
Education Program for Advanced Engineer Promotion in Collaboration with Technical College in Japan

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ABSTRACT

Nagaoka University of Technology (NUT) started the new educational program "Advanced Course" in collaboration with technical colleges in Japan. This program has been supported by Japanese Ministry of Education, Culture, Sports, Science and Technology (MEXT) for 6 years. Target of the talents for the advanced engineers are Flexible Idea Based on Multiple Specialties, Strategic Management of Technology, and Global Leadership. We decided 6 national colleges of technology (KOSEN) as collaborating colleges to begin with, and number of collaborating colleges will be increased using e-learning system. We accepted 32 and 24 students graduated from these 6 colleges in 2012 and in 2013, respectively. This program consists of three stages; 1) 4th and 5th grader of the technical college, 2) 3rd and 4th grade of undergraduates of NUT, and 3) 1st and 2nd grade of master course of graduate school of NUT. In Stage 1, college students can take several subjects whose credits can be transferred NUT's. In the Stage 2 and 3, students have to learn several extra subjects additionally in order to improve abilities of three target talents with ordinary majoring subjects. In this paper, program concept, target of the talent, and outline of this program are introduced.

Keywords: *advanced engineer, education program, collaboration with colleges.*

INTRODUCTION

Recently, Chinese gross national product (GNP) exceeded Japanese one, and it made a great leap to the 2nd place in the world. It is said that the newly emerging countries called BRICs (Brazil, Russia, India, and China) will lead the future world economy. We have to recognize the change in the world, especially around Japan, rapidly and drastically.

In our country, it is hard circumstance for job seekers, and the big gap takes place between the job offer of a company and students' wish of employment. Furthermore, it seems that the young men who show rejection to overseas service are increasing in number though called "globalization" although world is moving toward "globalization". In Japan, number of students, who have no clear future image and no clear dream of their life, increases recently and they don't have clear idea of choice of university. Furthermore, students have to be very busy due to job hunting for one year and a half in the second half of their university life, and therefore, many students can't surely recognize what they have studied at the university.

Companies have to recognize these circumstances and have to change to keep students more time to study in the university. Probably, our university side also needs to re-consider whether the curriculum to educate student's talent which companies need is truly offered or not. We recognize that it is very important for our university to show the originality, the uniqueness and the difference from other universities. It is well known in Japan that both Nagaoka (NUT) and Toyohashi (TUT) university of technology mainly accept the graduate students from technical colleges by admission as the third grade students, educate up to master course of graduate school, and send out to industries as practical and leading engineers.

And therefore, we are expected to show what education system is suitable for engineers who can lead the Japanese industries and can support Japanese economic development. In this paper what we are trying in education program in collaboration with national colleges.

PROGRAM OVERVIEW

Figure 1 shows the education system of our university. Most of Japanese universities were designed that they accept students graduated from high school as

1st grader and educate mainly up to 4th grade. On the other hand, we accept 80%

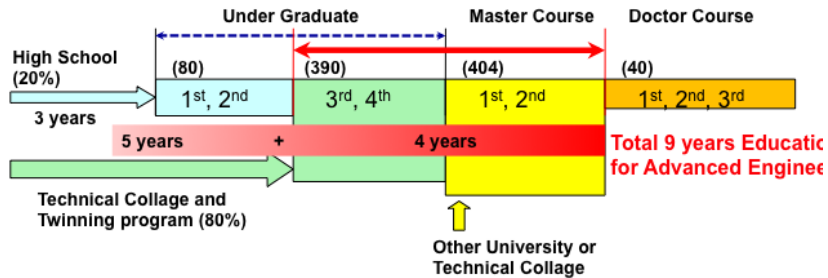


Figure 1: Education System of Nagaoka University of Technology

of students graduated from technical colleges as 3rd grader and educate up to the master course, although 20% of students are from high school. Therefore, if our university could collaborate with technical colleges, we can design 9 years-long advanced engineer education program. This program named “Advanced Program for Strategic Engineers Promotion” has been started 2010 with the selected 6 collaborating National College of Technologies (KOSEN); Fukushima, Oyama, Nagaoka, Toyama, Fukui, and Kagawa. (Nakamura, 2012)

This program covers over 6 years which is divided into three stages; 1) Stage 1 for 4th and 5th grader in KOSEN, 2) Stage-2 for 3rd and 4th grader in NUT, and 3) Stage 3 for 1st and 2nd grader in master course of graduate school of NUT. So far, this year is 4th year and so Stage 2 has not completed yet.

IMAGE OF A STARATEGIC ENGINEER AND TALENTS

Most important thing for education program is to make clear the image of students graduate from the education program and to make clear what kind of talents they have to be educated, which Japanese industries and society require for near future engineers. And then the curriculum and subjects of the program can be designed by so-called backcast style.

Figure 2 shows image and required talents required for advanced strategic engineers in advanced course in comparison with the existing conventional engineer education course. In conventional education course, main talents considered were limited idea of specialty, basic knowledge of management, and written English/paper writing shown in central portion in this figure. However, required talents for near future must be flexible Idea based on multiple specialties, strategic management of technology, and global leadership/communication ability shown in outside portion. These are the conclusion of our numbers of discussion. And then, we started to design curriculum and subjects to promote these three major talents for this advanced program. Please note that this advanced program is

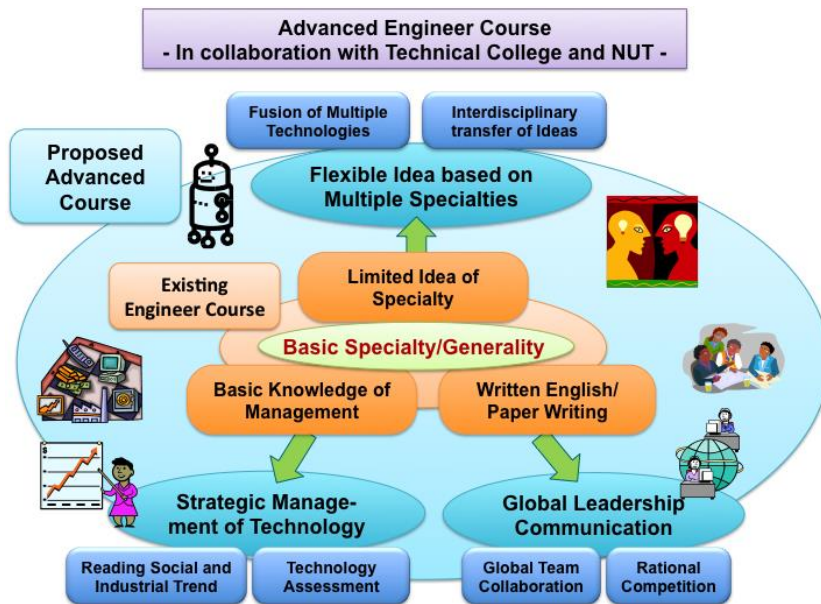


Figure 2: Image of Advanced Engineer and Required Talents. (Comparison of the Advanced Course with Conventional course)

not independent from the existing special education program such as mechanical engineering, electrical engineering and so on. Advanced program is additional one to promote the three major talents. (Fukuzawa, Nanko, Takeda, Nakayama, & Yamaguchi, 2013)

CURRICULUM AND MAIN EDUCATIONAL SUBJECTS

Educational subjects have been newly designed based on the above 3 major talents required for strategic engineer for industry in near future. The overall flow of main educational subjects is shown in Fig. 3. The grade advances toward the right in this figure from the left. Moreover, the contents of a subject based on the three

major talents such as; "Flexible Idea Based on Multiple Specialties", "Strategic Management of Technology", and "Global Leadership/Communication" toward the lower berth, respectively from the upper row are shown. In the Stage 1 program, subjects consist of three part; 1) Collaboration Course Subjects, 2) Preceding Subjects, and 3) Oversea Trip for Industrial Inspection.

Stage 1

1) Collaboration Course Subjects

These are the subjects offered to 4th and 5th grader in the regular course of technical colleges. Credits are for graduation from technical colleges. Subjects are designed and provided by professors of technical colleges, of NUT, of their OBs

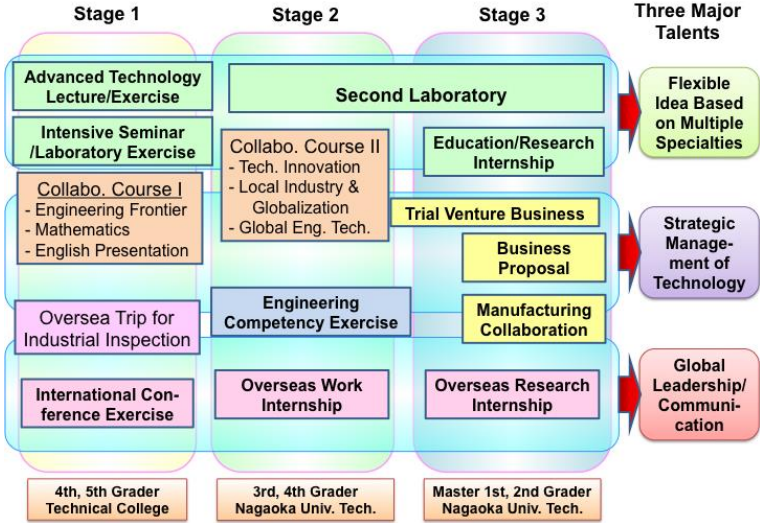


Figure 3: Outline of Curriculum and Subjects of Advanced Course

and lectures from industries. Generally, not only the advanced course students but also the other students in the technical college can study these subjects if capacity of the class didn't limit the number of students. Sometimes, lecture is concentrated during in summer, winter, and spring vacation periods as an intensive course according to the schedule of lecturers. At the present, we started with the following three subjects:

- **Introduction of Engineering Frontier**

This lecture is mainly intended to explain how advanced science and technology of a specific area was brought out. Lecture is omnibus style to explain key technology or innovative idea to break-through of research and development in

the specific research area. Oyama, Fukushima, Nagaoka, and Kagawa National College of Technologies are offering this subject (Jodai, 2012).

- **Mathematics Supporting New Technology**

Recently, it is pointed out that mathematical application capability and a practical-skill of technical college students has been declining. In this subject, mathematical importance and how mathematics can support the progress of technology are explained. It is expected to improve sensitivity over what mathematics can support and induce innovative technologies. This subject is offered at the Fukui National College.

- **Foundation of English Presentation**

This subject train students to improve the ability to perform the presentation in English. It is very important foundation skill for students who have to work abroad. This is also intended not to train English but educate students required skill to make a story of their presentation even in Japanese. Foundation must be the skills to use techniques of logical thinking, brain storming, decision tree, explanation using illustration, pros & cons list, and so on, which will be a help to improve communication skill. Toyama National College of Technology started this subject at the beginning and then Fukui and Nagaoka National College followed because this became popular and remarkable improvement of students' ability in English presentation (Shimizu, Nanko, & Nakayama, 2013).

2) Preceding Subjects

These are also subjects offered to 4th and 5th grader in the regular course of technical colleges as collaboration subjects above. However, credits which students take learning preceding subject can be approved as credits required for graduation from NUT if they admit to NUT and claim them. Therefore these subjects are designed and conducted by NUT.

As for the completion person who acquired the unit of this subject, it is possible for me to have you recognize as a gradual unit after the department size admission study of work as this course student for faculty 3-4 years.

By taking in advance, the margin of this course subject completion by Stage 2 will be made.

- **Advanced Technology Lecture/Exercise**

This is a subject combined lecture and exercise. We invite lecturers from three famous companies around NUT from different area of business such as energy, food, information technology, and eco-technology, which has advantage of their own advanced technology. Lecture is provided in the morning and small trip to inspect each company in the afternoon. So, one day is for one company and 4th day is kept for preparation of presentation which is scheduled the last day of the

week. Students have to come to NUT for a week in summer vacation period (Fukuzawa & Nakamura, 2012).

- **Intensive Seminar/Laboratory Exercise**

This is an experience of research work in laboratory, so-called open house. We already had the open house system for college students. However, that was only an introductory stay in laboratory of NUT. On the other hand, this subject in advanced course offer to students 2 credits when they admit to NUT. And therefore, students have to submit a report what they are doing and/or presentation. Every year about 30 students take this subject and some of them can publish a paper as a co-author. Laboratories of NUT offer their specific theme to students and students can choose which laboratory they will join. They can attend the seminar with NUT students as well. Figure 4 shows typical photograph of Intensive Laboratory Exercise (Nanko & Nakamura, 2012).

- **International Conference Exercise**

This is to improve presentation ability in English. Students have to present their research and/or proposal in English. However, this is not only to bluish up English but also how to make a structure of presentation. Topic of presentation is what each student is studying in technical college. Mainly, a professor and a teaching

- Research experience of graduate level
- Experiment of "Full paper" level
- Cooperation with Graduate students,
- English Skill, Experiment Skill



Figure 4: Intensive Seminar/Laboratory Exercise

assistant check their English step by step which means the flow of presentation. Generally, title of presentation is at first, second step may be abstract, experimental setup or numerical procedure, main results of the research, and conclusion and future plan may be the last step. Generally, bluish up and discussions are conducted over E-mail. We keep one day for presentation for

students to gather. Professors and lecturer invited from industries put score and students can get credit if score was accepted (Takeda, Nanko & Takahashi, 2012).

3) Oversea Trip for Industrial Inspection

We offer this subject to know industrial situation in foreign countries because Japanese companies have to compete with other companies at global market. Students have to know what is important to expand Japanese company to abroad. In the first year, we took students to two countries; Hanoi, Vietnam and Kuala Lumpur, Malaysia. These countries are strategic important to expand their factory or branch. In the second year, we choose Korea instead of Malaysia. We want to know activities and strategies of Korean developing companies such as Samsung, Hyundai and NANO. Students have to present what they have learned and what is their proposal to Japanese company if they want to operate in these countries. So far, no credit is given to students but only experience. Students had very impressive comments at the presentation. Typical photograph of trip to Korea is shown in Figure 5 (Aoyagi, Nakayama, Harada, Tanaka, & Ibayashi, 2013).

Stage 2

Now, advanced course program is conducting in Stage 2 and Stage 2 subjects have



Figure 5: Oversea Trip for Industrial Inspection (Korea, 2013)

not been completed. However, some of them were already designed and conducted and they are 1) Collaborating Course 2 and 2) Engineering Competency Exercise, and 3) Second Laboratory 1.

1) Collaboration Course 2

- **Local Industry and Globalization**

This is an introductory lecture mainly given by lecturers invited from local global company. Lecture is related to how local company can expand their market to world wide (Yamaguchi, Nanko, Takeda, Fukuzawa, Jodai, Inoue, Suzuki, Kurumada, Aoyagi, & Nakamura, 2013).

- **History of Technical Innovation**

This is a lecture to know history of technical innovation. Students can get knowledge of innovation and how to produce innovation.

- **Global Engineering Technology**

This is a lecture to know engineering technology required for globalization.

2) Engineering Competency Exercise 1

This is an exercise for students to acquire skills required to improve engineering competency. This includes many basic tools and skills such as brain storming, logical thinking, mind mapping, debate, and so on.

3) Second Laboratory 1

The 4th grade students in NUT have to belong to a laboratory for research work. They have to study their own first major subject. However, advanced course students must belong to one more laboratory called second laboratory which must be different area of research in order to acquire Flexible Idea based on Multiple

- Display of the University Activities
 - Fun, Easy to understand Display
 - Communication and design skills



Figure 6: Second Laboratory (Tech-Mu Lab)

Specialties. So far, there are Eco-Future Lab., Tech-Mu Lab., Sports Lab., 3D

Printer Lab., and Plasma Toy Lab. and expected skills are second specialty, practice of thinking framework, and practice for group working. Typical photograph of the Tech-Mu Lab. Is shown in Figure 6 (Nanko, Takeda, Yamaguchi, Shionoya, & Fukuzawa, 2013).

CONCLUDING REMARKS

We have been started a new educational program “Advanced Engineer Course” in collaboration with national technical colleges. Major three talents to be educated are "Flexible Idea Based on Multiple Specialties", "Strategic Management of Technology", and "Global Leadership/Communication". We designed three stages and we are in the Stage 2, now. No students have finished this advanced course, so far. However, we hope students in this course will be strategic engineer having high engineering competency and will be a leading engineer or founder of a global company. Also, we hope our educational system for advanced engineer will be expand to wide area of the world.

Effects of the advanced course from teaching side are as follows;
Leader of the discussion in group work was increased, students can communicate their own idea to others, fear to speak in English is reduced, learn voluntary, building a business model by their own idea, and mutual understanding between KOSEN and NUT becomes improved.

Also, students' comments are as follows;
Students can acquire skills and ability of presentation, debate, communication, logical thinking, relationship management and schedule management.

We can understand our advanced course works as we are intending although many modifications and improvements may be necessary to complete this educational program.

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