh now serves as the director of Women in Science, Engineering and Technology Seoul Regional Center, a vice president of Korea Federation of Women’s Science and Technology Associations, and a vice president of Korean Society for Engineering Education. She also served several government committees such as Energy Technology Advisory Committee and New and Renewable Energy Committee. She is a member of the National Academy of Engineering of Korea.