Communication Training for Students in Multidisciplinary Research Area of Biomedical Engineering

Shigehiro HASHIMOTO

Professor, Doctor of Engineering, Doctor of Medicine,
Biomedical Engineering, Department of Mechanical Engineering,
Kogakuin University, Tokyo, 163-8677, Japan
shashimoto@cc.kogakuin.ac.jp http://www.mech.kogakuin.ac.jp/labs/bio/

ABSTRACT

"Biomedical Engineering" makes multidisciplinary research area, which includes biology, medicine, engineering and others. Communication training is important for students, who have a potential to develop "Biomedical Engineering". Communication is not easy in a multidisciplinary research area, because each area has its own background of thinking. Because each nation has its own background of culture, on the other hand, international communication is not easy, either. A cross-cultural student program has been designed for communication training in the multidisciplinary research area. Students from a variety of backgrounds of research area and culture have joined in the program. The program works well for communication training in the multidisciplinary research area of biomedical engineering. Foreign language and digital data give students chance to study several things: how to make communication precisely, how to quote previous data. The experience in the program helps students not only understand new idea in the laboratory visit, but also make a presentation in the international research conference. The program relates to author's several experiences: the student internship abroad, the cross-cultural student camp, multi PhD theses, various affiliations, and the creation of the interdisciplinary department.

Keywords: Communication Training, Multidisciplinary Research Area, Biomedical Engineering, Training for Students and Cross-cultural Program.

1. INTRODUCTION

Communication conveys information. Engineering is research field to be applied to the society. Preciseness is important for the communication in engineering to be applied to the society.

Communication is realized through various networks: face to face conversation, letters, drawings, telephones, electrical networks.

Misunderstanding often occurs in a multidisciplinary research area, because each area has its own background of thinking.

A common base is necessary for communication. Similar experiences develop the common base. When common rules are defined, the communication becomes easier. That is the reason why you learn language, mathematics, SI unit, etc.

The biomedical engineering field is multidisciplinary [1-9]. That includes various fields: biology, medicine, pharmacy. In the field, communication is important between engineering and medicine.

In an international project, you may experience misunderstandings, which depend not only on the language, but also on the cultural background. In a research project in the interdisciplinary field, you also experience misunderstandings, which depend on the methodological backgrounds. In this point of view, both international projects and interdisciplinary projects have the common problem. The problem supplies a good chance for communication training.

Digital culture gives us useful tool of copy. We can easily access to large amount of previous data through internet. Student should learn right way to use these tools.

In the present study, a cross-cultural student program has been designed for communication training in the multidisciplinary research area.

2. METHODS

Group Activity and Presentation Competition

The annual cross-cultural student program of Biomedical Engineering in Thailand has been started in 2011 [8, 9]. The theme was "Oil dispersed over the ocean by an accident of a tanker" last year. Students, who participate in the program, divided into several groups. Each group has to make a report on the theme, and to make a presentation at the final session. Two days are available to make the report and to prepare for the presentation.

Students are allowed to use internet to check information. They can use personal computer to make the report, and to make slides for presentation.

Laboratory Visit

Several universities have special programs on biomedical engineering in the world. The author has communicated with several coordinators of the programs. Some of them supported to create a new department of biomedical engineering in Japan in 2006 [1-7]. Some of them agree to collaborate with our group. Some of them have welcomed our student, and exchanged idea in the annual laboratory visit since 2008 [8, 9].

Presentation in International Research Conference
Students have attended the annual international multidisciplinary research conference, and made the oral presentation since 2004 [8, 9].

3. RESULTS

Group Activity and Presentation Competition
In 2013, fifteen students from Thailand (includes international students) and ten students from Japan joined in the seminar. Their backgrounds are mechanical engineering, material science, environmental engineering, science of nursing, dentist, pharmacy, and electronics. In each group students discuss on the issue, pickup agenda, and adjust the process to make a final report of the group. Students exchange idea in each group (Fig. 1).

One student designs special machine to collect oil. Some students propose biological method to collect the oil. Another student proposes chemical method to change the material. Some students evaluate an economical aspect to the proposal.

They were able to translate English to their own native language at the internet. They easily found data on the internet (Fig. 2). They made slide with data, which is available on the web side.

Several groups made presentation with slides (Fig. 3). In the slides, they used figures, which they found on the web. In one group, a member used white board to write figures by himself (Fig. 4).

It was the first experience for Japanese students to make a group activity in English. The evaluation to their English was not very good, but the presentation of every Japanese student was understandable to Thai students. The figures in the slides might help for Thai students to understand the outline. The presentation is good training for the students to explain contents in the logical order.

The presentation also gave a Japanese student a good opportunity to express himself to the person of the first meeting. After the seminar, communication among students continues to the sightseeing in the traditional places (Figs. 5 & 6). Some students keep in touch with the participants by e-mail.

Laboratory Visit
In 2013, ten students visited two universities in Thailand, and four students visited two universities in USA.

It was not easy for Japanese students to understand the lecture in English (Figs. 7-9).

Several research projects in biomedical engineering were introduced to Japanese students. The topic was familiar to Japanese students, because they knew the instruments. Students exchanged ideas about the experimental system.

Presentation in International Research Conference
Four students made oral presentation last year (Fig. 10). The topics are as follows:

1) Behavior of Cells through Micro Slit
2) Effect of Mechanical Stimulation on Orientation of Cultured Cell
3) Micro Trap for Flowing Cell
4) Effect of Micro Ridges on Cell Culture
5) Observation of Biological Cells in Rhombus Parallelepiped Flow Channel
6) Finite Element Analysis of Bone Remodeling: Resident's Ridge Formation in Femoral Condyle

Several students made poster presentation in the international symposium last year (Fig. 11).

Fig. 1: Group discussion.

Fig. 2: Slide preparation with internet.

Fig. 3: Presentation with slides.

Fig. 4: Presentation with writing on board.

Fig. 5: Cross-cultural student program.

Fig. 6: Cross-cultural student program.

Fig. 7: Laboratory visit.

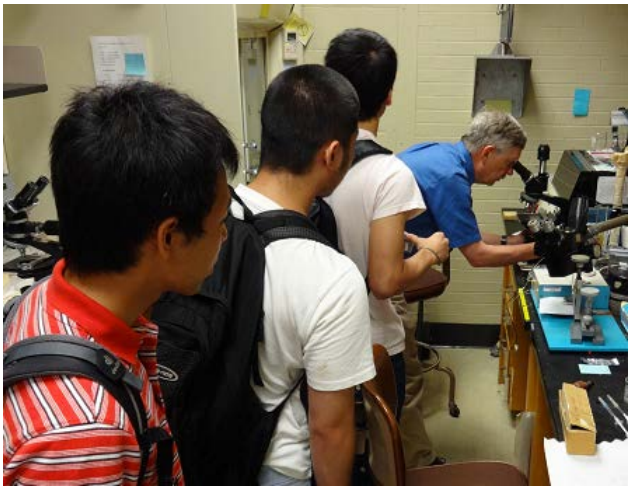


Fig. 8: Laboratory visit.

Fig.9: Laboratory visit.

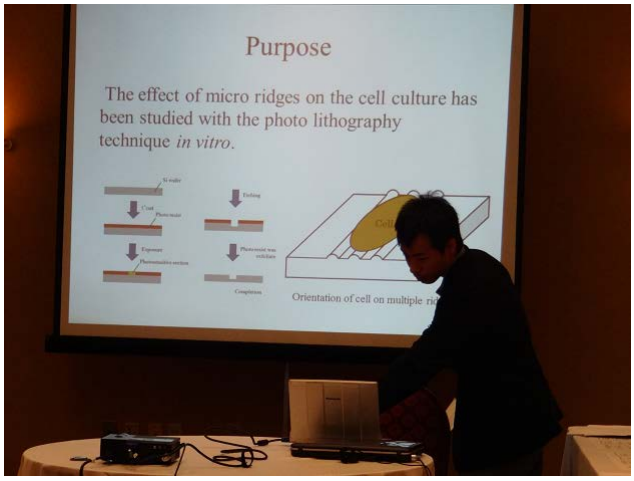


Fig. 10: Oral presentation in international conference.

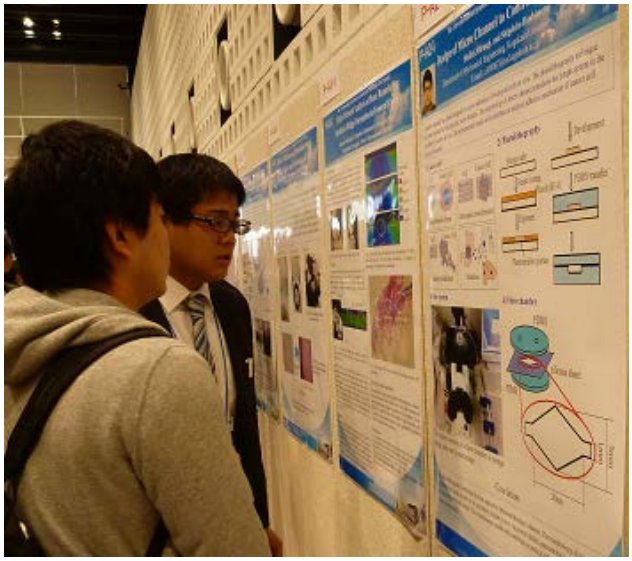


Fig. 11: Poster presentation in international conference.

4. DISCUSSION

Reproducibility

Reproducibility is important in the Science field. A result should be repeatable in the same condition. The result is confirmed, when the same result is realized with the following trial. Science is not magic. The condition should be disclosed to realize the same result by another trial.

In biology, on the other hand, it is not easy to confirm repeatability, because the same condition is hardly controlled. In biology, everything is variable, and never repeats same situation.

References

Finding is new, and nobody knows before. It is original, of course.

Design is created by someone, so that design has a previous origin, elsewhere. Design should be related to references, even if it is created through revolution.

References help the design in several aspects. They identify the position of the design in previous things. They show relation to another thing. They confirm the value. They help idea to be realized.

Reference should be quoted as that was existed. It should not be modified at all. It should be the same as the original.

Reference should be listed with enough information for someone to seek for the reference. If the information has been edited several times, the number of edition should also be listed. Do not quote like the way as telephone game or ear-duster. References are also effective for new findings, although you have to be careful for plagiarism.

Digital Data

Digitized data decrease ambiguity of analog data. Digital data are easily not only copied, but also modified. Digital data include not only text, but also figures. The figure made of digital data is easily modified: color, brightness, size, rotation, and so on (Figs. 12 & 13).

How should we use the function of copy in the digital culture. We should copy from original data. Do not give misunderstanding. We should identify the source. Adding arrow and scale bar would be allowed.

Although art should be original and creative, science is not art. The method to transmit the information should be universal. If the information is described in unique way, the information is not understandable for another person.

The information should be available to everyone, and attribute to society. For universal communication, mathematics is useful. A unit has been developed. Description should be logical.

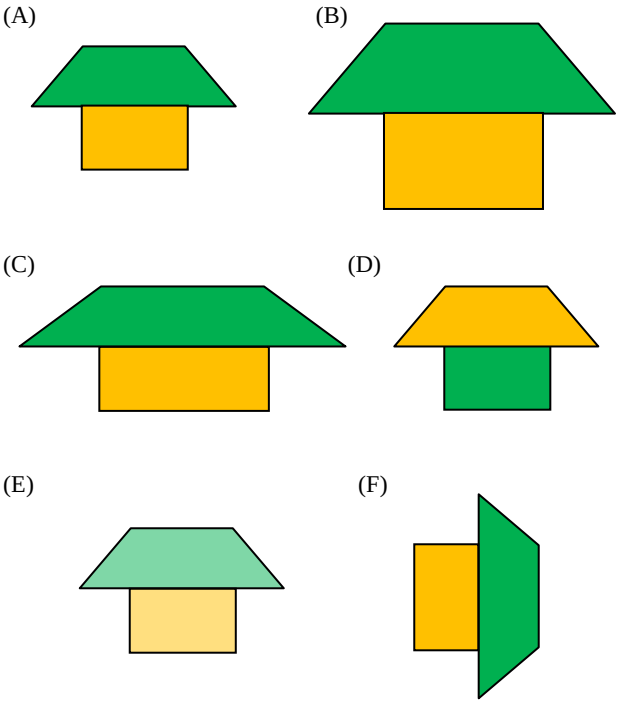
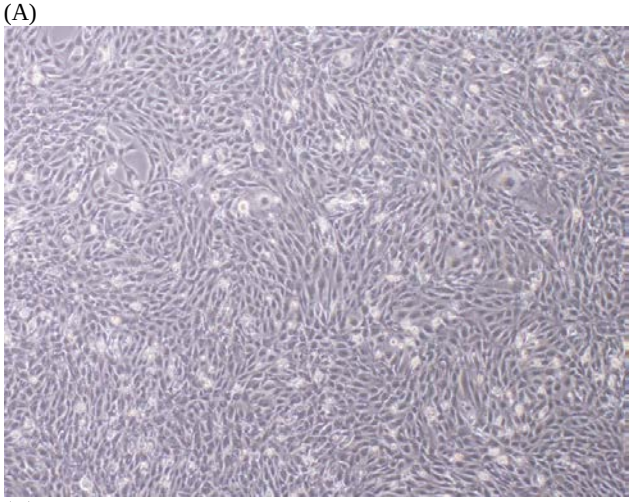
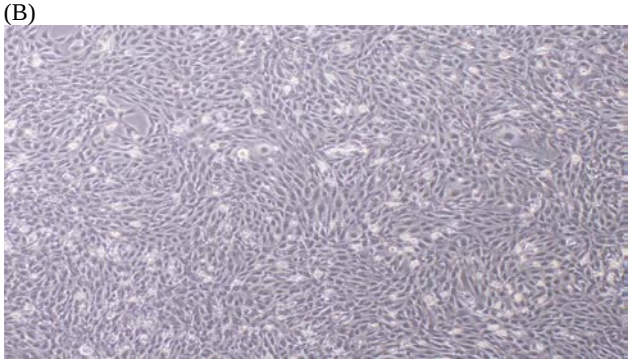


Fig. 12: Modification of digital data: original (A), bigger size (B), ratio changed (C), color (D), brightness (E), rotation (F).

(A)



(B)



(C)

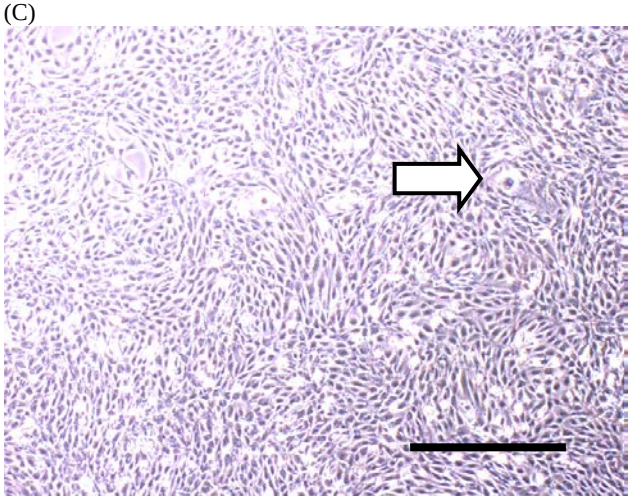


Fig. 13: Modification of digital data: original (A), ratio changed (B), contrast changed (C), additional arrow and scale bar (C).

Foreign Language

In one's own native language, communication is easier. A large amount of vocabulary can be used. In the native language, people feels nuance. The same background allows using abbreviations. It is not good for preciseness of communication. Be careful at symbols, which have different meaning according to its background.

It is not easy for foreigner to create original sentence in English. It is good training for logical expression. Grammatical check is not enough. Preciseness is necessary. Nuance is not necessary. Technical term is important. Each field has rule for expression. Author has better to follow the rule. Author may copy the expression in the same special field of study.

The note of experiment is important: it is precise record of protocol for oneself to memory for the next experiment.

Recently, we have a lot of tools for communication. Although the e-mail system is very convenient for communication, communication on face to face has more information than digital signals: movement, atmosphere, and many expressions. Letters can reveal feeling by handwriting. A telephone can give a tone of the voice. A handshake tells temperature, and the force of the muscle. Paying attention to the background is important for communication training. You may be surprised if some language systems do not have a term, which means "Reflection". The culture might be positive.
At the beginning, students tend to pay attention to the language itself. After the seminar, students found: "it is easy to find the rule, but difficult to understand the background".

"Biomedical Engineering" is a multidisciplinary field of study, which relates to engineering and medicine [2].

When I was a student, I experienced a technical internship in the institute of artificial heart in Free University Berlin. The research project of the artificial heart had been supported by collaboration between engineering and medicine. The experience gave me international sense and interdisciplinary sense, simultaneously.

I myself joined the cross cultural student camp every year, since I was nineteen years old. I experienced a lot of difficulties to communicate with students of different field of study, and of different background of culture.

I found different disciplines, when I take examinations for multiple PhD theses: one for medicine and the other for engineering. The research in the field of biology is based on individuality and time dependent, so that statistical processing is indispensable. The research in the field of engineering is based on homogenization, so that the experimental condition should be controlled. The referee of medicine requested number of experiment with keeping the protocol, although the referee of engineering requested the sophisticated condition of the experiment.

I also found different disciplines, when my affiliation changed: school of medicine, electronics, biomedical engineering and mechanical engineering. Each special field of study develops own discipline including the style of education. Each discipline has one's own technical terms. For example, "control" means "comparison" in medicine and "regulation" in engineering, respectively.

Creating the first department of "Biomedical Engineering (including bachelor, master, and PhD courses)" in Japan was a big challenge (Fig. 11). I created a new concept for the interdisciplinary department [1-7].

The multidisciplinary field makes students learn several things: logical thinking, and flexibility without prejudice. The common background of "Biomedical Engineering" helps them

find a way of thinking.

The shocking experience of the cross cultural seminar makes students notice “It is important to understand the background of thinking to learn the multidisciplinary field of study”. Most of students continue their research activity to the post graduate course.

5. CONCLUSION

A cross-cultural student program has been designed for communication training in the multidisciplinary research area. Students from a variety of backgrounds of research area and culture have joined in the program. The program works well for communication training in the multidisciplinary research area of biomedical engineering. The experience in the program helps students not only understand new idea in the laboratory visit, but also make a presentation in the international research conference.

ACKNOWLEDGMENT

Author is thankful to Dr. Mana Sriyudthsak of Chulalongkorn University, Dr. Jackrit Suthakorn of Mahidol University, Prof. Robert A. Linsenmeier of Northwestern University, to Prof. Richard L. Magin of University of Illinois at Chicago, for collaboration to our project.

REFERENCES

[1] R.A. Linsenmeier, “What Makes a Biomedical Engineer: Defining the Undergraduate Biomedical Engineering Curriculum”, **IEEE Engineering in Medicine and Biology Magazine**, Vol. 23(4), 2003, pp. 32-38.

[2] S. Hashimoto, et al., “Parallel Curriculum of Biomedical Engineering Subjects with Rotational Experimental Project for Interdisciplinary Study Field”, **Proc. 11th World Multiconference on Systemics Cybernetics and Informatics**, Vol. 4, 2007, pp. 39-44.

[3] S. Hashimoto, et al., “Parallel Curriculum between Application and Fundamental Subjects with Rotational Experimental Project for Multidisciplinary Study Field of Biomedical Engineering”, **Proc. 12th World Multi-conference on Systemics Cybernetics and Informatics**, Vol. 2, 2008, pp. 98-103.

[4] S. Hashimoto, et al., “Bridging –Charge System for Sustained Improvement of Curriculum of Biomedical Engineering Courses”, **Proc. 13th World Multi-conference on Systemics Cybernetics and Informatics**, Vol. 2, 2009, pp. 191-195.

[5] S. Hashimoto, “Bridge –Curriculum with Rotational Experimental Projects for Multidisciplinary Courses on Biomedical Engineering”, **Proc. 14th World Multi-conference on Systemics Cybernetics and Informatics**, Vol. 2, 2010, pp. 261-264.

[6] S. Hashimoto, “Bridge-Curriculum System for Multidisciplinary Courses: Application to Biomedical Engineering”, **Proc. 15th World Multi-conference on Systemics Cybernetics and Informatics**, Vol. 2, 2011, pp. 108-111.

[7] S. Hashimoto and A Nakajima, “Role of Bridge-Curriculum for Multidisciplinary Courses: Application to Biomedical Engineering”, **Journal of Communication and Computer**, Vol. 8 (12), 2011, pp. 1117-1122.

[8] S. Hashimoto, “Cross-Cultural Student Seminar for Communication Training in Multidisciplinary Field of Study: Application to Biomedical Engineering”, **Proc. 16th World Multi-conference on Systemics Cybernetics and Informatics**, Vol. 2, 2012, pp. 87-90.

[9] S. Hashimoto, “Interdisciplinary Area of Research Offers Tool of Cross-Cultural Understanding: Cross-Cultural Student Seminar for Communication Training on Biomedical Engineering”, **Journal of Systemics Cybernetics and Informatics**, Vol. 11, No. 9, 2013, pp. 17-22.