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Multidisciplinary Learning Using Online Networking in Biomedical Engineering

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ABSTRACT [1]

Multifaceted thinking is important to tackle global issues for a sustainable society. It is difficult to select useful information from big data with one-sided thinking. This article takes as an example the controversy related to "vaccines" and "masks" in pandemics. Online education is useful to help control of infectious diseases. Face-to-face group meetings make it easy to interrupt group activities for individual activities. Online meetings are considering various ideas as an alternative to face-to-face meetings. The field of biomedical engineering includes faculties and students from diverse backgrounds. "Cross-cultural exchange" is also useful for multifaceted experiences. With the keyword "life support technology," a Japanese academic society and a Thai university conducted online networking for information exchange. The academic society is working to encourage students. The university is developing new fields. Information exchange is expected to lead to further developments in complex fields. It is expected to lead to the development of human resources that can deal with global problems.

Keywords: Multidisciplinary Learning, Online Networking, Globalized Society, Biomedical Engineering and Students.

1. INTRODUCTION

Information networks have developed [1]. The speed of information transmission has increased. As a result, information has come to be shared globally. Issues such as the environment, resources, and climate change have come to be recognized as global issues [2]. The development of means of transportation has accelerated the movement of people and goods. The transmission rate of infectious diseases also increased, and a global pandemic occurred.

Multifaceted thinking is important for dealing with global problems. One-sided coping will cause another problem [3, 4]. Materials, energy, and information are connected through circulation. The realization of a "sustainable society" has become a hot topic. However, increased entropy is inevitable. Complete circulation is difficult. On the other hand, slowing down the rate of change creates time to consider multifaceted measures.

Ecosystems have survived natural selection while maintaining diversity [2]. It is wise to find a way out through trial and error of various measures, rather than narrowing down to a single measure.

This article takes as an example the controversy related to "vaccines" and "masks" in pandemics [5-7]. Online communication is helpful to control infectious diseases. Face-to-face group meetings make it easy to interrupt group activities for individual activities. Online meetings are considering various ideas as an alternative to face-to-face meetings. The field of biomedical engineering includes faculties and students from diverse backgrounds [8-16]. "Cross-cultural exchange" is also useful for multifaceted experiences [17-20]. With the keyword "life support technology," a Japanese academic society and a Thai university conducted online networking for information exchange. The academic society is working to encourage students. The university is developing new fields.

2. METHODS

Pandemic

In the Covid-19 epidemic, quarantine and disinfection were used for daily infectious disease control. Since it is a human-to-human transmission, it is clear that quarantine is effective. However, widespread social life restrictions cannot last long. The impact will spread globally. Unlike hospitals that handle various infectious diseases, it is effective in the public to continuously implement simple measures focusing on the characteristics of Covid-19. Regarding the narrowed down measures, a questionnaire to students was conducted at different times and grades.

Mask

There is a dispute over wearing a mask. Masks are worn in certain occupations (medical care, food,

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microfabrication). Is it obligatory to wear a mask in other cases? A questionnaire was conducted on the significance of wearing a mask.

Vaccine
There is controversy over the pros and cons of vaccination. A questionnaire was conducted on "wishing to get vaccinated" and "whether to recommend vaccination to friends."

Student Online Seminar
Under the theme of biomedical engineering, the research project was introduced online between the undergraduate 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," a Japanese academic society and a Thai university conducted online networking for information exchange on research topics.

3. RESULTS

Pandemic
According to the results of the questionnaire (Fig. 1), students' awareness of countermeasures was low. In relative terms, mask measures were implemented at the highest rate. Graduate students were more conscious because they take more face-to-face courses than undergraduate students. In particular, the awareness of ventilation and respiratory function tests is low in the second year and third year undergraduate students in 2022.

Mask
The effect of masks on preventing the spread of droplets was well known to students (Figs. 2 & 3). The effect was transmitted to undergraduate students over time. However, the effect of preventing direct contact with the nose and mouth by hand has been replaced by expectations for other effects over time. On the contrary, masks were expected to have an effect of preventing virus inhalation. The virus passes through a mask without a fine filter. Over time, it has been pointed out that trace amounts of virus inhalation may lead to immunity acquisition. This may have raised expectations for the virus inhalation prevention effect. The moisturizing effect in the oral cavity enhances immune function. However, low expectations for a specific effect on the virus may have reduced expectations for the effect, especially in master's course students. The effect of reducing viral shedding was highly popular, but overconfidence should be prohibited.

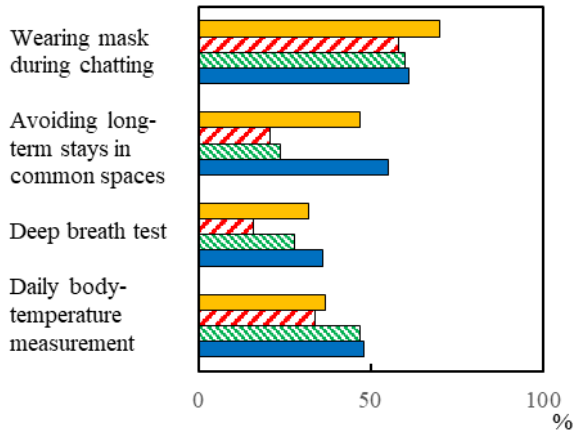

Fig. 1: Daily infectious disease control: First year (2021), second year (2022), third year (2022), graduate students (2022), from top to bottom.

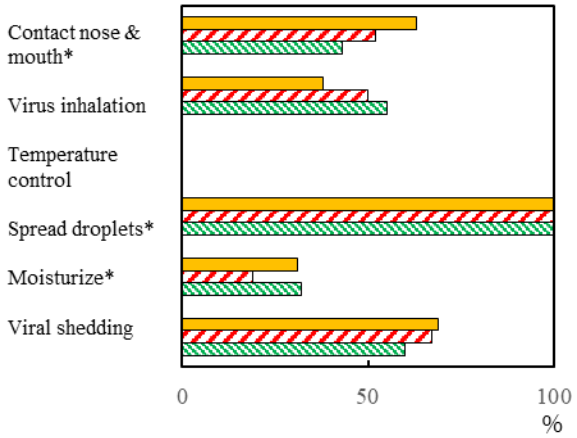

Fig. 2: Effect of mask: graduate students, 2020, 2021, 2022, from top to bottom: marks of "*" show recommended answers by microbiological considerations.

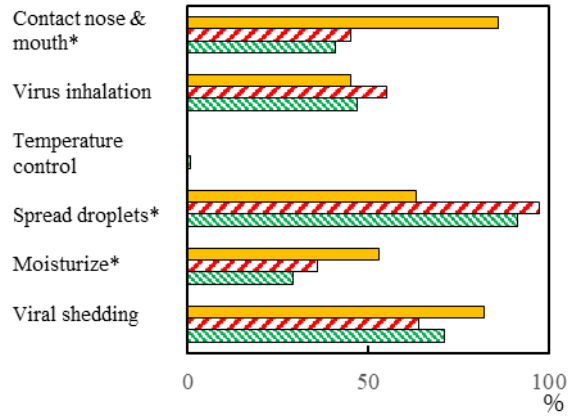

Fig. 3: Effect of mask: undergraduate students, 2020, 2021, 2022, from top to bottom: marks of "*" show recommended answers by microbiological considerations.

Vaccine

Vaccination applicants increased from 60% to 90% from July 2021 to September 2021. Initially, there were few applicants for vaccination because of side reactions. During the epidemic of Delta strains, the number of applicants for vaccination increased (Figs. 4-6). The percentage of inoculators was high among graduate students (Fig. 6). Laboratory activities were conducted face-to-face rather than online for graduate students. Even for undergraduate students, the inoculation rate increased in the upper grades due to face-to-face correspondence within courses (Figs. 4 & 5). Among graduate students, the number "recommending vaccinations to friends" increased (Figs. 7-9). This is probably because graduate students have a better understanding of the contents of the vaccine.

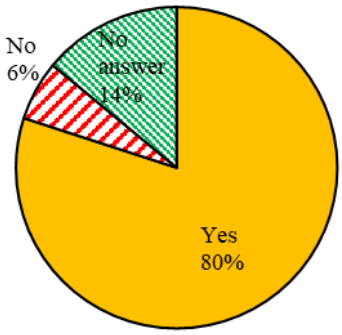

Fig. 4: Vaccination applicants, 2nd year 2022.

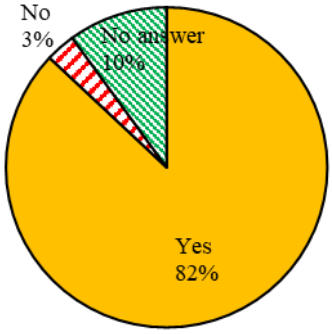

Fig. 5: Vaccination applicants, 3rd year 2022.

Fig. 6: Vaccination applicants, graduate 2022.

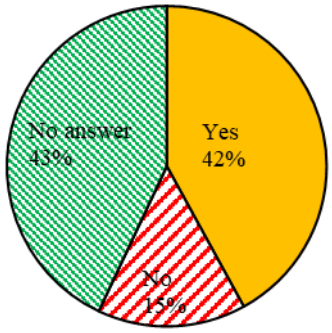

Fig. 7: Vaccination recommendation to friends, 2nd year 2022.

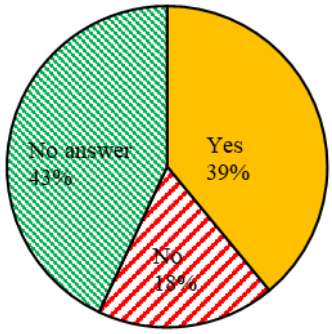

Fig. 8: Vaccination recommendation to friends, 3rd year 2022.

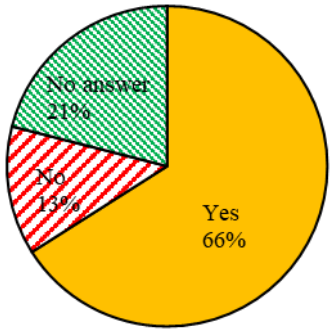

Fig. 9: Vaccination recommendation to friends, graduate 2022.

Student Online Seminar

The number of participants were 37: from Japan (faculty 1, students 16), from Thailand (faculty 3, students 17) (Fig. 10). In addition to the experience of communication in English, the training was experience for transdisciplinary explanations.

1) Direction of Cell Deformation During Micro-gap Passage.
2) Matrix Pattern Markers to Track Local Contractile Movement of Myotubes Layer.
3) Effect of Wall Shear Stress Gradient on Cell:

Distribution of Deformation and Rotation.

4) Effect of Wall Shear Stress Field on Cell Deformation Cell Behavior During Passing through Micro Gap.
5) Hysteresis Effect of Tangential Force Field on Cell Deformation on Micro-striped Topography: Behavior of Cell Migrating between Different Pattern Compartments.
6) Analysis of Dielectrophoretic Movement of Cell Flowing in Micro Channel Related to Shape of Cell.
7) Tracking Local Contractile Movement of Myotubes Layer Using Matrix Pattern Markers Microfabricated on Rear Side of Scaffold Thin Film.
8) Bumping Movement of Cell Flowing over Oblique Micro-groove: Comparison with Movement Outside Groove.
9) Behavior of Myoblasts in Two-dimensional Colony under Shear Flow Field.
10) New Biocompatible GaOOH Nanomaterials for Medical Application.
11) The Use of Basic Fibroblast Growth Factor in Cell-encapsulated Microbeads and Stem Cell Co-culture for Prolonging Hepatic Pre-transplantation.
12) Human-skin-on-a-chip: a New Paradigm for Toxicity Testing.
13) Detection of Bacteria Contamination in Water by Filtration System.

The impressions of the participating students were as follows. Some students were not accustomed to meetings in English. The figures helped convey the idea trans-disciplinarily. The system in an aging society was interesting. Research using Internet of Things (IoT) was easy to imagine. Techniques for collecting vital signs and personal identification information should be developed. Nanoparticles-embedded microneedles was interesting.

Fig. 10: Student online seminar in March 2022.

Fig. 11: Networking in May 2022.

Table 1: Fields of Biomedical Engineering in Thai University.

Robotics,
Biopolymer,
Biomaterials,
Artificial Intelligence,
Biomechanics,
Biosensors,
Brain Computer Interface,
Rehabilitation,
Artificial Organs,
BioMEMS,
Clinical Engineering,
Biomedical Signals,
Imaging,
Molecular Diagnostics,
Machine Learning

Table 2: Fields of Life Support Technology in Japanese Academic Society.

Medical and Welfare Engineering,
Nursing equipment,
Artificial organs,
Medical treatment equipment,
Inspection equipment,
Measurement equipment,
Computer,
Information processing,
Control,
Micromachining

Networking

Participants in the network were 30: from Thailand (faculty 9, students 5), from Japan (faculty 5, students 13) (Fig. 11). The biomedical engineering in the Thai University includes a variety of interdisciplinary fields (Table 1).

The life support technology in the Japanese Academic Society includes a variety of interdisciplinary fields (Table 2). The online meeting facilitated creation of networks between Japan and Thailand: education and research.

4. DISCUSSION

In 2022, students' awareness of infectious disease control has declined (Fig. 1). Probably this is because the pandemic period has been prolonged; the aggravation rate of the "Omicron Strain" was low; and vaccinations have reduced concern about COVID-19. Online habituation may also have an effect. Unlike undergraduate students, research activities of graduate students are mainly on-site.

As knowledge of COVID-19 spreads, consciousness shifts to airborne transmission rather than contact infection [6]. The mask has the effect of reducing the amount of virus scattered [7]. Students are more conscious of trying to protect themselves with masks. More consideration for society is needed. Multifaceted thinking is required.

Knowledge of splash prevention is widespread (Figs. 2 & 3). The increase in information has led to the spread of perspectives. The ability to discern the difference in importance is insufficient. There is also a problem in communicating the opinions of experts. Infection control measures are being implemented at hospitals, including those other than COVID-19. In the society, it is necessary to emphasize measures focused on COVID-19. In communicating information, it is necessary to distinguish between consideration for an individual and consideration for those around the individual. It is also necessary to distinguish between measures according to the characteristics of individuals, such as children (fetuses, babies, children) and adults. Sequelae are of great importance in our lives. Evaluation separate from mortality is important.

As the number of vaccinations increased, the awareness of vaccination increased (Figs. 4-9) [5]. The vaccination rate for graduate students has increased, probably because they have a deeper understanding of vaccines, and many on-site research activities. As the vaccination rate increased, so did the recommendations to friends. It was also understood that vaccination is a matter of self-judgment.

Information exchange between students provided an opportunity for training in transdisciplinary explanations (Fig. 10) [4, 19, 21]. The emphasis was on introducing one's own research. The stage of trying to understand other contents was insufficient. It has not yet led to an understanding of the background of other fields. Continuous training is needed.

The academic society attaches great importance to a place for young researchers to interact with each other. It is usually a place for training in information transmission that transcends specialized fields. Universities are also developing new fields in more complex fields. Information exchange utilizing cross-cultural backgrounds will be a place for training in transdisciplinary communication. It is expected to lead to further development of complex fields [22].

Since 2010, we have been promoting exchanges between Japanese and Thai students in the field of biomedical engineering with Mahidol University [18]. To expand the network, information will be released mainly to those involved in the "Department of Biomedical Engineering, Mahidol University" in Thailand and an interdisciplinary academic society related to the life support technology. The information exchange will lead to the expansion of the network among groups and individuals.

It is meaningful for young people to participate in research in the field of boundaries [23]. It will be an opportunity for technological innovation without being locked into a specialized field. Sustainability does not mean maintaining the same state. It is important to be aware of the circulation of things and information. The survival of mankind is not the only purpose of sustainability. The runaway pace of partial changes creates an unexpected cycle. For a bird's-eye evaluation, it is necessary to control the circulation speed. Artificial Intelligence (AI) is useful for referencing big data. In the selection of information (distinguishing fact and fake, mask controversy, vaccine controversy), a multifaceted understanding is effective [3].

5. CONCLUSION

Multifaceted thinking is important to tackle global issues for a sustainable society. This article takes as an example the controversy related to "vaccines" and "masks" in pandemics. The field of biomedical engineering includes faculty and students from different backgrounds. "Cross-cultural exchange" is also useful for multifaceted experiences. With the keyword "life support technology", Japanese academic societies and Thai universities conducted online networking for information exchange. It is expected to lead to the development of human resources who can deal with global problems.

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