FORMING 'BA' FOR ENHANCING ONLINE COMMUNICATION SKILLS BY CDIO APPROACH

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ABSTRACT

This paper aims to examine the applicability of the CDIO approach to online Project-Based Learning (PBL). Particularly, focusing on students' online communication skills, we examine the effectiveness of forming 'ba' for enhancing online communication skills. Due to COVID-19, our education has been forced to change a lot. Many classes were held online from 2020 to 2021. This paper introduces two examples of online PBL activities to discuss how those activities helped students to enhance online communication skills. To consider students' online communication skills, we will introduce the concept of 'ba', a concept that has been studied in organizational science. 'Ba' is a kind of space in which relationships are forged and human interactions take place. We also discuss the effects of applying the CDIO framework to those activities. By considering these activities conducted using the CDIO framework and considering from the perspective of the concept of 'ba', it was revealed that the CDIO approach helped students improve their online communication skills.

KEYWORDS

Online communication, COVID-19, Concept of 'ba', Project-Based Learning,
Standards: 3, 6

INTRODUCTION

This paper aims to examine the applicability of the CDIO approach to online Project-Based Learning (PBL). Particularly, focusing on students' online communication skills, we examine the effectiveness of forming 'ba' for enhancing online communication skills. Due to COVID-19, our society has been forced to change a lot. The same is true for education. Since on-campus classes were replaced by online-based classes, we observed that many classes had been held online from 2020 to 2021. As we can find in the proceedings of the 17th International CDIO conference, many practical reports regarding COVID-19 and online classes have been submitted at the international CDIO Conference 2021.

For example, Zapevalov et al. (2021) introduce a case of adapting the EduScrum methodology to their online teaching for software engineering program. They conclude that the implementation of EduScrum has ensured success in PBL. In another example, Manna et al. (2021) also introduce a case of a computer programming module conducted with flexible online teaching, virtual practical session, virtual CDIO sessions, and an online cafe. They conclude that flexible online platform encouraged students to be adaptive. Especially, their online cafe which is purely an informal chit-chat session for tutors and students provided mental support to the students who feel alone during the lockdown period. In addition, there are many other studies (e.g., Kuptasthien et al., 2021, Einarson & Teljega, 2021, or Chew et al., 2021) showing that online teaching methods such as online video instruction, online meetings, and so on have brought preferable outcomes of students.

As mentioned in these studies, students were required to study online. PBL, however, needs communicating and discussing activities. Thus, students are required to improve their online communication skills. This is the point we focus on in this paper.

This paper introduces two examples of online PBL activities to discuss how those activities helped students to enhance online communication skills and discuss the effects of applying the CDIO flamework to those activities.

At the same time, we will also introduce a concept being studied in organizational science to consider students' online communication skills. The concept is called 'ba', in which relationships are forged and human interactions take place.

First, we will briefly review the concept of 'ba' followed by case studies of PBL activities conducted from 2020 to 2021. After describing the cases, we will discuss how the CDIO approach is effective to enhance online communication skills for students.

THE CONCEPT OF 'BA': A BRIEF OVERVIEW

The concept of 'ba' has been studied in organizational science. Originally, it was introduced by Nonaka & Konno (1998) studying knowledge creation processes of Japanese companies. In Japanese, 'ba' means place, space, or field. They defined 'ba' as a shared space for emerging relationships in which human interactions take place. The examples of 'ba' typically would be meetings, working groups, project teams, and informal circles which are physical or tangible, but they emphasized that 'ba' is not restricted to something physical or tangible; "The concept of 'ba' unifies the physical space, the virtual space, and the mental spaces". A later study (Nonaka & Takeuchi, 2019) showed several examples of forming 'ba' online and virtual 'ba' in companies. They mentioned that creating a 'ba' online or a virtual 'ba' is extremely useful in today's network world in which numerous communities flourish online.

Although the concept of 'ba', the Japanese language, is originally derived from Japanese philosophy as mentioned by Nonaka & Konno, it is attracting worldwide attention as a great contribution to the study of knowledge creation processes in companies. Therefore, it is recognized that the concept of 'ba' is not just a Japanese concept, but applies to numerous companies (Creplet, 2000).

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We will introduce two cases of PBL in the next section and consider how students acquired online communication skills. We will also keep in mind how 'ba' was formed online during the students carrying out the projects.

CASE STUDIES

A project to reproduce townscape online

The first example is a project to reproduce a townscape online and use it for tourism promotion, set in a local town in Hokkaido, Japan. The town of Shinhidaka, where the project takes place, has a population of about 20,000. The annual "Cherry Blossom Festival" attracts more than 100,000 visitors. However, the tourism industry of the town was damaged due to COVID-19.

8 students from the e-sports club of Hokkaido Information University (HIU) participated in this project. Their major activity is planning and managing e-sports events, however, their activities had been limited only to online activities due to COVID-19.

In June 2020, they started their project. Their idea is that they reproduce the townscape faithfully using the sandbox game "Minecraft" and develop some e-sports-like game in the virtual space. You can create your own rules for the game on Minecraft using its programming function. By July, the rules of the game were set to "collect the treasure chests that appear in the virtual town, and the player with the highest score within certain time wins."

In September 2020, 5 students visited Shinhidaka to check the detailed streets, which cannot be seen on Google Maps and Street View. They also visited the town hall and discussed with the town hall staff which buildings to reproduce. They took photos of buildings and scenery in the town. Figure 1 shows the students taking pictures of the town. This was the only opportunity for the students to interact with the locals face-to-face. Based on the photos they took, they began reproducing the townscape. They gathered and discussed every weekend on a server on Minecraft.

Figure 1. Students taking photos in Shinhidaka Town.

They also used "Discord" for discussion. Discord is a chat application that they usually use in their club activities. They reported their progress and exchanged opinions on Discord. Discord

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has screen sharing and voice communication functions, therefore, they were able to share the photos and Minecraft screenshots they took on Google Drive. They were able to communicate with each other easily by using online communication tools and increased their online communication skills. Figure 2 shows Discord screens. The faculty members instructed that the students should report progress by uploading images and should create a list of productions. What the faculty members wanted students was to communicate spontaneously.

Figure 2. A faculty member interacting with students on Discord.

Their work was completed in December and the game was named "TREASURE COLLECT." The students started preparing for the release of the game. Figure 3 shows screenshots of the game screens.

Figure 3. "TREASURE COLLECT" game screens.

In March 2021, "TREASURE COLLECT" was released at an e-sports event that was organized by the students with the cooperation of the e-sports organizations in Hokkaido. Figure 4a shows the event. The Minecraft server was also opened to the public.

Their works were exhibited at the tourist information center in Shinhidaka (Figure 4b), and the leaflet was distributed to visitors during Cherry Blossom Festival in May. The leaflet, shown in Figure 4c, includes screenshots of the townscape and cherry blossom trees created in Minecraft, as well as a QR code for a website that explains how to play the game. The townscape reproduction world created in this project was reported by the local newspaper.

By playing "TREASURE COLLECT", game players can freely stroll around the townscape online and learn about the scenery of the town and the back alleys. Because it is released online, people from all over the world can see the townscape without visiting the town. The town hall staff and other local citizens expressed their desire to use this game for regional revitalization in the future. This was an example of a great contribution to tourism promotion using online technology.

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Figure 4. (a): e-sports online event, (b): display at the tourism center, (c): leaflet design.

A Project to reproduce a library online

The second example is a project to reproduce local libraries online. Due to COVID-19, citizens lost their opportunities to visit libraries because local libraries were closed. Libraries wanted to stay connected with citizens, even when they were closed.

Figure 5. Students taking measurements in the library.

5 students from the 3DCG club of HIU participated in this project. They, like the e-sports club, were also affected by COVID-19 and all activities were limited to online. In March 2021, they began creating a reproduced world of the university library most familiar to them. Even though the local libraries were closed due to COVID-19, the university library was still available. The library of the HIU is located on the fourth through sixth floors of a ten-story building. The entrance is on the fourth floor. The students started by measuring the dimensions of the sixth

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floor, where the space is large and easy to work with. Figure 5 shows the measurements made by the students.

From April 2021 to July 2021, they created 3D models of the shelves and tables in the library. For this project as well, they used Discord for reporting and confirmation, and Google Drive to manage the production. A spreadsheet was used to list the items that each student would create. They proceeded with the modelling process through the Discord screen. Figure 6a shows the progress report on Discord.

Figure 6. (a): Communicating on Discord, (b): Check the appearance in "cluster."

In August 2021, they started building a world based on the model they created. The platform they used was the virtual SNS "cluster". This is a platform that can be accessed from PCs, VR devices, and smartphones. They chose "cluster" because it is easy for anyone to use. Texture and other appearance adjustments were made in the world inside "cluster" shown in Figure 6b. On August 19, 2021, the library reproduced world was opened to the public as a beta version. It was accessed by the library staff and was well received. However, there were still some materials missing at this point, so the students continued with the modelling work and update the world.

During the creation of the reproduced library world, they conducted interviews with the library staff. They used the online conference tool "zoom" for the interview. As a result of the interview, they decided to add a mechanism unique to the online space. So, they added the "mascot character" and the "entrance to the library in Space" appearing on the library website. Figure 7a shows them in 3D modelling. They decided to place mascot character avatars as staff and guests in the world.

In December 2021, 3D modelling of the "mascot character" and the "entrance to the library in Space" were completed. In January 2022, the students met within the library's reproduced world to identify problems. Figure 7b shows a meeting in "cluster". The final update was made, and the library reproduced world, which was the original goal, was completed. In the future, they will increase the number of users and survey the functions of the VR library. Based on those results, local libraries will also be converted to VR.
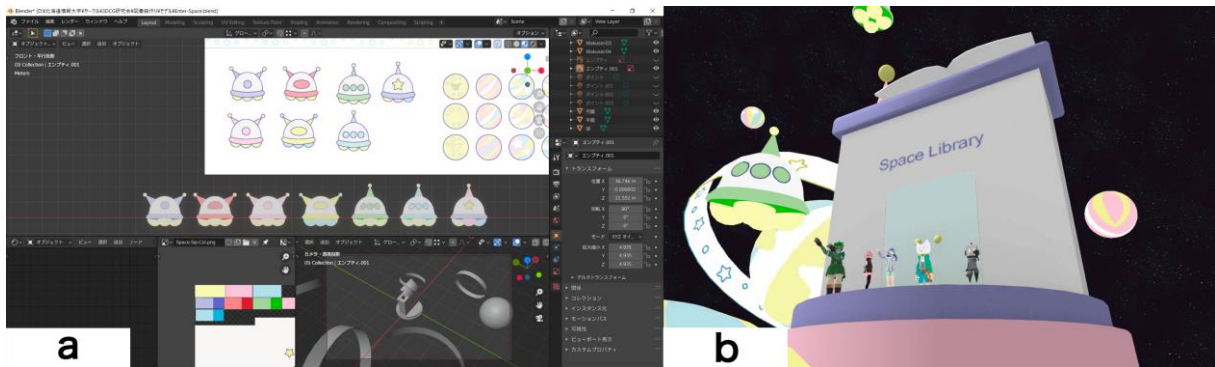
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Figure 7. (a): 3D modeling of characters, (b): Meeting with students in "cluster."

DISCUSSION

These 2 activities were designed and conducted with a strong awareness of the CDIO approach (see Table 1). We introduced the chat application Discord as a place for students to work. In other words, we prepared an online "Engineering Workspaces" [CDIO Standard 6]. Other Google services were used to visualize the progress check and data storage, providing an opportunity for everyone to be online and manage the project at any time. In addition, by gathering in real-time in the virtual space of Minecraft or "cluster", we could prepare places for communication that were no different from offline [CDIO Syllabus 3.1, 3.2]. Over about 10 months, the students did almost all of the "conceiving - design - implementation – operation" online. Both projects were new challenges to solve the various problems caused by the impact of COVID-19 [CDIO Syllabus 4.1].

Table 1. The CDIO Approach for the projects

	The CDIO Approach	Contents of the project
CDIO Standard 6	Engineering Workspaces	Discord, a chat application as a place for students to work.
CDIO Syllabus 3.1,3.2	TEAMWORK, COMMUNICATIONS	Interaction as if you were offline, including conversations and progress checks.
CDIO Syllabus 4.1	EXTERNAL AND SOCIETAL CONTEXT	Resolve various problems caused by COVID-19.

The students set their goals by themselves as well as realize what they should do. In the first case, especially, they implemented the "TREASURE COLLECT" game to the public, designed the leaflet, and exhibited their work. Their activity contributed to the town tourism promotion. As Fukuzawa (2020) mentioned, education should not be unrelated to society or industry. Students must learn that projects are not realized by themselves, but only after considering their social value. The CDIO approach is quite a useful way to let the students experience real projects because that approach includes the Implement and Operate stages.

We also conducted self-evaluation questionnaires for the participating students after the projects had been completed. Figure 8 shows the results of each. The project to reproduce townscape online received high marks for "gained knowledge about the area" and "improved ability to collaborate". Even though the activities were mainly online, they had a certain

educational effect on knowledge acquisition and teamwork. However, the results for "understanding the problem" and "cooperation with the community" were low. The reason may be that they could not visit the site as they had expected due to COVID-19. The project to reproduce a library online received high marks for "improved ability to solve problems" and "cooperation with the community". We believe this is a good result of our increased approach to the people involved, based on the lessons from the previous project, reproducing townscape online. Unfortunately, "On schedule" was low for both projects. This may be the difficulty of managing online. The students tend to waste time because online activities do not need physical meetings. They may think they have plenty of time than they have.
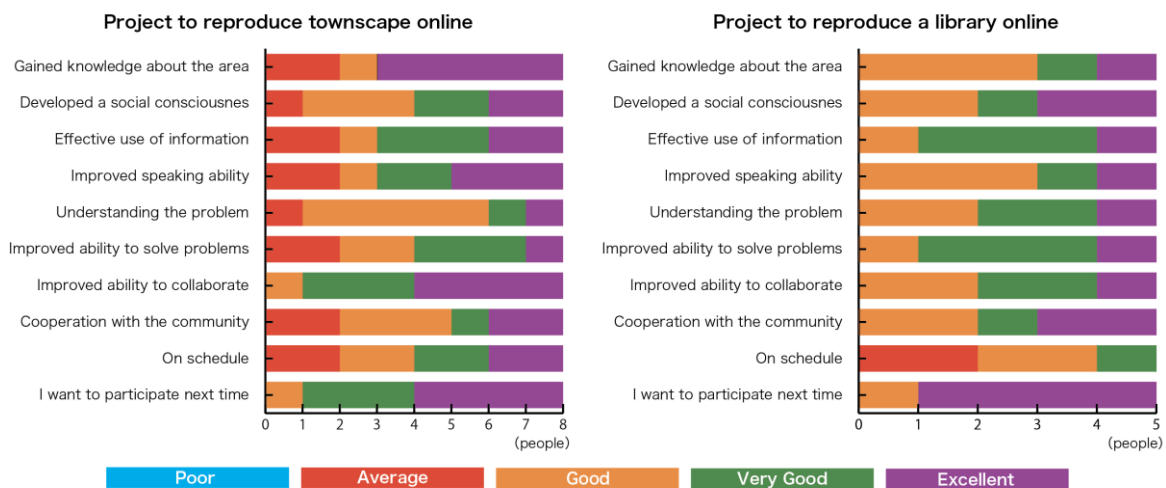

Figure 8. Results of the self-evaluation questionnaire for each project.

We could also observe that the students communicated with each other quite well using online tools. The students were able to deepen their understanding because they visited the town by themselves and reproduced the townscape, rather than only staying in virtual spaces. The students' ability to speak and the solving problem was improved in the 2 years as shown in Figure 8. It is revealed that if appropriate tools are given, it would help form useful 'ba', even if it is virtual space. As Nonaka & Konno (1998) stated, 'ba' is not restricted to something physical or tangible; it may be the virtual space. Here, we can reconfirm the significance of Nonaka & Konno's suggestion.

CONCLUSION

This paper introduces two examples of online PBL activities to discuss how those activities helped students to enhance online communication skills. Due to COVID-19, on-campus projects have been replaced by online-based activities. In the 2 activities, the students formed a community on the online chat application, Discord. Since the students got used to Discord, they smoothly conduct implementation and operation activities. Regarding the CDIO standards and syllabus, we believe that the quality was maintained online as well. This is the result of the students' adaptation to this pandemic situation. In addition, the students were mainly second-year students or above, who owned high-performance PCs and were accustomed to operating PCs. The use of online tools has made communication more visible and easier for teachers to evaluate. According to the questionnaire we conducted, we can confirm that the students have

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enhanced online communication skills, such as solving the problem and speaking through the project. In addition, we observed that if appropriate tools were given, it would help form useful 'ba', even if it is virtual space.

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