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The Design of New Curricular Program with Multi-disciplinary Integration-Biomedical Engineering Education in Feng Chia University

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Abstract: This article is aimed at presenting the experience how we integrate professors, space, experimental instruments, and most importantly curriculums from different departments to provide a brand-new biomedical engineering program in Feng Chia University. There are four basic steps to design a brand-new biomedical engineering program with multi-disciplinary integration in a university without the department of biomedical engineering. First of all, we formed a biomedical system research group consisting of professors with research interests in biomedical engineering. In the meantime, professors cooperated with each other by many joint-research projects. Undergraduate or graduate students who worked for the research projects had the needs in biomedical engineering background. Therefore, they took some biomedical engineering classes out of their own department or school in the second step. Thirdly, professors in the research group might discuss to integrate the curriculums in order to provide more students the biomedical engineering training. The curriculum consisted of some core courses and a few selective courses. The minimum credits to obtain a certificate are no more than 30 credits with most credits (roughly half of them) being admitted in their own department. Therefore, students can not only pursue a minor program but also have no burdens. Currently, there are at least 60 students registering for this program every school year in Feng Chia University.

Keywords: biomedical engineering, Feng Chia University, multi-disciplinary integration

1. Introduction

One of the current trends in engineering education is to encourage and provide students to pursue at least one minor program with certificate conferred for their undergraduate study in Taiwan. Certainly, it becomes the responsibility of engineering educators to design practical and multi-disciplinary programs for students to take nowadays. The field of biomedical engineering as shown in Fig. 1, which integrates engineering technology, basic science, and medicine, is a newly applied technology to the clinic treatment and diagnosis, injury prevention, ergonomics, artificial organs, and development of medical devices and tissue materials. Obviously, the field of biomedical engineering involves multi-disciplinary programs.

In the middle part of Taiwan (i.e., Taichung area), there are two medical colleges, three medical centers and some large regional hospitals. On the other hand, many general universities provide the education of science and engineering. There is indeed great deal of potential to develop the field of biomedical engineering. However, no institutes or departments were established in this area. It is worth to mention that there are three institutes of biomedical engineering in the north part of Taiwan, and two other institutes in the south part of Taiwan. Furthermore, there was no program related to biomedical engineering in the middle part of Taiwan before the year of 1998. The biomedical system research group of Feng Chia University was formed in 1997. This research group consisted of twelve professors who had research interests in the field of biomedical engineering. They are from the departments of automatic control engineering, electronic engineering, computer and information engineering, mechanical engineering, industrial engineering, and the department of statistics. The research field of the biomedical system research group can be roughly divided into three correlated sub-fields namely bioelectronics, biomechanics

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and medical statistics. The bioelectronics and system concentrates on the researches in development of medical instruments, image processing, virtual reality, physiological signal, biosensor design and fabrication, and optical systems. The biomechanics focuses research in the field of biomechanics study of rehabilitation, material testing, motion-aid device and, related devices development. The medical statistics provides information and solutions in clinical practice and instrumental validation related to both western and Chinese medicine. During the past few years, they have developed many biomedical measurement and analysis system and instruments such as eye-ball tracking system, computerized tongue diagnosis system, optimal respiratory system simulation and modeling, pressure biosensor, a multi-functional sphygmograph for Chinese pulse diagnosis, biomedical image processing, physiological signal processing and analysis system for autonomic nervous system, step measurement and analysis system, medical statistics, etc.

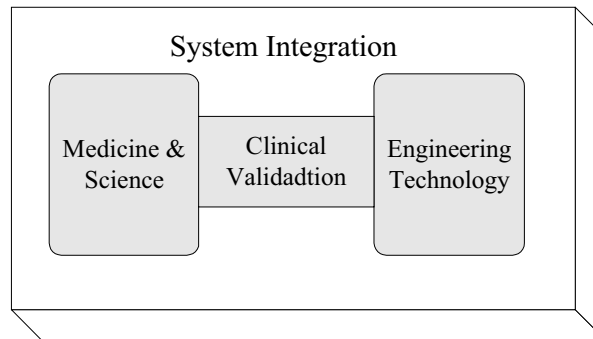


Fig. 1. The field of biomedical engineering.

This paper is aimed at presenting the experience how we integrate professors, space, experimental instruments, and most importantly curriculums from different departments to provide a brand-new biomedical engineering program in Feng Chia University. There are four basic steps to design a brand-new biomedical engineering program with multi-disciplinary integration in a university without the department of biomedical engineering. First of all, we formed a biomedical system research group consisting of professors with research interests in biomedical engineering. In the meantime, professors cooperated with each other by many joint-research projects. Undergraduate or graduate students who worked for the research projects had the needs in biomedical engineering background. Therefore, they took some biomedical engineering classes out of their own department or school in the second step. Thirdly, professors in the research group might discuss to integrate the curriculums in order to provide more students the biomedical engineering training. The curriculum consisted of some core courses and a few selective courses. The minimum credits to obtain a certificate are no more than 30 credits with most credits (roughly half of them) being admitted in their own department. Therefore, students can not only pursue a minor program but also have no burdens. Once the curriculum has been decided, part-time instructors must be appointed in advance for those classes in medicine (note that there is no medical school in Feng Chia University) at the final step. Currently, there are at least 60 students registering for this program every school year in Feng Chia University.

This paper is organized as follows. In section 2, we will introduce how the biomedical engineering program was designed in Feng Chia University. The integration of the resources such as experimental instruments and space for biomedical engineering education will be depicted in section 3. In the final section, we will give a brief conclusion and the future work.

2. Curriculums Design

The curriculums of the biomedical engineering program in Feng Chia University were designed as follows. The minimum credits to obtain a certificate are at least 30 credits. There are 15 credits for the core courses and 15 credits for the selective courses. The selective courses are divided into four different fields, which are signal and system, mechanics and material, statistics, and instruments. Students are requested to select courses within at least two different fields. The purpose of this program is to give the students a broader view and knowledge in the field of biomedical engineering. Therefore, These 15 selective courses must cover at least two different fields. However, roughly half of the credits will be admitted in their own departments being counted as the minimum graduation credits. Thus, this might be the incentive for the students to pursue a minor program without burdens. Note that the minimum graduation credits for most of the departments in Taiwan are set between 128 to 148 credits. In Fig. 2, the interconnection of courses in our curricular design is shown. The courses are separated to four different types, which are the fundamental physics, mathematics, and engineering curriculums, medical theory, selective courses (with



emphasis on applications in biomedical engineering), and the core courses. Nowadays, there are getting more and more new courses being offered in this program. The remote-site network education is also seriously considered in cooperation with other universities in the near future.

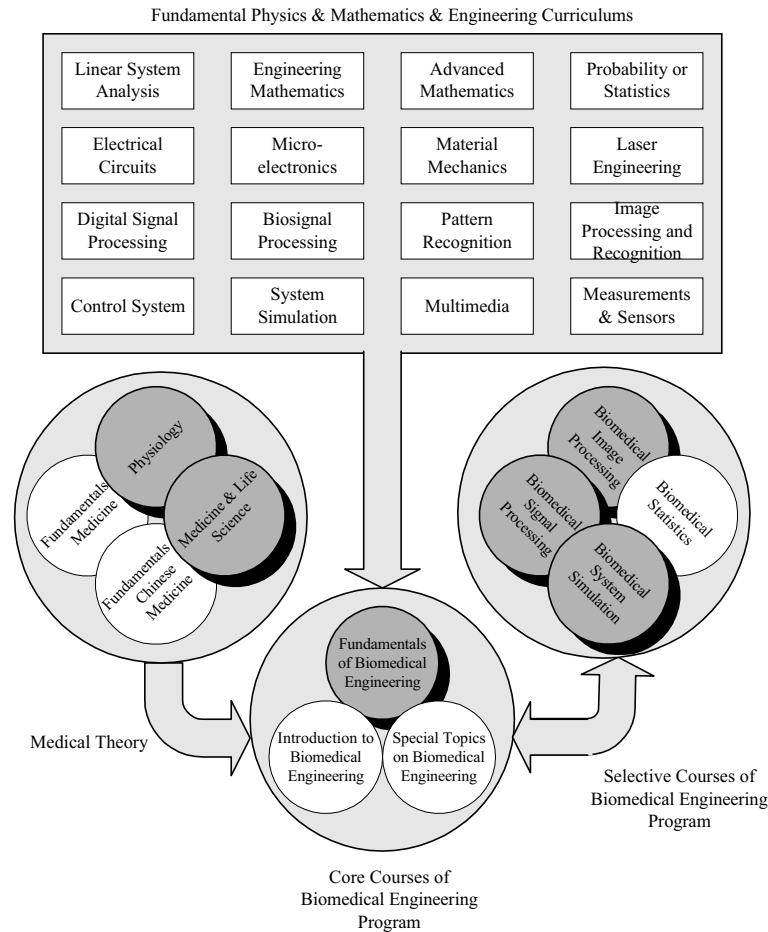


Fig. 2. The interconnection of courses in the curricular design.

3. Integration of Resources

To begin with the designed curriculums, one of the difficulties encountered was the integration of the limited resources within the campus that has no biomedical-related department and medical school for further support. The resources which have been seek includes human resource for teaching, and space resource for core courses and laboratories.

3.1 Human Resource

As was mentioned earlier in the paper, a biomedical research group consisting of professors with research interests in the field was assembled in 1997 and it has been proven later to be a gigantic step for the continuing development of biomedical curriculum in Feng Chia. The teachers engaged in the group contain 12 professors all with doctorate degree. Although it was originally formed for the need of research, they may have been assigned as a designated curriculum advisor in the program. The responsibilities of a curriculum advisor to a program student include providing consultation about curriculum courses, academic scheduling, and personal future development from the viewpoint of the field. On the other hand, they were also encouraged to take part of the designed core courses. In Table 1, it can be found that the professors mainly come from the College of Information and Electrical Engineering, College of Engineering, and College of Business. Although they have been scattered over several departments, the integration went on successfully on the basis of teaching and advising while group meeting was carried regularly in each semester. As it may also be seen from the tabulated information, professors from the departments, including Electrical Engineering, Textile Engineering, Material Science, and Chemical Engineering, which were expected to

contribute in the biomedical engineering are absent from the group. It is believed that this can be improved in the near future as more students from the corresponding departments enrolled in the program.

Table 1: The Integration of Human Resource-*Biomedical System Research Group in Feng Chia*

Professor	Research Field	Department	College
1	Biomedical Signal Processing Chinese Biomedical Engineering	Automatic Control Engineering	Information and Electrical Engineering
2	Control System Design, Biosensor		
3	Biomedical System Modeling, Control, and Simulation		
4	Microsensor Design, Fabrication, and Application		
5	Optoelectronic Measurement, Machine Vision		
6	Parallel Processing Biomedical System Computation	Information Engineering	Engineering
7	Image Processing and Visualization	Electronic Engineering	
8	Biomedical Signal Processing Image Processing		
9	Gait Analysis, Optimal Design, Finite Element	Mechanical Engineering	
10	Machine Vision Image Processing	Industrial Engineering	Business
11	Biostatistics,	Statistics	
12	Statistics of Chinese Medicine		

3.2 Space Resource

It is not difficult to imagine that space has grown to be a major problem for 28 departments as nearly 18,000 students and 1,000 faculty and staff members occupy over 23 hectares. However, under the school policy of supporting interdisciplinary education and multidisciplinary integration, the space need for the undergoing biomedical engineering education has been answered by providing two classrooms, Rm-B101 and Rm-101, in the basement and first floor of the College of Information and Electrical Engineering, respectively. Of course, the obtained space sum up only $150 m^2$ and is far insufficient for the needs, nevertheless, the integration among the needs has to be carried before further demand is met.

In Fig. 3, it is clear that the obtained space, Rm-B101 and Rm-101, were assigned as the Biomedical Engineering Education Classroom and Biomedical Research Laboratory, respectively. The Research Laboratory (Rm-101) serves as a base for Biomedical Research Group. The related research activities, especially those specified in the left circle of the figure, are encouraged to be carried in the laboratory as computer hardware and software, electronic instruments, and basic signal processing facilities are supported by the school. On the right half of the figure, the Education Classroom (Rm-B101) mainly supports the fundamental course laboratory of designed biomedical engineering curriculum program. On the other hand, the research facilities and instruments in the Research Laboratory are demanded to uphold some advanced laboratories for the program. Since 1998, we have been fortunate enough to be supported by the Educational Bureau under the grant named to upgrade biomedical engineering curriculum program for universities without related department. One of the major goal of such project is to compose a local center in central Taiwan and to provide continuing education for biomedical engineer around the area. The above two spaces will also be integrated to furnish such service in the future.

4. Conclusion and Future Work

One of the current trends in engineering education is to encourage and provide students to pursue at least one minor program with certificate conferred for their undergraduate study in Taiwan. This paper has presented the experience how we integrate professors, space, experimental instruments, and most importantly curriculums from different departments to provide a brand-new biomedical engineering program in Feng Chia University. Four basic steps were proposed to design a brand-new biomedical engineering program with multi-disciplinary integration in a university



without the department of biomedical engineering. The curriculum consisted of some core courses and a few selective courses. The minimum credits to obtain a certificate are no more than 30 credits with most credits (roughly half of them) being admitted in their own department. In the future, a biomedical engineering program with diploma conferred will be designed in the same university. At that time, we will cooperate with some medical colleges to have joint classes.

5. References

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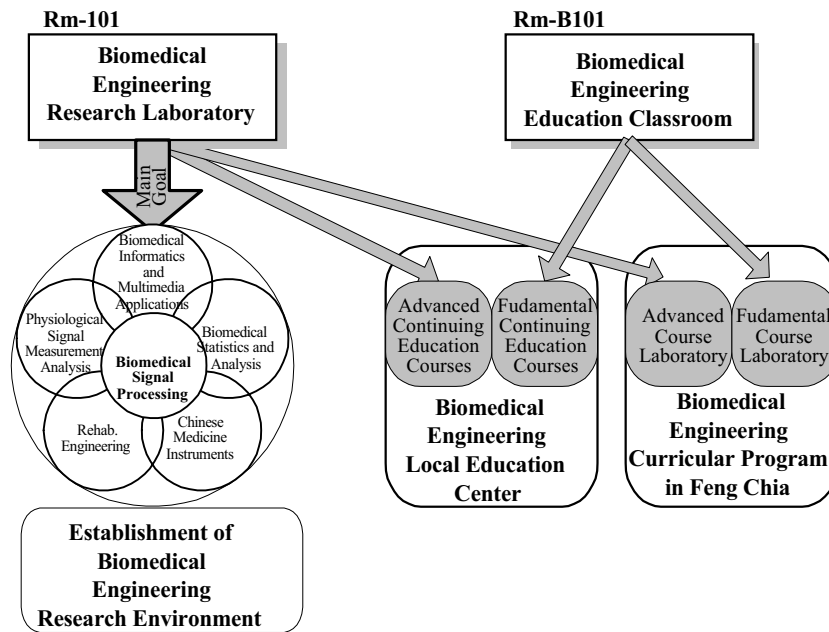


Fig. 3. The Integration of Space Resource of Biomedical Engineering in Feng Chia

