

## Toward the Next Stage of Graduate School Education

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### Abstract

Global Resource Management (GRM) Program proposed by Doshisha University was admitted as a Program for Leading Graduate Schools of Japan Society for Promotion of Science. The program substantiated the effectiveness of research-based education system for postgraduate students. It also presented an exemplary model to reconstruct the students' learning contents and procedures through covering wide areas of academic disciplines. The fundamental concept and the methodology for enhancing students' capability of the program were transferred to succeeding graduate education programs designed and started at the Doshisha Institute of Higher Education and Research. The expected outcome of the second stage GRM program is discussed.

Key words: Graduate School Education, Cultural Diversity, Infrastructure Engineering

### I. Introduction

It can be a common understanding that Academia (Academia Platonica) started by Plato in 387 BC is the origin of educational institutes [1, 2]. Later in Europe, the system of conferring a degree was established in twelfth century [3] and the universities became symbols indicating national strengths. After the renovation of higher education systems by Wilhelm von Humboldt [4], the form of present-day universities with the activities in both research and education became popular in the world. The concept of the graduate school-based research university was further developed in the United States of America; Johns Hopkins University enrolls larger number of postgraduate students than that of undergraduate students [5].

Tomomi Iwakura visited Europe to learn and implement the education system to Japan after the Meiji restoration and the system was developed through importing the management processes of the US research universities during the recovery from World War II. Experiencing the 1990s economic bubble burst, Japan tried to reorganize the industrial structure to be knowledge-intensified for realizing high productivity. Thus, the Japanese society demanded universities to renovate for improving research capability and education quality collecting proposals from the universities for good practices. Japanese university performances are always examined by the university evaluations prepared in other countries based upon the standards set by organizations which gather data through English language. This forced Japanese universities to prepare their proposals for including the aspect of globalization and international student/staff mobility.

The Global Resource Management Program (GRM) was proposed from Doshisha University to the JSPS (Japan Society of Promotion of Science), an affiliated organization of the MEXT (Ministry of Education, Culture, Sports, Science and Technology) in 2011. The program advocates the importance and effectiveness of setting a communication link between natural science/engineering students and social

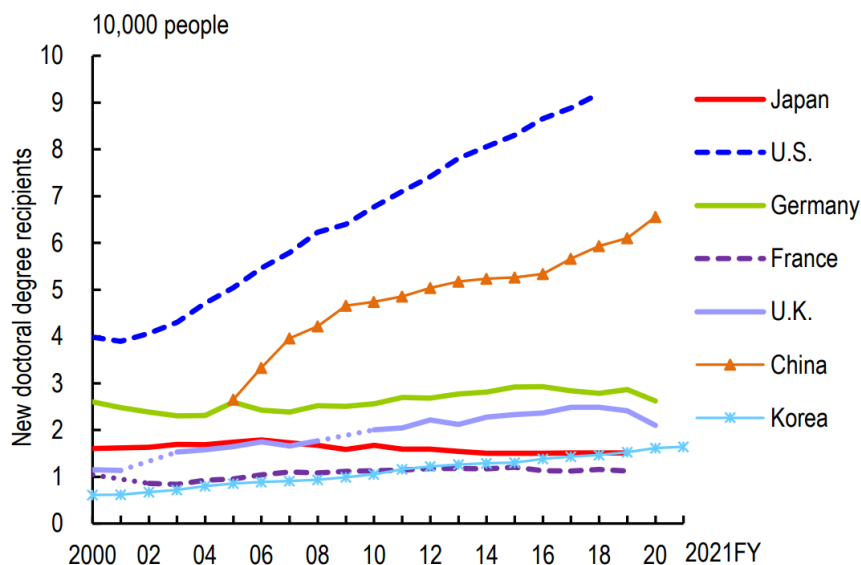


Fig. 1. Changes in the number of new doctoral degree recipients in the selected countries [6].

science/humanity students for the graduate level study of both sides. The program has started immediately after the proposal acceptance in 2012 and finishing the first stage letting students visit many parts of the world for the discussion on what they can do on the local problems. The opportunity to participate in the program allowed the faculty members of the Graduate School of Science and Engineering reconsider the future of educational programs for graduate students in a review-check process manner. This paper summarizes the fundamental concept of the second stage GRM program based on what faculty and staff members learned from the first stage program.

## II. Graduate School Education Program

Figure 1 plots the changes in the number of new doctoral degree recipients of Japan with other countries: US, Germany, France, UK, Korea, and China [6]. Unlike Korea, the numbers decreased until 2001 in other nations except Japan in which the younger generation had to face against smaller job market after the country's economic bubble burst. They proceeded to graduate school to get jobs expecting the job market to recover during the period they finish their educational program. The numbers of US, UK, Germany, and France started increase after 2001 corresponding to the rapid expansion of US National Science Foundation (NSF) budget from the fiscal year 2000 [7]. Meanwhile, carrier paths of doctoral degree holders did not appear attractive among Japanese students, and Japan became the only country losing number of doctoral graduates among other nations after 2006. Thus, Japanese MEXT has started programs to renovate universities for graduate school education.

### II.1 Center of Excellence Projects

The MEXT started the proposal collections from Japanese universities for “21<sup>st</sup> Century COE (Center of Excellence) Programs” in 2002. The first-generation COE programs were funded to established research projects; the MEXT assumed that a university COE can be only built upon an existing research organization. The program helped universities organize/reorganize strong research units. However, the advanced research topics did not motivate students for proceeding to postgraduate education. The number of students enrolled in doctoral program in the natural science/engineering field continuously decreased after 2004 as shown in Fig. 2. The COE programs failed in increasing the number of doctoral course students. Note that there exists a small recovery bump in the year 2010, three years after the subprime mortgage crisis. Again, one important factor to increase the number of students seeking for doctoral degree is the shrinkage of job-markets.

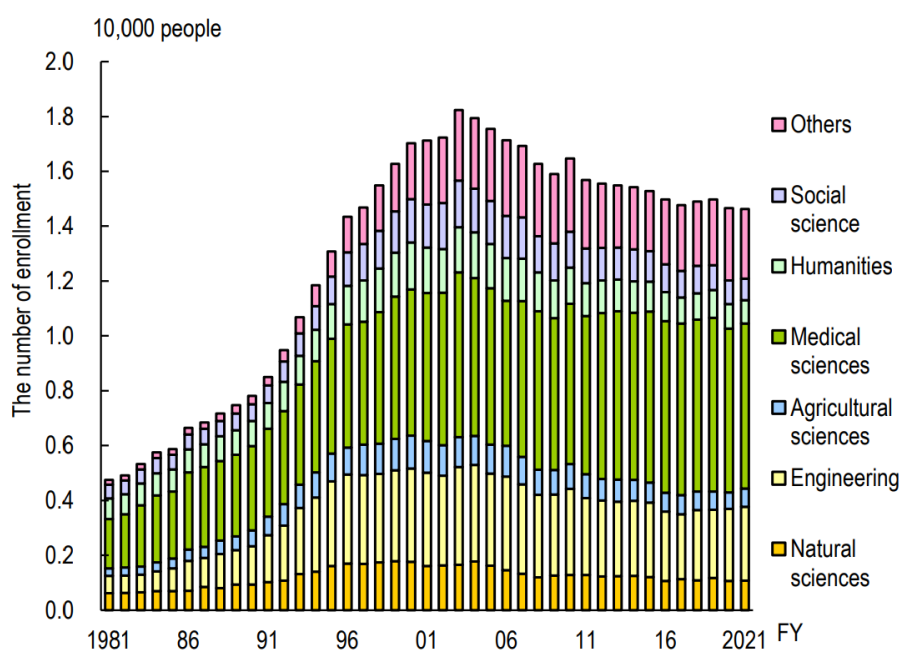


Fig. 2. Changes in the number of new enrollments in graduate schools by major subject (doctoral programs) [6].

The Global COE Program, or GCOE, started in 2007 with strong concerns for graduate students' education. Students seeking for their doctoral degrees often had to learn in the individual research seminar or under a strict supervision of a single professor before the start of the GCOE program. Some graduate students often must follow the guide by the professors to be their miniatures in the research fields. The renovation of the graduate school education system by the GCOE program made students have the possibility to learn subjects and exchange opinions with experts in different research fields. The Graduate School Education Reformation Support Program also started in 2007. The guideline for the proposal preparation for the program asked a core competence in the research field like GCOE, while it required new ideas on educational methods with pedagogical aspects.

## **II.2 Program for Leading Graduate Schools**

Doshisha university started “Electrical Power/Communication Infrastructure Researcher/Engineer Fostering Program” in 2007 as the Graduate School Education Reformation Support Program of MEXT. The program encouraged graduate students to go abroad for internships, international conferences, and overseas research collaborations. Remote conference systems realized operations of joint classes by linking Doshisha classrooms in Japan and partner university classrooms in abroad. The program coordinator, Professor Ametani of Doshisha Graduate School, started the renovation of education system of entire Doshisha Graduate School of Engineering. The program philosophy originated from the words of the Doshisha University founder Neesima: “fostering graduates who are to be referred to as conscience of the nation.” Ametani came up with the idea of educational programs for graduate students who are competent in building public infrastructure with good understanding of cultural diversity as he started working on filing a proposal to Japan Society for Promotion of Science (JSPS) in applying to the Program for Leading Graduate Schools in 2011.

## **III. Global Resource Management Program**

The GRM program started in March 2012 with the kick-off event visiting Miyako-jima, a small island in Okinawa with the semi-closed water supply and electrical power infrastructures. Professors, staffs as well as students participating in the program developed the methodology for improving learning in the program through this event. The program sent students to Miyako-jima several times to further improve graduate students’ training method of on-site problem solving.

### **III.1 Fundamental concept**

The fundamental concept of the GRM program is to foster graduate students having a mind of global good citizen. The counter part of science and engineering lead by Professor Ametani was the coordinator of the entire program, Professor Naito working as the Dean of the Graduate School of Global Studies. Teaching courses in engineering subjects together with fundamental physics and earth/environmental science were open to students who major in social science and humanity. Students learning science and engineering must take credits of subjects offered by professors of Global Studies and other social science/humanity fields. The most important part of the educational program is the cooperative study in a groupwork style by forming a team with members from different research fields; students from the wide spectrum of academic backgrounds must communicate for proposing some solutions together. Feedback from professors were immediately given after the submission of solution proposal by students. The procedure enabled both students and teaching staffs work in a highly time-efficient manner.

The concept of “Advanced Liberal Arts” was introduced to the program. Social science/humanity students were advised to learn not only simple mathematics but also differentiation and integration to understand the way of thinking in natural science and engineering. On the other hand, methods employed to analyze problems associated with human systems and variety of written expressions to prepare persuasive documents were taught to students of natural science and engineering major. Courses were designed for

students to save time for learning their sub-major fields. Several classes hosted students from both sides of natural science/engineering and social science/humanity. Contents of discussion in such a classroom of students from both sides were often stimulating and produced some hints for new areas to research.

### **III.2 Attempts made in the program**

An experimental trial to set up a mathematical model for social science problem was made in one of the joint classes hosting engineering/social science students. The lecturer advised the class students with less background knowledge in mathematics to formulate the problem. However, students from science/engineering major mainly treated the mathematical modelling processes. Thus, the data treatments done by social science students were limited only to primitive statistics. The attempt to letting students learn both quantitative and qualitative analyses became a challenge. The interdisciplinary parts of the class contents were constantly reviewed in accordance with the evaluation by students. Science and engineering students use mathematics and statistics while they do not employ problem approaching methods like comparative study. Social science/humanity students are good at categorizing problems through which they find similarities and discrepancies but they often fail to show some important figures. In some contents of GRM classes, knowledge from both natural science/engineering and social science/humanity majors became necessary. The Infrastructure Engineering is one of the GRM classes open to social science/humanity students, in which the "public opinion monitoring" is discussed as one of the important class subjects. The social science aspects of infrastructure engineering now become a proper class content to be taught for natural science/engineering students.

Contents of all teaching class subjects have been routinely reviewed as well as interdisciplinary subjects. They are updated to improve the education quality and teaching efficiency. A subject numbering system was introduced by setting prerequisites with the list modified based on the result of questionnaire to students. Education on information technology (IT) skills was advocated important from relatively early stage of the program development, and the concept was transferred to other programs developed at the Institute for Advanced Education and Research of Doshisha University [8].

## **IV. Future of Graduate School Education**

There is no doubt that the GRM program worked as a training ground for Doshisha professors and staffs to design and develop new graduate school education programs. The financial assistance from JSPS to hire professors and staff members and to maintain the teaching environment with IT facilities for operating the GRM was indispensable to advance the maturity of the educational program. Doshisha university already started sharing the knowledge acquired through GRM program to other graduate school educational programs. The developed system can continuously improve the specific graduate educational program until the designed program becomes the seed of the next generation education program.

However, the small demand from the Japanese society for the graduate school education can be the problem for future sustainability of graduate school education. Figure 2 indicates the number of students seeking for doctoral degree converges to 15,000. The graduate school renovation can benefit Japanese

universities, provided more students want to learn in doctoral courses. Ideally, Japanese universities can host more graduate students as the quality of postgraduate education programs improve. However, graduate school enrollments become smaller against the expanding size of the Japanese job market. It is often said that having a Ph.D. can even harm the job carrier depending on the research field.

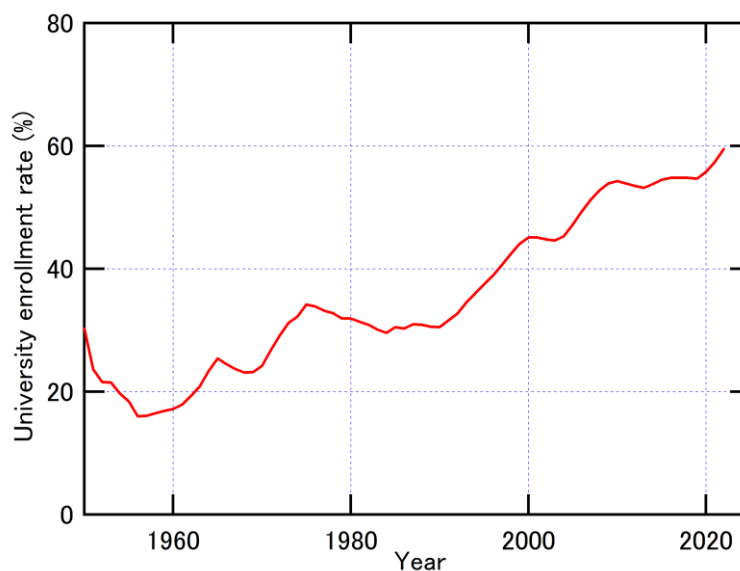


Fig. 3. Japanese university enrollment rate from 1955. Source: ref [8].

We used to have a similar problem for undergraduate education in Japan. The trend of the university enrollment of the country is shown in Fig. 3, which exhibits the enrolment rate below 20% during the initial stage of the Japanese high-economic growth period. The figure also shows several stagnation periods corresponding to world and Japanese economic conditions. The undergraduate diploma is now regarded as a license to get into the Japanese job market and the university enrollment exceeds 50%. Similar mechanism can work for postgraduate degree holders against Japanese job market in the future. The success in achieving a high enrollment of graduate school necessitates universities' effort to prove that graduate school education substantially enhances the students' talent and capability.

## V. Toward the next stage

When the GRM program was started in 2012, the political situation in Arab world was a great concern for the world politics and economy. Constructions and organizations of the public infrastructures after the reformation of the countries' political systems produced realistic problems to tackle for the students of the time. These problems trained students well in learning methodologies to collect data and analyze them to draw some conclusions. Even after one decade, the link between the global issues and infrastructure engineering still is and surely will be a good material for graduate school education. The problems of political and religious confrontations are currently making national securities of some countries difficult. Meanwhile, the future infrastructure management policy must be adaptive to environmental protection and

post-pandemic policies. It should contain many global issues of contemporary society in fields that require reorganization of public infrastructure. The research area for the next generation graduate students choosing GRM subjects is surely expanding, and the program can proceed to the second stage with a small modification to the first stage. However, there is a problem in manpower; professors and staffs competent enough to maintain the second stage program are all busy. Organization of a good team of professors and staffs for managing the graduate level education with the most recent contents is the key to the success of the second-stage GRM program.

## References

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