

Recipients view of Science and Engineering University Education in Japan The results of a joint industry - university study

Yokichi Itoh¹ & Nobuko Hosogaya²

¹Advisor, Fuji Xerox Co., Ltd., 2-17-22 Akasaka, Minato-ku, Tokyo, <http://www.fujixerox.co.jp>

Tel: (+81) 3-3585-3211, Fax: (+81) 3-5573-2231, yitoh@fujixerox.co.jp

²Associate Professor, Sophia University, 7-1 Kioicho, Chiyoda-ku, Tokyo, <http://www.sophia.ac.jp>

Tel: (+81) 3-3238-3118, Fax: (+81) 3-3238-3086, n-hosoga@hoffman.cc.sophia.ac.jp

Abstract: This study performed by the Business University Forum of Japan aims to clarify the current status of science and engineering university education in Japan primarily from the perspective of whether the education is useful or not as the preparation for the students' professional careers. A questionnaire and a group interview were made for 40 young employees graduated from 25 major Japanese universities with 2 or 5 years experience in 4 big corporations. 80% of them are masters, 7% are doctoral course graduates and others are bachelors.

The results are summarized by the percentage of people who evaluated the subject they learned or the thesis work they experienced to be useful. Content of usefulness includes 'very' and 'in some degree or partly'. Regarding lectures and practical assignments of special subjects in bachelor course, 94% of them evaluated those useful. As for master's thesis work, 75% of them said so. In case of foundation subjects including mathematics, physics, chemistry etc. 59% of them evaluated those useful. The above results show that the majority of people acknowledged both special subjects and foundation subjects were useful for their careers. On the contrary, only 23% of people appreciate English lesson completed during freshman and sophomore. In case of liberal arts subjects, those who remember what they studied are half or less. Totally, 70% of them feel that each university education was satisfactory, however, 28% of them are not so much satisfied. As a supplement of the above usefulness evaluation, personal opinions of Japan and U.S. university graduates regarding each of their valuable educational experience were quoted from the interview and their reports.

Universities should listen to these most important customers' opinion to improve their educational systems and to enrich the contents of the systems provided to their students.

Keywords: master thesis work, special subject, foundation, liberal arts, personal effect,

1. Introduction

Business University Forum of Japan [1] organized by top management of industry and leaders of academia have made proposals on the fostering of ability of people through the cooperative research work of industry and academia.

In 1996, the study group organized in BUF, interviewed CEOs and managers of human resource development from 13 companies as well as presidents and managers of job guidance from 7 universities. From industry side, top management requested new graduates to acquire more fundamental knowledge and problem solving skills, which will not become obsolete in future. They also requested new graduates to have knowledge of liberal arts reliable when they would encounter some difficulties in their lives. They also gave other suggestions to the university education and propose the expansion of contacts between universities and industry. The results were issued from BUF [2] and also presented at the meetings [3,4].

Complementary to the above mentioned industry's view toward university education, the 2nd study group was organized to survey the opinion of the people who experienced science and engineering university education in recent years. The group aimed to clarify the current status of science and engineering university education primarily from the perspective of whether the education was useful or not as the preparation for the students' professional careers. This paper shows the results of the study [5] and discusses strong points and weakness of Japanese science and engineering university education, containing useful information for other countries.

2. Results of Survey

40 young employees who graduated from 25 major universities in Japan [6] with 2 or 5 years experience in various technical areas of 4 companies [7] filled out a questionnaire via e-mail. They then attended a 2-hour group interview in each company and explained the background of their answers to the questionnaires. 80% of them are master graduates, 7% are doctoral course graduates and others are bachelors. Additionally, we have obtained the information from a few U.S. university graduates to see difference and similarity of master course education between the U.S. and Japan. Three of them are doctoral course graduates and one is a master graduate.

2.1 Thesis work (master course)

In Japan, during master course, students spend most of their time for their thesis work in the offices or laboratories of their professors who guide and examine their thesis. The master graduates of the young employees told in their interview that the majority of them devote 80-90% efforts to their thesis works. In their professors' offices or laboratories, they were trained how to proceed their research. They learned the method of experiments and data analysis, how to write good technical papers and how to make presentation in English, from the laboratories' staff, senior people in their professors' offices or directly their professors.

In the former survey, many companies were of the opinion that research topics of thesis work have little relevance for actual interest of industry. However, regardless of the subjects of research, majority of graduates acknowledged that the thesis work was very useful as the basic training for the preparation of their professional careers as shown in Fig. 1.

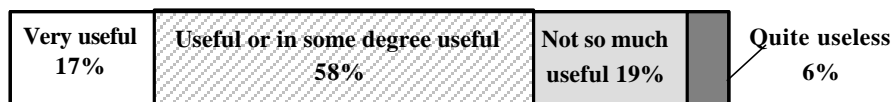


Fig.1. Usefulness evaluation of thesis work

While, the usefulness of the thesis work became clear, in many Japanese universities, lectures and practical assignments of special subjects were held in low regards during master course both from students and professors.

Whether we should continue master education almost entirely occupied with thesis work, or reinforce class lectures with practical assignments up to some balanced condition is the point of discussion.

2.2 Special subjects (undergraduate)

94% of them acknowledged lectures and practical assignments of special subjects useful or very useful. A very few people (4%) say that it is not so much useful, but no one says it is completely useless (Fig. 2).

Having learned special subjects, it gives them self-confidence. Many of them experienced that the confidence they acquired by learning the special subjects would encourage to read the text book they used again and finally they could recollect the clue to solve the problem even though they forgot each item of them.

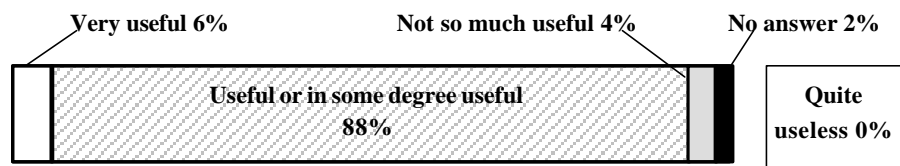


Fig. 2. Usefulness evaluation of special subject

In addition, many of them have experienced that fundamental knowledge they acquired is more useful than knowledge of particulars. The same opinions were expressed by industry leaders during the former interview [2].

Special subject gives them the fundamental knowledge useful for the professional career, whereas, thesis work gives them the chance of training as professionals to carry out their tasks. Special subjects with practical assignments for undergraduates should be realigned together with those for master students.

2.3 Foundation subjects (undergraduate)

Mathematics with its practical assignments, physics and chemistry accompanying experiments are typical compulsory foundation subjects for science and engineering course students. As shown in Fig. 3, about 60% of them concede that those subjects were useful. But among them, those who work in computer science and software field showed the objection that physics, chemistry and their experiments were compulsory subjects for them. Computer science and software people said that they did not encounter any chance to feel that physics and chemistry were useful after graduated. Among foundation subjects, the majority of them, irrespective of their field, acknowledged that all kinds of mathematics learned in the foundation subjects were useful. But many people said that mathematics learned in the stage was very difficult because of large gap from the level they had learned in their high school days. Taking these matters into account, selection of the compulsory foundation subjects should be reconsidered for each of professional courses, especially for computer science and software course students.

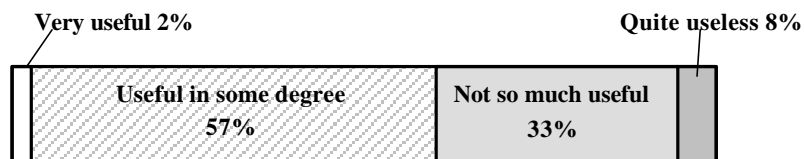


Fig.3. Usefulness evaluation of foundation subjects

2.4 Liberal arts subjects (undergraduate)

39 people out of 40 took the subjects of this category. However, as shown in Fig. 4, the number of those who recognized that there was any liberal arts subject, which they could remember to be instructive, interesting, or anything in their minds, are only a half. Even for those who recognized so, impression of the subjects was generally very weak except a few people who told they had a very interesting lecture of this category. The common characteristics of the interesting lectures are that they contain high level of speciality being enthusiastically given by professors.

In many universities, variety of liberal arts subjects has been fixed for years and this narrow selectivity causes discontent among students. They wanted to select the liberal arts from wide variety, not only classical subjects such as history, literature and philosophy but also contemporary subjects such as economy, finance, business in general, knowledge of patent and etc.



Fig.4. Was there any liberal arts subject which they could remember to be instructive, interesting, or anything in their minds?

2.5 English

More than 90% of them are using English in some degree in their work. However, persons who are satisfied with their ability of using English are only 7%. Others show dissatisfaction as shown in Fig.5-1.



Fig.5-1. Satisfaction with ability of using English

The answers to the question asking whether English they learned in their university life was useful to improve their ability of using English are almost negative. As shown in Fig.5.2, 75% of them said that English lessons in their universities were useless. However, many people said that reading or writing of English technical papers and correction of the papers by professors or his staff during their thesis works gave better chance to learning of practical

English usage. This fact shows that Japanese universities must be aware of their incompetent English lessons continued for many years in the past and must start new method to teach practical English. The other foreign language lessons in universities proved to be not useful and therefore the method should also be reformed.

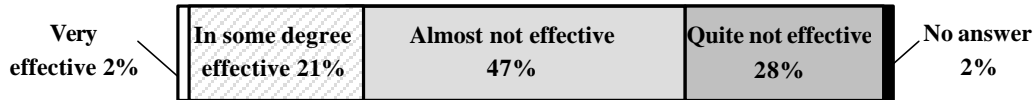


Fig.5-2. Usefulness of English lesson in university education

2.6 University education in general

Fig. 7 shows the results of the answer to the questionnaire asking whether their university education generally gave them satisfaction or not. About 3/4 of them showed satisfaction. However, being fully satisfied is only 8%, and being not so much satisfied is up to 28%. Main reason of the satisfaction is that they felt the fundamental or practical knowledge acquired and the basic training completed during their university days were useful for their career. Contrary, the major reason of discontent is that they didn't feel the knowledge and the practice so much useful.



Fig. 6. Satisfaction of university education in general

As for one of the common requests to the university education, professors should make every effort to avoid monotonous lectures and should enthusiastically lecture for students. Professors should choose exercises, which will come across in actual business, and should offer them the chance of good practice through the laboratory works.

Among computer science and software people, relatively large discontent is observed toward their university education. The reason is that in IT area, which is changing very fast, the effective curriculum has not yet established, moreover, the foundation subjects to support the special subjects for IT area have not yet defined also. This might be a common feature for newly developing professional areas.

3. Discussion

3.1 Thesis work vs. special subjects in master course

In the interview, it was told that students spent most of their time in the office or the laboratory of their thesis advisor. Compared to the thesis work, lectures and practical assignments of special subjects are relatively held in low regards in many Japanese universities. Concerning the above trend, we have gathered a few reports of master course graduates in the U.S. They experienced class lectures accompanied by practical assignments of time consuming homework. In the first case, a material science master graduate typically took one or two classes of special subjects per a quarter (10 weeks) and classes were 4 hours per week. He would spend about 2-3 times of the class hours for doing homework or studying for the tests. In his last year of master course, he had to do thesis work while taking 2 classes for the entire year, he used to work in the lab until 1 AM for doing his thesis work. In the 2nd case, a computer science master graduate, for whom thesis work was not compulsory, told that he took 5 classes per semester (a half year) and the class lectures accompanied by assignments of problem solving which in most cases were programming. They took considerable time and creativity to solve. He said programming practice was too hard looking back that fun after many years. But he also said what these lectures and assignments really provided him in his subsequent career was the ability to talk to a domain expert at a deep level of understanding and that to offer reasonable solutions. Since the total time is limited, universities should reconsider the most effective way of master education and training systems including the balance of thesis work and classes.

3.2 Personal effect of university education

Through the communication with the young graduates in the interview and with the graduates from the U.S

universities by e-mail, we got their comments regarding on what occasion they had personally obtained useful experience in their universities.

Both Japan and the U.S. master graduates expressed that they had very useful experience in their thesis work. A master graduate who participated in a collaborative project during his master thesis work with outside research institutes told that he could have a very useful experience which would never be obtained through usual activity in his university. One of the U.S. university graduates told that in his thesis work one to one meetings with his thesis advisor were most helpful for him to learn how to look at a problem and solve it in the most straightforward and direct manner. Moreover, the conversations with his professor in that occasion were typically at a peer-to-peer level, which could never be seen in usual relationship between teacher and student. As a result, these helped to build his confidence for interacting with others in the scientific community.

Both Japan and U.S. university graduates experienced teamwork through laboratory works. One of the U.S. university graduates mentioned about practice of teamwork through the design projects in which they designed an entire signal processing LSI chip.

4. Conclusions and Comments

The young graduates from science and engineering universities of Japan expressed that the thesis work, special subjects and foundation subjects were all useful for their careers. However, the subjects of liberal arts and lesson of foreign languages, especially for English, in their university are not always effective for their careers. As a whole, about 3/4 of them showed a certain level of satisfaction to the university education they experienced. The evaluation will probably include not only effectiveness from the viewpoint of their career preparation, but also various factors of university lives that they experienced. As a supplement of the above usefulness evaluation, we have shown a few opinions of Japan and U.S. university graduates in what occasion they had valuable educational experience and training useful for their careers.

In conclusion, first, we are suggesting to science and engineering course of Japanese universities for their improvement of educational systems, through the evaluation by the young graduates from the universities on each category of subjects and thesis work. Secondly, the universities should listen to these most important customers' opinions to improve their educational systems and enrich the contents of the systems. Then, universities must be sensitive to how their educational systems have been effective to knowledge preparation and training experience for each student and establishment of his or her personality.

5. Acknowledgements

Authors would like to thank Dr. Ikuo Karube, Prof. Univ. of Tokyo, and the 2nd study group members of BUF; Dr. Mutuhiro Arinobu of Toshiba Corporation, Dr. Tomoji Hikita of Tokyo Gas Co., Ltd. and Dr. Koichi Yoshimi of NEC University, LTD. They are very much grateful to Dr. John Knights and Dr. Masakazu Shoji who made arrangements to obtain information of U.S. university graduates and/or gave their personal suggestions.

[1] BUF (Business University Forum) of Japan chaired by Dr. Hiroyuki Yoshikawa, consists of 17 academic and 16 corporate members. Dr. Shuzaburo Takeda is Executive Director, and Haruichi Nishio is Director of BUF. E-mail address of BUF office is: buf@dori.co.jp

[2] Research Report of BUF No.2, (written in Japanese) July 1998.

[3] Y.Itoh "University Education -A Perspective from Industry" Proceedings of the Symposium (written in Japanese) at the annual meeting of the Physical Society of Japan, in Hiroshima, March 1999.

[4] Y.Itoh, "What does the industrial world require from university education?" BHEF/B/HERT/BUF/C-HEF Joint meeting, in Banff, Sept. 1998.

[5] Research Report of BUF No.6 and No.7, (both written in Japanese) Sept. 1999,

[6] The names of universities are; Chuo, Hokkaido, Ibaragi, Kanazawa Inst. of Technology, Keio, Kobe, Kyoto, Kyushu Inst. of Technology, Nagaoka Univ. of Technology, Ochanomizu, Osaka, Osaka Prefecture, Science Univ. of Tokyo, Shibaura Inst. of Technology, Shinshu, Tohoku, Tokai, Tokyo Inst. of Technology, Tokyo Metropolitan, The Univ. of Electro-Communications, The Univ. of Tokyo, Utsunomiya, Nihon, Waseda, Yokohama National. (in alphabetical order).

[7] The 4 companies are NEC Corporation, Toshiba Corporation, Tokyo Gas Co., Ltd. and Fuji Xerox Co., Ltd.