Cross Cultural Seminar Inspires Multidisciplinary Learning: from Biomedical Engineering to Gerontechnology

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ABSTRACT

Gerontology is picked up in the aging society in the world. In Japan, for example, the generation balance will change in a few years. A variety of technology, on the other hand, will help the ageing society (Gerontechnology). In "Biomedical Engineering", the human being is analyzed by the methodology of engineering, and the engineered design is applied to the human being. Between the engineered system and the biological system, the interface has been studied and the collaborative system has been designed. You can find out the same base of philosophy between "Biomedical Engineering" and "Gerontechnology". The effectiveness of the cross cultural seminar on multidisciplinary learning has been discussed in relation to "Biomedical Engineering" and "Gerontechnology". Several multidisciplinary learning programs have been practiced as cross-cultural seminars of students: in Japan, in Thailand, and in USA. They have learned how to communicate with persons, who have a variety of studying backgrounds and a variety of cultural backgrounds. The training awakes students to several points: thinking from different points of view, and using various communication tools. The process extends the communication skill, inspires cross-cultural understandings, and compensate the gap between generations.

Keywords: Multidisciplinary Learning, Biomedical Engineering, Communication, Gerontechnology and Cross-cultural Seminar.

1. INTRODUCTION

The term of "Gerontechnology" is used as an interdisciplinary field combining gerontology and technology (Fig. 1). Gerontology is picked up in the aging society in the world. In Japan, for example, the generation balance will change in a few years (Fig. 2). Including assistive technology, a variety of technology, on the other hand, will help the ageing society.

In "Biomedical Engineering", the human being is analyzed by the engineering methodology, and the engineered design is applied to the human being [1]. Between the engineered system and biological system, the interface has been studied and the collaboration has been designed: prostheses, diagnosis, and treatment.

Between "Biomedical Engineering" and "Gerontechnology", you can find out the similar base of discipline to assist human.

The present article is based on experiences in the author's personal history [2]: multidisciplinary experiences, and cross cultural experiences (Table 1). The author's first motivation relates to artificial organs (Fig. 3), which is based on multidisciplinary field between medicine and engineering. The main topic of artificial organs is "device coexists with human". The present article hopefully could help next generation for multidisciplinary leaning.

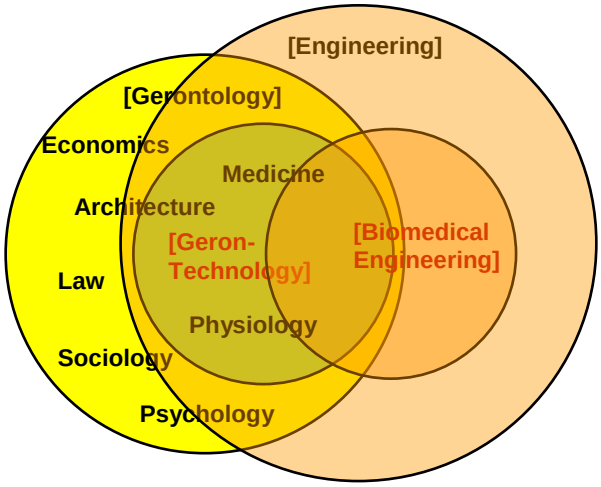

Fig. 1: Gerontechnology and Biomedical engineering.

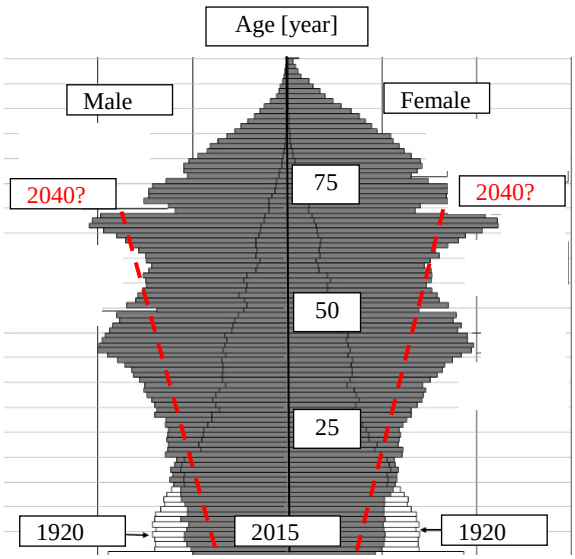

Fig. 2: Population pyramid in Japan.

Table 1: Cross-cultural, and multi-disciplinary experiences (year).

	Cross-cultural	Multi-disciplinary
Student seminar	1975-	1975-
Internship	1975-	1975-
Academic society	1990-	1975-
Research project		1979-
Lecture	1994-	1981-
Affiliation (Faculty)		1981-
Thesis		1987-
Text book	2017	1996-
New department	2004-	2004-
Research center		2005-
Accreditation		2000-

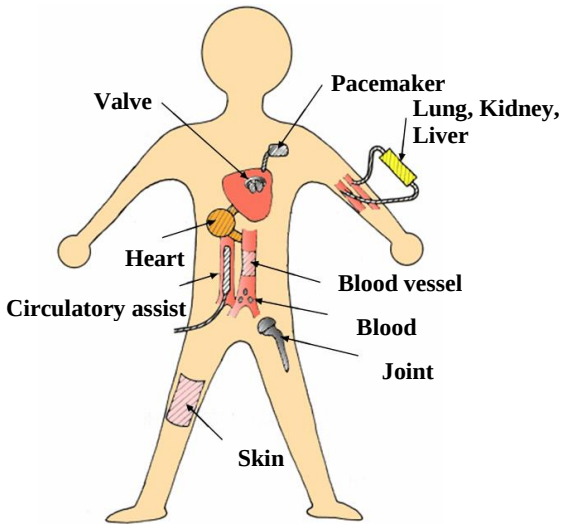

Fig. 3: Artificial organs.

Biomedical engineering makes collaboration with many medical departments on many research projects: cardiovascular surgery on the artificial heart, orthopedics on the artificial joint, plastic surgery on the artificial vessel, neuro surgery on the shunt, and anesthesiology on the laryngoscope. The medical engineering research center supports a variety of research projects, which are related to biomechanics, bio-rheology, bioelectronics, biomaterials, bio-systems, bioinformatics, bio-measurements, and biosensor. The author attended at the first meetings of two Japanese multidisciplinary academic societies established in 1978: Biomaterials, and Bio-rheology.

Many interviews gave a variety of information to create a new department of "Biomedical Engineering". Creating the first department of "Biomedical Engineering (including bachelor, master, and PhD courses)" in Japan was a big challenge [3-8]. A lot of pioneers in the world (Case Western Reserve University, Northwestern University, University of Illinois at Chicago, University of California Berkeley, Boston University, Massachusetts Institute of Technology, and University of New South Wales) helped the author to make the new discipline [9].

Attendance of conferences related to Biomedical Engineering gave the author concepts of multidisciplinary fields. Biomedical Engineering is one of the multidisciplinary fields, which have connections to a lot of disciplines: mechanics, electronics, materials, biology, medicine, pharmacy, economics, sociology, ethics, religion, etc.

The internship-abroad provides the cross cultural experiences to students. The internship program at the institute of the artificial heart in Free University Berlin in 1977 gave the author both cross cultural sense and interdisciplinary sense simultaneously: collaboration between engineering and medicine [10]. Kogakuin University, on the other hand, accepts internship students from Thai Universities, since 2017.

The author experienced reviews of two kinds of PhD theses: medicine and engineering. Each discipline has its own reviewing process. Medicine keeps statistic evaluation related to individuality and to time-dependency. Engineering demands sophisticated methodology related to standardize.

The author also found different disciplines, when the affiliation changed: mechanical engineering, school of medicine, electronics, and biomedical engineering.

In the present article, multidisciplinary learning has been discussed in relation to cross-cultural seminar.

2. METHODS

Several types of cross cultural seminars have been practiced for students: group works, joint seminars, presentations, lectures, and discussions.

Group Work

The annual cross-cultural student program of Biomedical Engineering between Kogakuin University and Chulalongkorn University in Thailand has been started in 2011 [11]. Students, who participate in the program, divided into several groups. Each group includes Thai students and Japanese students. The backgrounds of students have variations: pharmacology, nanotechnology, medicine, mechanical engineering, computer engineering, biology, material science, and biomedical engineering. Each group has to make a report, and to make a presentation at the final session. Two days are available to make the report with the presentation: setting of the issue, designing the solution, and evaluation of contribution to the society.

Joint Seminar

Several joint student-seminars of biomedical engineering have been held between universities: in Mahidol University, in University of Illinois at Chicago (Fig. 4), and in Illinois Institute of Technology.

Your Proposal for Research Topic in Biomedical Engineering

Each student made a report for the training of multi-disciplinary design in the course of "Biomedical Engineering". The title is "Design a new system related to biomedical engineering". Each report should describe the specifications, including drawings and numerical description. The description should include following items: problem to be solved, devised methods, background, expected results, contribution to the society, and references.

Fig. 4: Joint seminar between Kogakuin University and University of Illinois at Chicago.

Presentation in International Research Conference
Students of "Biomedical Engineering Laboratory" attend the international multidisciplinary research conference, and made presentations.

Laboratory Visit
Several universities in the world have programs on biomedical engineering. The author has communicated with several coordinators of the programs: Stanford University, Massachusetts Institute of Technology, University of California Berkeley, Harvard University, California Institute of Technology, Illinois Institute of Technology, Vienna University of Technology, Keele University, National Technical University of Athens, Chulalongkorn University, and Mahidol University [12].

Cross Cultural Lecture
The annual cross cultural lecture has been held in Mahidol University since 2011 [2].

3. RESULTS

Group Work
Table 2 shows the number of students who joined in each cross cultural seminar. Every year, theme was set: "Find a project to be solved in biomedical engineering field (2012)", "Oil spill cleanup from the surface of sea (2013)", "Visiting the hospital (2014)", "Magnesium (2015)", and "Innovation for aging society (2016) (Fig. 5)".

In 2017, "Research topic for collaboration" was selected for the theme of the group work. After presentation of each student on his own research topic, students were divided into four groups. Each group selected the following topic, and discussed what should be the research topic for collaboration in each group.

1) Behavior of osteoblast on calcium phosphate granule.
2) Discovery of cancer cells by micro PET and electric stimulation.
3) Deformation behavior of red blood cell.
4) Development of microneedle patch to decrease CaOx on native urine under electric field.

Fig. 5: Visiting nursing home.

Table 2: Annual cross cultural seminar for students in Chulalongkorn University.

Year	Number of Students
2011	3
2012	6
2013	5
2014	10
2015	11
2016	6
2017	10
2018	4

Joint Seminar
The annual cross-cultural student program of Biomedical Engineering between Kogakuin University and Mahidol University in Thailand has been started in 2012.

In 2017, the topics of presented at Mahidol University in Thailand are as follows:

1) Effect of mechanical property of scaffold surface with micro hybrid stripe pattern on cell migration.
2) Deformation of cell passing through micro-slit.
3) Orientation of cells on micro-pattern by electric impedance.
4) Effect of hypergravity on cells cultured on micro-pattern.
5) Effect of flow stimulation on cell orientated by micro-pattern.
6) Cell sorting by migration behavior under flow stimulation.
7) Measurement of contraction force of single myotube by electric stimulation using thin film device.
8) Measurement of elastic modulus of cell by micro slit.
9) Sorting of muscle cells by dielectrophoresis.
10) Cell sorting by micro-slit.

Every student made a presentation on the topic of his own research plan in English. After each presentation, students discuss on the topic at the seminar and at the laboratory tour in Mahidol University in Salaya.

Several Japanese students participated in the joint seminar between Kogakuin University and University of Illinois at Chicago (UIC) since 2013 (Table 3).

In 2018, the cross cultural biomedical engineering seminar was held in Illinois Institute of Technology.

Students prepared slides with drawings to compensate their English ability. The experience gave motivation to brush up their skill for communication. Both interdisciplinary discussion and cross cultural discussion help understanding peer reviewing.

Table 3: Annual cross cultural seminar for students on biomedical engineering in UIC.

Year	Number of students
2013	4
2014	5
2015	6
2016	5
2017	5
2018	2

Your Proposal for Research Topic in Biomedical Engineering
Each students made a report on the following topic.

1) Ex-vivo evaluation of mucoadhesive properties of nonionic surfactant vesicle.
2) Dual antibiotic drug loaded hydrogel coating to prevent biofilm formation on stainless steel.
3) Flexible thermoelectric generator for human body heat energy harvesting.
4) Wireless EEG signals processing system for monitoring epileptic patient.
5) Portable hypothermic machine perfusion for kidney.
6) A survey on intra-operative data requirements from surgeons for tele-surgical operations.
7) Device for brain-computer interface paradigm design.
8) Portable phonocardiography and its application as heart disease diagnostic tool.
9) Drug delivery system for bone healing and for inhibition of infection.
10) Universal interface for prosthesis arm.
11) Artificial blood vessel using spider's thread.
12) Smart contact lens.
13) Aspirator for pneumonia patients.
14) Electricity-type prosthetic pharynx.
15) Prevention of aging of muscle by electro stretch taping.
16) Power assist artificial muscle.
17) Tooth brushing device for disabled people.
18) Alarm clock to promote body temperature change.
19) Pain monitoring by electroencephalogram.
20) Database of traditional techniques using electromyogram.
21) Recording and reproduction technology of information of five senses.
22) Three dimensional printer for medicine (training, simulation).
23) Novel design for bone healing and inhibit the infection.
24) Flexible thermoelectric generator by human body heat energy.
25) Portable hypothermic perfusion machine for kidney.
26) Tele-surgery.
27) Universal interface for prosthesis arm.
28) Brain-computer interface.
29) Wireless EEG signals processing system for monitoring epileptic patient.
30) Portable phonocardiography for heart disease diagnostics.
31) Power assist glove using Magneto Rheological Fluid.
32) Supporters using electromyogram.
33) Artificial hearing controlled by brain electrical signal.
34) Implantable microchip for electric therapy.
35) Vibrating pad with laser sensor for visual aid.

Although it was not easy for student to find originality, the report gave students opportunity for multidisciplinary learning.

Presentation in International Research Conference
The cumulative total number of participating students in the World Multi-Conference on Systemics, Cybernetics and Informatics (WMSCI) (Fig. 6) is 60 from 2002 to 2018 (Table 4). The topics of presentation in 2018 are as follows:

a) Behavior of Cell Cultured on Micro Striped Pattern after Stimulation of Excess Gravity.
b) Dielectrophoretic Movement of Cell around Surface Electrodes in Flow Channel.
c) Observation of Cell Passing through Single Micro Slit between Weir-walls.
d) Tracings of Orientation of Cell on Scaffold with Micro Striped Pattern after Stimulation of Vertical Excess Gravity.
e) Slit between Micro Machined Plates for Observation of Passing Cell: Deformation and Velocity

Table 4: Presentations in World Multi-conference on Systemics Cybernetics and Informatics.

Year	Number of students
2002	1
2004	3
2005	5
2006	3
2007	4
2008	5
2009	4
2010	5
2011	2
2012	1
2013	4
2014	5
2015	6
2016	5
2017	5
2018	2

Laboratory Visit
In 2017, nine students of "Biomedical Engineering Laboratory" visited two universities in Thailand, and five students visited three universities in USA. In 2018, one student of Mahidol University visits Kogakuin University for three months (Fig. 7).

Cross Cultural Lecture
The cross cultural seminar has been held in Mahidol University since 2011 (Fig. 8).

Fig. 6: Presentation in WMSCI.

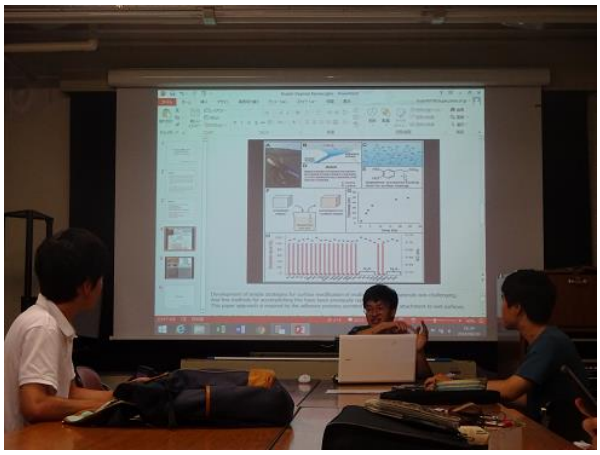

Fig. 7: Presentation in internship.

4. DISCUSSION

Young people must fight with multidisciplinary topics. The multidisciplinary learning extends the communication skill. Curiosity can be motivation for communication. Language is not the only tool for communication. Drawings, figures, or equations can be global communication tools. The terms of technology are basically global. A multidisciplinary textbook should describe not collection of topics, but describe relationships between topics under a multidisciplinary viewpoint [2, 13, 14].

For the workshop of biomedical engineering, you can pick up many interdisciplinary topics, which are related to gerontology: hospital, nursing home, and prosthesis. The hospital, for example, is supported by a variety of specialists, and accepts patients form a variety of backgrounds [15].

The high speed of transmission and the large capacitance of memory realized database. You can pick up any information from the database. The database has capability to make scenario for the user.

If you can access to every medical data, it might be possible for you to pick up answer to take care of your health. You do not have to listen to the second opinion from another medical doctor any more.

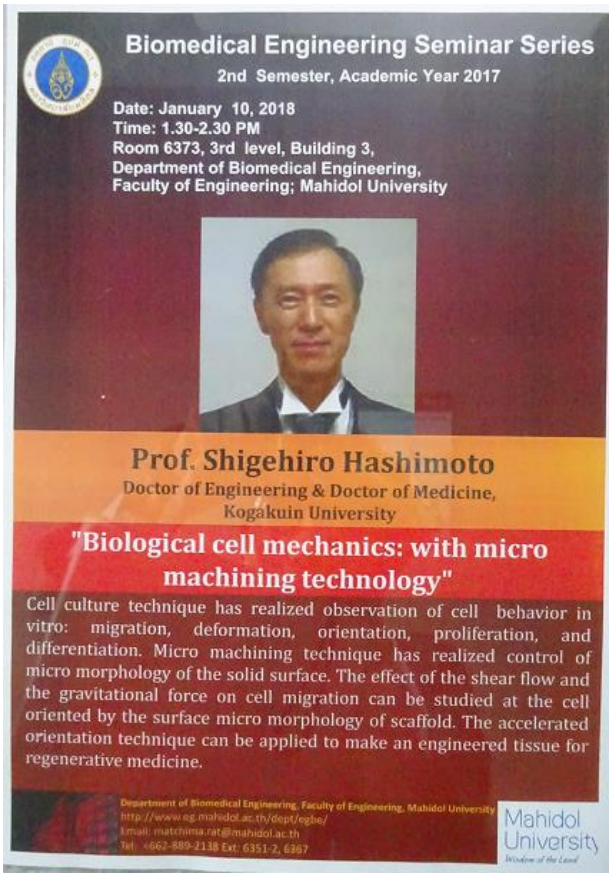

Fig. 8: Seminar "Biological Cell Mechanics: with Micro Machining Technology" in Mahidol University in January 2018.

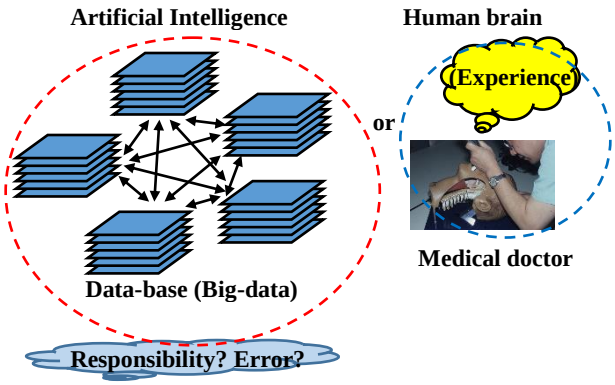

Fig. 9: Do you prefer AI (Artificial Intelligence) than Medicine for diagnostics?

Do you prefer AI (Artificial Intelligence) than the medical doctor for diagnostics (Fig. 9)? When I make the question to freshman students in the classroom, more than half of students answer "yes". From the database ("Big Data"), you could pick up the best solution according to the statistics at any time.

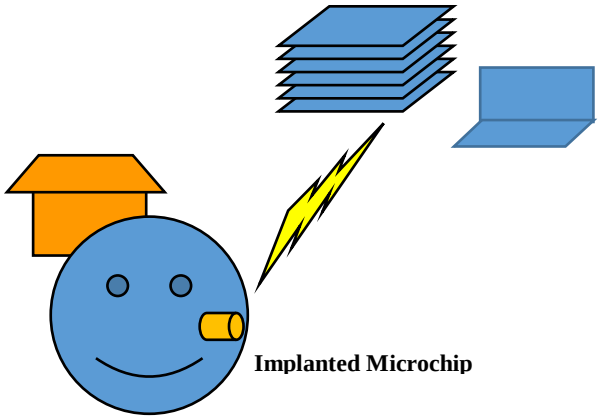

Fig. 10: Self-Monitoring, or go to hospital.

The system can be extended to health care system of the society. Noninvasive methodology is preferable to detect daily condition of the subject. Both informatics and network technology support the system. You can access to the system every moment, which helps registration before change of condition of yourself (Fig. 10). It might be possible for you to access the administration system even during exercise or sleeping.

You might prefer input your own data to the system rather than declare to a medical doctor. In front of the medical doctor, it might be not easy for a patient to maintain daily conditions. In a hospital, the emotional state can change the biological signal of the patient.

What cannot be replaced from human brain to artificial intelligence? What cannot be replaced from "face to face" to "virtual reality via network"? What should we pass down from human to human directly? How can we inherit emotion, inspiration, and traditional technology?

How can be the skill of the elderly generation conveyed to the young generation? The elderly person is supported by a social system. On the contrary, the society is supported by the skill of the elderly person.

Cross cultural seminar inspires students (young generation) multidisciplinary learning: from "Biomedical Engineering" to "Gerontechnology".

5. CONCLUSION

The effectiveness of the cross cultural seminar on multidisciplinary learning has been discussed in relation to "Biomedical Engineering" and "Gerontechnology". Several multidisciplinary learning programs have been practiced as cross-cultural seminars of students: in Japan, in Thailand, and in USA. They have learned how to communicate with persons, who have a variety of studying backgrounds and a variety of cultural backgrounds. The training awakes students to several points: thinking from different points of view, and using various communication tools. The process extends the communication skill, inspires cross-cultural understandings, and fills the gap between generations. Cross cultural seminar inspires students to multidisciplinary learning: from Biomedical Engineering to Gerontechnology.

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