Journal of Systemics, Cybernetics and Informatics (2023) 21(4), 13-17
https://doi.org/10.54808/JSCI.21.04.13

Cross-cultural Online Networking Based on Biomedical Engineering to Motivate Transdisciplinary Communication Skills

Shigehiro HASHIMOTO

Professor, Doctor of Engineering, Doctor of Medicine,
Biomedical Engineering, Department of Mechanical Engineering,
Kogakuin University, Tokyo, 163-8677, Japan
At13351@g.kogakuin.jp http://www.mech.kogakuin.ac.jp/labs/bio/

ABSTRACT

It is not possible to understand the whole with only a specialized field. The content is not always correctly conveyed to non-specialists. In this study, based on students' awareness of preparing for the future under a pandemic, understanding of the utility of masks against infectious diseases, and the transition of students' daily behavior under a pandemic, a student group activity was carried out with the theme of "designing tools and systems to contribute to social life in pandemic". In addition, to motivate students to improve their transdisciplinary communication skills, cross-cultural online networking was carried out based on biomedical engineering as a multidisciplinary field.

Keywords: Multidisciplinary Learning, Online networking, Pandemic, Biomedical Engineering and Students.

1. INTRODUCTION

It is not possible to understand the whole with only a specialized field. Furthermore, the content is not always correctly conveyed to non-specialists. This has also been experienced in social issues such as pandemics. Interdisciplinary activity experiences [1] are effective for communication of specialized content beyond specialized fields: experience in multiple specialties, experience in fusion field, experience in communication between different specialties, etc.

It is similar to communication difficulties due to cultural differences. Cross-cultural experiences are also effective [2]. Stimulation of intercultural communication experience provides hints for interdisciplinary communication training [3]. In a pandemic, it is hoped that multifaceted considerations will deepen understanding and lead from individual self-awareness to promoting behavioral change in society.

Infectious disease control is not limited to knowledge in the medical field. Medicine itself cannot exist without the help of engineering. Engineering is useful in the medical, health, and welfare fields.

Biomedical engineering is one of the multidisciplinary fields. By adding cross-cultural experience, the young generation will be more motivated to study multidisciplinary fields. Opportunities to learn how to approach from the engineering field are about to be provided in order to build a society that is strong against infectious diseases. Countermeasures against infectious diseases are not limited to improving masks. It is expected to find applications in unexpected fields.

In this study, based on the transition of students' daily behavior under a pandemic [4], a student group activity was carried out with the theme of "designing tools and systems to contribute to social life in pandemic". In addition, to motivate students to improve their transdisciplinary communication skills, cross-cultural online networking [5] was carried out based on biomedical engineering as a multidisciplinary field.

2. METHODS

Effect of Mask
There is a dispute over wearing a mask. Masks are worn in certain occupations (medical care, food, microfabrication). Is it obligatory to wear a mask in other cases? A questionnaire was conducted to the 1st year students in the undergraduate course of Kogakuin University Japan on the significance of wearing a mask [6] from 2020 to 2022 in Pandemic.

Daily Activities
A questionnaire on career design was conducted for first-year students at Kogakuin University under the pandemic. Another questionnaire was conducted to the 1st year students in the undergraduate course of Kogakuin University Japan on the daily activities to prevent COVID-19 from 2020 to 2022. During this period of two months, workshops were held by students on the following themes as group activities: "your proposal (group activity for 1 month) on tools and systems that contribute to a society that is resistant to respiratory infections".

Student Online Seminar
Research topics were introduced online between the students of the Biomedical Engineering Research Center of Chulalongkorn University and the graduate and undergraduate students of the Biomedical Engineering Laboratory of Kogakuin University. The same kind of student online seminar was conducted between the students of the Department of Biomedical Engineering of Mahidol University and the graduate and undergraduate students of the Biomedical Engineering Laboratory of Kogakuin University.

Networking
With the keyword "life support technology", Japanese academic society and Department of Biomedical Engineering in The University of Illinois Chicago conducted online networking for information exchange on research topics.

3. RESULTS

Effect of Mask

Fig. 1 shows the percentage of the student response for the following questions.

"Select three effects of everyday mask wearing on COVID-19".

1) Prevention of the outflow of the virus.
2) Enhancement of the immune capacity by maintaining humidity in the oral cavity.
3) Reduction of splashing of water droplets including virus that accompany sneezing.
4) Prevention of the inflow of the virus.
5) Prevention of direct touch by your hands to your mouth (or your nose).

The large number of "drop" responses is related to the fact that "Masks reduce the virus-laden water droplets associated with sneezing" was enlightened from the beginning. Initially, it was believed that masks would prevent the passage of the virus. If the filter is not matched to the properties of the particles, the particles will pass through. Even if the passage of the virus cannot be prevented 100%, it was re-understood that the effect of reducing the passage of the virus is also effective as an infection prevention measure. The effects of humidification and contact are also gradually being understood.

Fig. 2 shows the percentage of responses to the opinion that "wearing a mask should be made compulsory". In Japan, there are no penalty and most people wear masks as recommended to prevent infectious diseases. However, in response to the question, 55% of first-year students oppose making masks mandatory.

Daily Activities

Fig. 3 shows the percentage of first-year students who chose to act as their career design under the pandemic. Despite the pandemic, some student projects are active. In Japan, there are not so many students who go on to graduate school. Internships as work experience have declined due to the pandemic.

The upper graph in Fig. 4 shows the number of patients in Tokyo Japan. Each bar indicates the daily number. The line shows the mean value for one week. During this period, the number of patients increased in Tokyo. Kogakuin University is located in Tokyo.

The lower graph in Fig. 4 shows the percentage of student responses to the following questions.

"From the items below, select all the things you have been doing on a daily life over the past week."

1) I measure my temperature every day.
2) Every day, I check my respiratory function by taking deep breaths and climbing stairs.
3) Do not stay in an odor-filled space for more than 10 minutes, except in your own room.
4) Always wear a mask when talking, except in your own room.

Initially, students relied on masks. As the number of infected people increased, students began to measure their body temperature as part of their self-health management. Awareness of the respiratory function test also increased. The effects of ventilation and air purifiers were enlightened, and awareness improved.

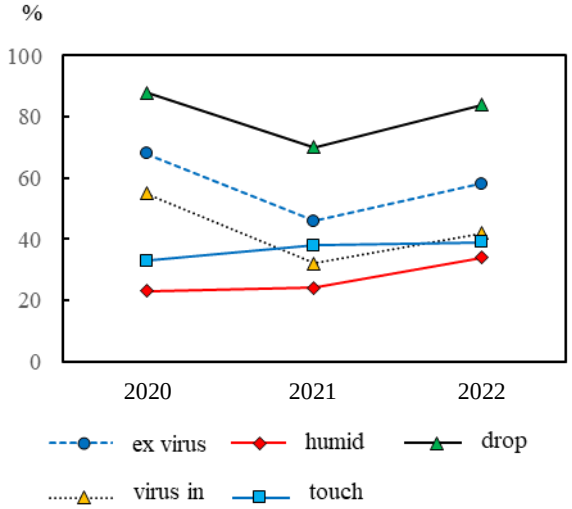

Fig. 1: Effect of mask: 1st year students, 2020 (n = 140), 2021, 2022 (number of samples n = 77).

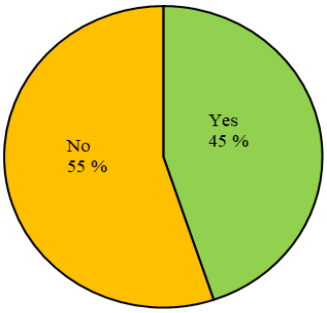

Fig. 2: Obligation to wear a mask: n = 78: December 2022.

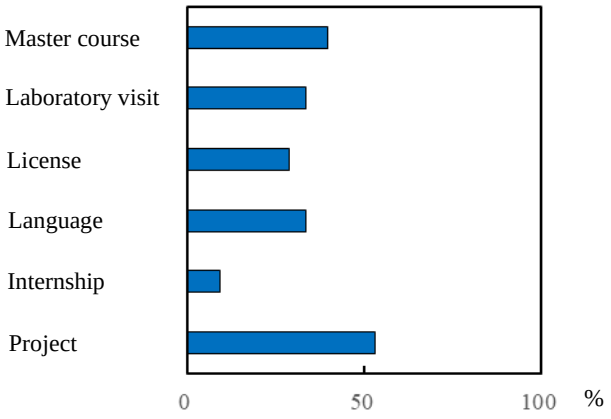

Fig. 3: Carrier design: Master course, laboratory visit, license, language, internship, project: n = 66.

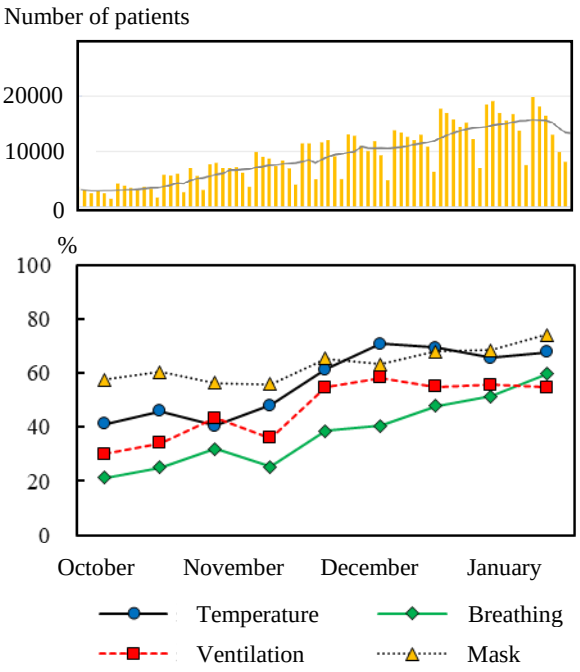

Fig. 4: Number of patients in Tokyo Japan, bar shows the daily number, line shows mean value for one week (upper); ratio % of answer in 1st year students (lower) in 2022. *n* = 70.

The following was the topic of each group on the proposal.

1) Air circulation suit.
2) Auxiliary arms that support the standing position without directly gripping.
3) Air touch panel.
4) Unmanned transportation.
5) Portable disinfector.
6) Handrail sanitizer.
7) Air purifier.
8) Folding partition.
9) Magic hand.
10) Upper arm vital signs sensor.
11) Washable three-dimensional non-woven mask.
12) Enhanced contact app.

Initially, the discussion tended to be limited to the medical field. Over time, the discussion expanded to encompass everyday life, including engineering applications.

Student Online Seminar

On the student seminar between Chulalongkorn University and Kogakuin University, 28 students (Chula 7 and Kogakuin 21 (online 18)) and 3 professors (Chula 2 and Kogakuin 1) participated in (Fig. 5). Of the Japanese students, 18 students were online. The aim of the Biomedical Engineering Research Center is as follows: Multidisciplinary collaboration from problem to solution, Integrative learning to develop research, Medical Instruments and Biosensor, Medical Imaging, etc.

Introduced topics were:
1) A Finite Element Analysis of Lumber Spine.
2) 3D bioprinting for Tissue Engineering.
3) Silk Hydrogel for Biomaterials.
4) Rehabilitation System Based on 3D Motion Tracking.
5) Effect of Cell Velocity on Dielectrophoretic Movement in Microchannel.
6) Measurement of Repetitive Contractile Movement of Myotubes by Markers on Scaffold Film.
7) Effect of Wall Shear Stress on Myoblast Orientation Distribution.
8) Effect of Force Field Direction on Elongation of Myoblast.
9) Movement of Cell Flowing over Oblique Microgroove.
10) Deformation Direction of Cells Related to Passing Velocity through Microgap.

Fig. 5: Student online seminar in Chula in March 2023.

On the student seminar between Mahidol University and Kogakuin University, 27 students (Mahidol 6 and Kogakuin 21 (online 18)) and 2 professors (Mahidol 1 and Kogakuin 1) participated in (Fig. 6). Of the Japanese students, 18 students were online.

Introduced topics were:
1) Biocompatible Material for Medical Application.
2) Biosensor.
3) Artificial Blood Vessel.
4) Classification of Music Genres.
5) Prosthetic Eye.
6) Materials for Active Prostheses.
7) Sensor for Emotion.

Fig. 6: Student online seminar in Mahidol in March 2023.

The impressions of the students were as follows.

1) Illustrations are easier to convey than text.
2) Logical structure is important.
3) Non-native English is hard to understand.
4) Use common terminology.
5) The ability to listen is important.
6) The cross-cultural experience made me realize that I need to broaden my horizons.
7) The fresh experience helped motivate me to study.

Networking

On the online networking between The University of Illinois Chicago and Japanese academic society, 6 students (UIC 3 and JP 3) and 17 professors (UIC 13 and JP 4) participated in (Fig. 7).

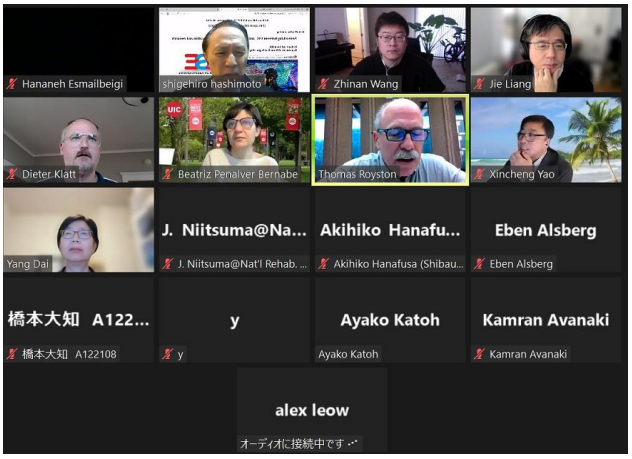

Fig. 7: Networking in November 2022.

Fields of Biomedical Engineering in UIC are as follows.

1) Bioinformatics,
2) Regenerative Medicine,
3) Devices for Diagnostics and Therapy,
4) Medical Imaging,
5) Physiological Modeling,
6) Rehabilitation Engineering
7) Smart Prosthetics,
8) Multidisciplinary Education,
9) Computational Genomics,
10) Machine Learning,
11) Cell Mechanics,
12) Microfluidics,
13) Tissue Engineering,
14) Biomedical Optics,
15) Artificial Intelligence,
16) MR Elastography,
17) Robotics,
18) Medical Device Simulation

Fields of Life Support Technology in Japanese Academic Society are as follows:

1) Biomaterials,
2) Biometrics,
3) Medical systems,
4) Artificial organs,
5) Medical equipment,
6) Medical robots,
7) Rehabilitation,
8) Welfare,
9) Human interfaces,
10) Informatics.

Participating online was not always easy due to the time difference between early morning in USA and late night in Japan. However, the participants were able to experience fresh information exchange.

4. DISCUSSION

The experience of the past three years of pandemics has highlighted the importance of transdisciplinary communication.

If complete isolation is not possible, the most important thing is to change the daily behavior of each individual. Expert advice should be understood and used by non-professionals. Communication skills that transcend specialized fields are important [7].

The compulsory daily examination encouraged individuals to change their daily behavior with the motive of “not wanting to be isolated.” This has been a great force in reducing the number of infected people in the group. Overconfidence in test results is prohibited [8], but the statistical effect on society as a whole should be reaffirmed.

Face-to-face communication can be difficult. These include measures against infectious diseases, interpersonal fear, and long-distance communication. Online networking has become more popular due to the pandemic [9]. There is also an example of a new network being built at this networking event.

Even if you understand it with your brain, you cannot control your daily behavior unless the number of infected people increases. There are many people who just listen to the opinions of experts and do not understand. Most expert opinions are based on one-sided observations. Being in the habit of multifaceted thinking like biomedical engineering [10] helps multifaceted understanding.

At first, students think of infectious diseases as medicine. Engineering considerations are effective in deploying medical care to society [11]. Through group activities to tackle the familiar task of “designing tools and systems from an engineering perspective from the perspective of infectious disease control,” the students became aware of the diversity of engineering that can be applied to society.

5. CONCLUSION

In this study, based on understanding of the utility of masks against infectious diseases, a student group activity was carried out with the theme of “designing tools and systems to contribute to social life in pandemic”. In addition, to motivate students to improve their transdisciplinary communication skills, cross-cultural online networking was carried out based on biomedical engineering as a multidisciplinary field. Cross-cultural online networking based on biomedical

engineering helped motivate students to learn transdisciplinary communication skills.

ACKNOWLEDGMENT

The author thanks Prof Thomas J. Royston of University of Illinois Chicago, Dr. Norased Nasongkla of Mahidol University, and Dr. Juthamas Ratanavaraporn of Chulalongkorn University for collaboration to the student education program.

REFERENCES

[1] S. Hashimoto, "Communication Training for Students in Multidisciplinary Academic Field", R.V. Nata ed., **Progress in Education**, Vol. 73, New York, Nova Science Publishers, 2022.

[2] S. Hashimoto, "Multidisciplinary Learning Extends Communication Skill, and Helps Cross Cultural Understandings: Biomedical Engineering", **Journal of Systemics Cybernetics and Informatics**, Vol. 15, No. 6, 2017, pp. 106–112.

[3] S. Hashimoto, "Cross Cultural Seminar Inspires Multidisciplinary Learning: from Biomedical Engineering to Gerontechnology", **Journal of Systemics Cybernetics and Informatics**, Vol. 16, No. 4, 2018, pp. 1–7.

[4] S. Hashimoto, "Does Learning Multidisciplinary Field of Biomedical Engineering Help Pandemic of COVID-19?", **Journal of Systemics Cybernetics and Informatics**, Vol. 20, No. 1, 2022, pp. 45–64.

[5] S. Hashimoto, "Multidisciplinary Learning Using Online Networking in Biomedical Engineering", **Journal of Systemics Cybernetics and Informatics**, Vol. 20, No. 6, 2022, pp. 7–12.

[6] S. Hashimoto, "Multidisciplinary Learning for Multifaceted Thinking in Globalized Society", **Journal of Systemics Cybernetics and Informatics**, Vol. 20, No. 6, 2022, pp. 43–48.

[7] S. Hashimoto, "Communication Training in Multidisciplinary Field: Biomedical Engineering and Symbiosis Engineering", **Journal of Systemics Cybernetics and Informatics**, Vol. 17, No. 5, 2019, pp. 106–111.

[8] S. Hashimoto, "Does Multidisciplinary Learning Help Global Problem: Covid-19 by Biomedical Engineering?", **Journal of Systemics Cybernetics and Informatics**, Vol. 18, No. 7, 2020, pp. 42–49.

[9] S. Hashimoto, "Interdisciplinary Background of Biomedical Engineering Helps Communication in Pandemic", **Journal of Systemics Cybernetics and Informatics**, Vol. 20, No. 1, 2022, pp. 390-406.

[10] R.A. Linsenmeier and A. Saterbak, "Fifty Years of Biomedical Engineering Undergraduate Education", **Annals of Biomedical Engineering**, Vol. 48, 2020, pp. 1590–1615.

[11] S. Hashimoto, "How Are Students Motivated for Learning Multidisciplinary Field: Biomedical Engineering?", **Journal of Systemics Cybernetics and Informatics**, Vol. 18, No. 7, 2020, pp. 1–6.