Trends in Japanese University Education Digital Transformation (DX) and Case Study of Hybrid Group Work Exercises in 2022: Digital Whiteboard, DX Learning Environment, and AI Chatbot Systems for Hybrid Group Work Exercises

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ABSTRACT

The purpose of this research paper is to report the following three research issues: (1) various class formats for online classes and their characteristics, (2) trends in the promotion of the university education Digital Transformation (DX) business concept in Japan, and (3) a case study on hybrid group work exercises in 2022 by effectively utilizing educational DX technology. In Japanese higher education, in addition to general lecture subjects, group work exercises and project-based learning (PBL), active learning (AL), experimental and practical training subjects have typically been conducted in face-to-face classes. In 2020, due to the impact of the COVID-19, it become no longer possible to conduct face-to-face classes, and it was necessary to urgently

introduce online classes, including on-demand, real, and hybrid types of class. As part of the measures for the post-coronavirus era, leading universities in Japan started working on their own education DX business concept as starting a public offering subsidy under the Digital Utilization Education Advancement Project by the Ministry of Education, Culture, Sports, Science, and Technology (MEXT). Hybrid group work exercises by effectively utilizing educational DX technology deals with the following: (1) Curriculum design for hybrid group work exercises combined with PBL and AL, (2) Shared digital whiteboard and DX learning environment systems, and (3) Q&A system using knowledge BOMs (Bill of Materials) and AI chatbot.

Key words:
University education Digital Transformation (DX), Project-Based Learning (PBL), Active Learning (AL), hybrid group work exercise, business producer, Sustainable Development Goals (SDGs), Circular Economy (CE), BOM (bill of materials), AI chatbot

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Contents

1. Introduction

Due to the impact of the COVID-19 pandemic that begun in 2020, it was no longer possible to conduct face-to-face classes for all subjects, and there was an urgent need to introduce online classes in the form of on-demand, real, and hybrid classes.

As part of a DX subsidy project promoted by the Ministry of Education, Culture, Sports, Science, and Technology (MEXT) in 2021, advanced higher education institutions in Japan would further accelerate the conversion to education DX for the post-coronavirus era.

Therefore, the following three research issues are described in this research paper:

Research issue 1: The Characteristics of Different Online Class Formats

There are two types of online learning: asynchronous (on-demand) and synchronous (real). These include blended-learning, a high-flex, and hybrid classes. Table 2.1 shows the advantages, disadvantages, and examples corresponding to these three types of online class.

Research issue 2: Trends in Promoting the University Education DX Business Concept in Japan

In March 2021, the MEXT announced that an open call for promotion subsidy applications had been made to universities and vocational schools across the country. These schemes included the Digital Utilization of Universities and Technical Colleges Education Advancement Plan (Digital Utilization Education Advancement Project). The following introduces two initiatives, including examples from advanced universities：Initiative 1 Realization of Learner-Oriented Education, and Initiative 2: Improv-

ing the Quality of Learning.

Research issue 3: Case Study on Hybrid Group Work Exercises in 2022 for the post-corona era

Our Japanese industry-university project group of Aoyama Gakuin University investigated and studied new educational programs for cultivating "business producers in future-oriented business strategy design" for human resources over several years (Tamaki et al., 2019). To develop such new human resources, the research team has been engaged in developing new educational methods for group work exercises that combine both "Project Based Learning (PBL)" and "Active Learning (AL)" as industry-academia joint research.

The new educational methods combining both PBL and AL are developed to accommodate hybrid group work exercises by effectively utilizing educational DX technology, for a flexible response to the new normal era as a countermeasure against COVID-19. These chapters report on the following research topics: (1) Curriculum design for hybrid group work exercises combined with PBL and AL, (2) Shared digital whiteboard and DX learning environment systems, and (3) Q&A system using knowledge BOMs and AI chatbot.

2. Online Class Format Types

Table 2.1 shows the advantages, disadvantages, and examples of the on-demand, real-time, and hybrid types of online class.

Table 2.1: Advantages, disadvantages, and examples of the on-demand, real-time, and hybrid types of online classes (Morita, 2021, Tamaki and Arame, 2023)

Class format type	Advantage	Disadvantage	Example
On-demand online	● Learners view teaching material content registered in a learning management system (LMS) as self-learning. ● Effective for classes with knowledge transfer as an educational goal. ● Learners can watch the teaching material content as many times as they like at any time within the specified period. ● Learners can change the viewing speed of the teaching material content.	● Due to the nature of asynchronous online classes, it is not possible to give immediate feedback to learners' questions. ● Instructors need considerable effort and time to create educational content, prepare quizzes, and so on. ● Q&As and learning support are required via LMS corresponding to the learning progress of each learner's self-learning.	● To maintain learners' concentration, it is desirable to edit the viewing time for each item of teaching material content to be within about 10–15 minutes. ● To ensure interactivity, use of the question and bulletin board functions allows asynchronous online discussion and is equipped in the LMS.
Real-time online	● As real-time online classes via web conference systems, online lectures are possible while sharing teaching materials. ● Instructors and learners can use the web conference system to ask questions using the chat function, discuss among learners using the session function, and collect and organize opinions using the voting function.	● If the network or PC environment on the learning side is not suitable, there is a possibility that a failure will occur and prevent students from participating in online classes. ● If the learner has stopped the video function of the web conference system, it is difficult to confirm whether they are actually attending the lectures.	● By recording class content, learners who could not participate in the real class can refer to the recording at a later date. ● If the learner is abroad, it is necessary to consider the time difference.

Hybrid	● Blended class: A combination of on-demand classes and face-to-face classes or real-time online classes within the class period. ● High-flex class: Real-time online delivery of class scenes while conducting face-to-face classes.	● Blended class: When classes are on demand, instructors require considerable effort and time to create educational content, prepare quizzes, and so on. ● High-flex class: When delivering classes in real-time and online, the camera and microphone attached to the PC used by the instructor are often insufficient, and it is necessary to prepare dedicated equipment for cameras and microphones in the classroom.	● Blended class: To improve the learning effect, in on-demand classes, knowledge is acquired in advance, while in face-to-face or real-time online classes, class content that utilizes the acquired knowledge and group work exercises are combined. ● High-flex class: Since it is a heavy burden for instructors to deal with both types of learners, it is desirable that Teaching Assistants (TAs) provide learning support for learners taking real-time online courses.

2.1 Asynchronous and Synchronous Online Class Types

Face-to-face classes have traditionally been the norm in Japanese higher education, but due to the impact of COVID-19, online classes are now being actively introduced. There are two types of online class, which are asynchronous (on-demand) and synchronous (real).

The on-demand type often takes the form of self-learning classes for the purpose of acquiring knowledge. This type has previously been introduced, and e-learning content is distributed through the LMS. The asynchronous teaching format enables distance learning from anywhere at any time within a predetermined learning period.

In contrast, a web conference system is used in “real” classes.

For example, Zoom, Teams, and Webex are often used as web conferencing systems. Since they are delivered in real time, such classes are held at a predetermined time.

2.2 Characteristics of Other Online Class Types

The blended-learning class format combines face-to-face and online classes. On-demand classes are used to acquire knowledge, and face-to-face classes are sometimes combined with them to utilize acquired knowledge and conduct group work.

High-flex classes consist of face-to-face lessons that are held in the classroom and can be taken online at the same time. They provide learning opportunities for students who cannot participate in face-to-face classes for various reasons; for example, they may be unable to attend due to COVID-19 or they are international students who cannot complete immigration procedures.

However, high-flex classes increase the burden on instructors because they have to deal with students who are participating in face-to-face and remote classes at the same time. As a countermeasure, it is necessary to improve the classroom's facilities (e.g., installing equipment such as cameras and microphones to capture the class scene). In addition, students who participate remotely may require the assistance of teaching assistants (TAs) so that they do not become isolated.

Hybrid classes combine face-to-face and online classes and can be a combination of the blended-learning class and the high-flex class types. In the post-coronavirus era, classes are increasing in importance. For example, they can provide a wide range of learning opportunities for students who have difficulty participating in the classroom, such as those engaging in

collaborative learning from overseas or in remote locations and working students who are taking graduate school.

3. Trends in Promotion of University Education DX in Japan

3.1 Business Purpose of the MEXT's Digital Utilization Education Advancement Project

In March 2021, Ministry of Education, Culture, Sports, Science, and Technology (MEXT) announced an open call for promotion subsidy applications. Among these, the Digital Utilization of Universities and Technical Colleges Education Advancement Plan (Digital Utilization Education Advancement Project) was made available to universities and vocational schools nationwide (MEXT, 2021).

Due to the spread of the COVID-19 pandemic, universities and technical colleges, where face-to-face classes had been the norm, were forced to implement remote classes. Although there were some issues in implementing remote classes, many positive comments were received from instructors and students, among them, "it was possible to study repeatedly and easy to ask questions." Taking advantage of this opportunity to increase awareness of digital utilization in the educational environment, the development of high-quality grade management systems and educational methods would be accelerated. It was necessary to strongly promote DX in schools to establish and increase learning quality improvements in the post-coronavirus era.

Initiative 1: Realization of Learner-Oriented Education

(Initiative example)

With the aim of developing grade management methods for distance learning, an Learning Management System (LMS) would

be introduced to collect and accumulate data on the proficiency level of individual students across all curricula from the time that they enroll until their graduation. AI would analyze the accumulated learning logs of all students to realize education optimized for individual students (according to proficiency level, course guidance, etc.).

Initiative 2: Improving the Quality of Learning

(Initiative example)

Experiments and practical training (not face-to-face) would be realized by introducing digital technology and virtual reality (VR). Furthermore, the educational systems and digital content would be shared and utilized not only among individual universities but also other universities.

3.2 Case Study of Initiative 1: "Kansai University", A Smart Campus Concept Adapted for the Next-Generation of Society

(1) Visualization of the Learning Process by Viewing a Video Materials Log by Enhancing the LMS Function

By enhancing the functionality of the LMS, it is now possible to distribute videos and materials together and to automatically add subtitles corresponding to individual video scenes (Okada and Ueda, 2021). Instructors can visualize students' learning process by checking the viewing log status of each student and using it for class improvement. In addition, the instructors provide individual learning support for students who have not watched a video or who need supplementary learning. All students can learn effectively and efficiently, regardless of their disability or nationality, inclusive learning environments being

built and managed in this way.

(2) Remote Access to Libraries' Contracted Electronic Academic Content

Due to the increasing number of online classes, students can remotely access contracted electronic academic content in the library while studying or performing research at their homes.

(3) Career Support System: Management of Student Activity Data Portfolio

Students can record their own learning content and various extracurricular activities through a career support system from admission to graduation. When designing their future careers or deciding on a job or career path, students can look back on their own activities by accumulating individual student portfolio management information.

3.3 Case Study of Initiative 2: "Kanazawa Institute of Technology", Initiatives for Digital Transformation

Overview of the DX Business Concept

(1) Construction of an Integrated Database and its Operational Management

The university operates multiple databases; its data are copied every day, and its data lake is built on the cloud (on Oracle Cloud Infrastructure) as an integrated database (Shikada et al., 2021). In this data lake, the copied data are organized in a format that is linked to individual student anonymized IDs. By using data groups linked to individual student IDs, it becomes possible to analyze student behaviors from various perspectives as described below.

(2) Use of Data Analytics with Integrated Data

Learning analytics refers to the collection, accumulation, and analysis of learning data (learning log data) generated in the process of learning by each learner using information terminals and the Internet during and outside of the class. The following data analytics methods are performed on the data accumulated in the integrated database to improve teaching and learning methods.

- Correlation analysis between grade profiles from admission to graduation and grade point average.
- Clarifying which subjects and units each student has the most trouble with. Based on the results, either the operation method of troubled subjects can be revised or the appropriate learning support methods can be implemented for troubled students.
- Conducting a comparative analysis of learning behavior history data between the high-performance group and the low-performance group.
- Providing a learning support system using AI after predictive analysis of dropouts for the next semester based on the results of correlation analysis of grade data and attendance rate. Based on the results, appropriate advice and support will be given to the relevant students.

(3) Creation of New Learning with DX Beyond the Constraints of Time/Place

PBL subjects work on problem discovery through team collaborative learning, and education that tackles real-world problems with engineering approaches centered on experiments

and practical training subjects. Team activities for the PBL subjects and experiments/training subjects can be conducted through a remote communication system. It is possible to use digital content, simulation, VR/AR headsets, and avatars at the same time.

For example, in an engineering course, when explaining the experimental procedure for operating a device, a video taken with a 360-degree camera is converted into digital content. The student can repeat the operation and check it at home. In another example, after creating a vibration experiment simulator, virtual experiments such as changing vibration parameters and materials can be performed.

4. Curriculum Design for Hybrid Group Work Exercises Combined with PBL and AL

Considering the characteristics of the education methods, a curriculum of the "hybrid group work exercises" that consists of PBL and AL methods was proposed as shown in Table 4.1.

Table 4.1: Curriculum combining PBL and AL methods (Tamaki et al., 2022)

No.	New educational methods	G1: business model	G2: new product/service planning	G3: smart product design	G4: platform service management
1	PBL : Collaborative learning with all team members	Introduction: team and groups building, learning goals for educational program of the business producers			
2		Survey of advanced cases of platform services and application software			
3		Determining the theme of new product/service planning of "application software" for each team			
4		Creating the business concept plan for platform service management for each team (1),(2)			
5					
6	AL : Collaborative learning within the same group and/or [Collaborative learning between different groups]	Own required management resources and business partners	Customer purchasing decision process	Image of service utilization of smartphones and mobile products	Required functions and specifications of platform service
7					
8		[G1 : G4] Business and service process model for platform services and application software	New application software planning	Product architecture of smartphones and mobile products	[G1 ⇔ G4] Platform services and application software
9			[G2 ⇔ G3 ⇔ G4] Application software content flowchart	[G2 ⇔ G3 ⇔ G4] Application software	[G2 ⇔ G3 ⇔ G4] Application software
10		Improved business model canvas with customer behavior and service processes		[G2 ⇔ G3 ⇔ G4] Processing algorithm for application software linked with smartphones and mobile products	[G2 ⇔ G3 ⇔ G4] Processing algorithm for application software linked with platform systems
11			[G2 ⇔ G3 ⇔ G4] Design of each screen content transition when the customers use the application software		
12		Revenue business model	Promotion strategy of application software as new product/service planning	Usability of application software linked with smartphones and mobile products	Algorithm of collection/ accumulation/ analysis of customer usage data and behavior data
13					
14	PBL :	Submission of final business scheme planning ⇒ Learner's grade evaluation [evaluated from the point of team, group, personal contribution]			
15					

4.1 PBL by Whole Team: "Business Concept" for MSP Business Model Aimed at SDGs

In the first to fifth classes in **Table 4.1**, each team formulated a "business concept for future strategic design" with all team members" by applying PBL method. The theme of PBL for future strategic design adopted a type of the "Multi-Sided Platform (MSP)" business model. The main feature of this platform service was that it dealt with the MSP business model. This MSP business model operated a platform and application software that mediated between the "supply side" that provided products/services, and the "demand side (customer)" who wanted them. In other words, the MSP built a new business model by acting as an intermediary between the providers of products/services and the customers.

When deciding on the theme of this MSP platform service, each team should be involved in drafting the "business concept" that would be useful in solving social issues related to the SDGs. Therefore, the instructor (Professor Tamaki, in charge of this course) suggested each team to choose a theme for MSP platform services related to SDGs target 12.3 "reduction of food loss" or SDGs target 12.5 "reduction of waste" involved in the SDGs 12 Goal "responsible consumption and production".

The SDGs target 12.3 was "By 2030, halve per capita global food waste at the retail and consumer levels and reduce food losses along production and supply chains, including post-harvest losses". The latter SDGs target 12.5 was "By 2030, substantially reduce waste generation through prevention, reduction, recycling and reuse". Furthermore, this target 12.5 was related to the "Circular Economy (CS)". The shift from a linear economy to CE required new marketing methods. The European Commission

suggested that successful adoption of CE would require new consumer behaviors. It was necessary to conceive a CE business and considered how to solve CE-specific social business issues.

4.2 Four Different Types of Group Role for AL

In team building exercises for the AL method, learners were separated into four project groups (Groups 1, 2, 3, and 4) with different business roles, and each group worked on virtual project management. In the sixth to 13th classes in **Table 4.1**, the group work exercises shown below were performed with four different roles for each group.

- Group 1: Business model
- Group 2: New product/service planning
- Group 3: Smart product design and usability
- Group 4: Platform service management

There were two types of collaborative learning for AL group work. One way involved carrying out collaborative learning within the same group, and the other way involved collaborative learning between different groups, described, for example, by [G1 ⇔ G2] in **Table 4.1.**

In team building exercises for the AL method, learners were separated into four project groups (Group 1, Group 2, Group 3, and Group 4 with the following different business roles), and each individual group worked on virtual project management. In the sixth to 13th classes shown in **Table 4.1** above, the group work exercises shown below were performed with different roles for each group.

(1) Group 1 business model:

- own management resources and partners,
- business and service model, improved "business model canvas" with customer behavior and service processes, and
- business model by revenue type.

(2) Group 2 new product/service planning:

- customer purchasing decision process,
- new application software planning,
- design of screen content transition when the customers use the application software in smartphones and mobile products, and
- promotion strategy of platform services and application software.

(3) Group 3 smart product design and usability:

- imagining of service utilization of smartphones and mobile products,
- product architecture of smartphones and mobile products,
- processing algorithm for application software linked with smartphones and mobile products, and
- usability of application software linked with smartphones and mobile products.

(4) Group 4 platform service management:

- required functions and specifications of platform service,
- business and service process model for platform services and application software,
- processing algorithm for application software linked with platform systems,
- algorithm for collection/ accumulation/ analysis of customer usage data and consumption behavior data.

4.3 Items in "Business Scheme" as Final Deliverables for Each Team/Group

The final deliverables of the "business scheme" for each team/group in the 14th and 15th classes at the end of the semester were created and submitted. The instructor presented each team/group with the table of contents of "Items in Business Scheme" to be submitted as the final deliverable as follows:

1. Inventing a new value chain management (VCM) system aiming to reduce food loss and waste, identifying various stakeholders engaged in the VCM.
2. Building an MSP business model used by various stakeholders and planning products and services for new application software operated by the MSP.
3. Outline of the MSP business model proposal (team common work)
   - 3-1. Where in the value chain did you focus on reducing food loss?
   - 3-2. Target customers
   - 3-3. Collaborating stakeholders
   - 3-4. Business purpose of the MSP
   - 3-5. Impact of MSP services on society (effects, market size, etc.)
4. MSP business concept planning/use case diagram (team common work)
5. G1/G4 (collaboration between groups); MSP business model worksheet (WS)
6. G3/G4 (collaboration between groups); smart products and application software (APS) WS
7. G1 (group work); business process model diagram, business

model canvas, profit model WS
8. G2 (group work); SDGs product planning for food loss reduction, touch points for target customers, website construction for promotion WS
9. G3 (group work); system design of smart products, APS service content, usability WS
10. G4 (group work); platform data flow/information processing flow chart WS

While collaborative learning among all team members was performed by applying the PBL method, and collaborative learning within the same group and/or among different groups was performed by applying the AL method, individual worksheet "white WS" was provided according to each type of collaborative learning. After the exercise, a deadline was set in advance, and the "deliverable WS" from each team/group was submitted, and feedback from TA was added within those submitted WS.

5. Shared digital whiteboard and DX learning environment systems

In 2022, as the impact of COVID-19 gradually subsides, Japanese universities have reduced the ratio of online classes to around 30% and are tending to return to face-to-face classes.

Therefore, we decided to take the form of face-to-face class for the hybrid group work exercise of this research target in 2022. However, digital lecture materials were distributed at the same time via LMS in order to use the on-demand class format as well.

Furthermore, even in the classroom, we decided to use the digital whiteboard platform service so that team/group members could conduct collaborative learning together by sharing data

online during group work exercises.

The following is described how to manage class operation before, during, and after for the group work exercises related to **[regular class times]**, and how to use the DX learning Environment Platform (DX learning EP). Next, the class management method and DX learning EP related to **[special class times]** are shown as the following.

5.1 Class operation management methods before, during, and after classes and how to use DX learning EP related to [regular class times]

Table 5.1 shows how to manage classes before, during, and after classes and how to use DX learning EP for [**regular classes times].**

Table 5.1 "Class management method" related to before, during, and after the classes for **[regular class times]**

	1. Class management, creation of digital teaching materials	**2. Class preparation, learning support, learning EP**	**3. Collaborative learning, submission of deliverables by learners**
Before class	**1.1 Lecture materials:** Theories/techniques for each lesson **1.2 Exercise Procedure and WS materials:** ● White WS, ● Case study introduction WS, ● Deliverable WS	**2.1 Upload lecture materials to LMS** **2.2 Exercise materials for team/group collaborative learning:** ● Prepare "White WS" for collaborative learning in Google Drive ● Submitting" Deliverable WS" in miro	
During class	**1.3 During each class:** Lectures by instructors, explanations of exercise methods, learning support, and educational guidance corresponding to the learning situation of each team and group	**2.3 Utilization of AI chatbot's "question and answer system":** ● Enter the question code/question keyword in each "case study introduction WS" ● Each learner uses the question-and-answer system above during the learning process of the exercises	**3.1 Collaborative learning using the sharing function of Google Drive:** ● Team common collaborative learning ● Inter-group collaborative learning ● Group collaborative learning **3.2 Attach each learner "Deliverable WS" to the corresponding sheet in miro**
After class		**2.4 Each learner uses the question-and-answer system** during the learning of 3.1 to 3.4 on the right	**3.3 Homework with using Google Drive** **3.4** After completing homework, **submit deliverable WS for each exercise to miro**
		2.5 TA gives feedback to each deliverable WS **(3.4)** using miro's comment function	

For "1. Class management/creation of digital teaching materials," instructors created digital lecture teaching materials

necessary for group work exercises related to each [regular class times]. The TAs created team/group exercise "Worksheet (WS)" that served as guides for each learner to proceed with the exercises they were in charge of.

There are three types of WS. The first type of WS organized contents such as tables, diagrams, and explanations so that each learner could easily describe and express the results of learning with collaborative learning according to the procedure of the individual exercises. It is a format WS for descriptive expression (referred to as a "**white WS**" on which nothing is written in the format).

In the second type of WS, instructors and TAs guided case examples corresponding to the content of their respective exercises in the white WS so that they could visualize how to write the WS (**"case study introduction WS"**).

The third type of WS was a summary of the results of collaborative learning by each team/group in response to the assignments of the group work exercise presented by the instructor (referred to as **"deliverable WS"**).

In "2. Lesson preparation/learning support/learning EP", first, through LMS, the learner was instructed on how to deliver the digital lecture materials, and how to proceed with the class and group work exercises on the day.

Next, the following two types of digital whiteboard platforms were utilized for the group work exercises. In addition, their own "working board" for each team was set up on each platform, and WS materials were uploaded into their own board, prepared for collaborative learning corresponding to each group work exercise.

(1) Collaborative learning method using platform service of Google Drive "Google Docs"

"Google Docs" and the other apps in the "Google Drive" suite serve as a collaborative tool for cooperative editing of documents in real time. Documents can be shared, opened, and edited by multiple users simultaneously and users can see character-by-character changes as other collaborators make edits (https://www.google.com/docs/about/).

Changes are automatically saved to Google's servers, and a revision history is automatically kept so past edits may be viewed and reverted. An editor's current position is represented with an editor-specific color/cursor, so if another editor happens to be viewing that part of the document, they can see edits as they occur.

A sidebar chat functionality allows collaborators to discuss edits. The revision history allows users to see the additions made to a document, with each author distinguished by color. Only adjacent revisions can be compared, and users cannot control how frequently revisions are saved.

Files can be exported to a user's local computer in a variety of formats (ODF, HTML, PDF, RTF, Text, Office Open XML). Files can be tagged and archived for organizational purposes.

The collaborative learning method using the platform service of Google Drive "Google Docs" during the group work exercise in this research is described below. Based on the group work exercise procedures and method explanations shown in the digital lecture materials created by the instructor, TAs prepared a WSs set that summarizes multiple white WSs according to the exercise procedures. TAs uploaded the WSs set into their own "work board" for each team/group before class within the Google Drive

platform.

While referring to the group work exercise methods and "case study introduction WS" mentioned in the lecture's materials, each team/group member could work each other with using the same white WS in their own "work board".

(2) Collaborative learning method using miro platform service

Miro is the online collaborative whiteboard platform that enables distributed teams to work effectively together, from brainstorming with digital sticky notes to planning and managing agile workflows (https://miro.com/app/dashboard/). With Miro, users can take advantage of a full set of collaboration capabilities, make cross-functional teamwork effortless in real-time, and organize meetings and workshops: use video chat, presentation, sharing, and many other features. As digital whiteboards, the miro platform provides a wide variety of templates that allow multiple remote members to collaborate: Creating mind maps, concepts maps, customer journey maps, and planning roadmaps easily.

In particular, as a method of submitting exercise assignments for each group work, the instructor should instruct the members belonging to each team/group in order to place individual "deliverable WS" deliverable in their own miro's "work board", according to a fixed order of the exercise procedure. After the deadline for submission of the deliverables by each team/group, the specific TA in charge of each group provided feedback on the "deliverable WS" deliverable with using miro's comment function.

5.2 Class operation management method corresponding to [special class times] and DX learning EP

Table 5.2 shows the "class operation management method" and how to use the DX learning EP for **[special class times].**

Table 5.2: "Class management method" for **[special class times]** and how to use DX learning EP

Class	**1. Class management, creation of digital teaching materials**	**2. Class preparation, learning support, learning EP**	**3. Collaborative learning, submission of deliverables by learners**
6th	**1.4 PBL learning outcomes:** How to submit the "SDGs/CE business concept" for each team	**2.6 Prepare the format sheet** for the "business concept" in miro	
		2.7 TA feedback to each WS using miro's comment function for the deliverables submitted in miro in 3.5	**3.5 Collaborative learning shared by the team:** Submit the deliverable of the "business concept" to the format sheet in miro
11th	**1.5 AL interim result report:** explanation of how to review the results of collaborative work between groups or collaborative learning for each group	2.8 Prepare a format table for each team's **interim result presentation** in miro 2.9**Attach the "Deliverable WS"** submitted by each team/group to the above format table in miro	**3.6 Mutually evaluate all deliverable WSs between each team/ group member:** Comments on good points and points to be improved
		2.10 For the deliverables in miro in 3.6 above, **TA feedback to each WS** using miro's comment function	
14th	**1.6 PBL/AL final result report meeting**: Explanation of how to submit the "**SDGs/CE business scheme**" for each team **1.7 Preparing a class evaluation questionnaire**	2.11 **Prepare concept map formats** for announcing the "SDGs/CE business scheme" in miro	3.7 Using the LMS, each learner conducts an **online class evaluation questionnaire**

			3.8 **Improve all Deliverable WSs and add explanatory documents** from each team/group member. 3.9 Paste all the WSs of **SDGs/CE Business Scheme on the 2.10 concept map format** 3.10 **Preparing presentations** for all 15th classes results
15th	1.8 **Operation of the results presentation** of the "SDGs/CE Business Scheme" of each team 1.9 Explanation of the **mutual evaluation method** for the presentation contents of other teams	2.12 **Questions and comments** from instructors and TAs for each team's presentation	3.12 **Presentation** by each team using 3.9 above and Q&A 3.13 **Online mutual evaluation** of other teams' presentations using LMS
After classes	1.10 **Preparation of test questions** corresponding to knowledge BOMs by each group, which became the basis of AI chatbot's "question-and-answer system"		3.11 Each learner took **online comprehension tests** corresponding for each group after reviewing using the AI chatbot's "question and answer system"

The method of submitting some series of "deliverables WS" such as "SDGs/CE business concept", interim deliverables WSs, and final deliverable "SDGs/CE business scheme" per team was the same as described above, namely instructing the members belonging to each team/group in order to place individual "deliverable WS" deliverable in their miro's "work board", according to a fixed order of the exercise procedure.

TAs also gave similar feedback on their respective "delivery WS". The merits of being able to implement feedback using the miro platform on the instructor and TA side are discussed below. The merits are that each TA in charge of each team/group can

cross-observe their "work boards" of different teams/groups, select and add comments on the specific "deliverable WS" related to each TA from remote environments.

Figure 5.1 shows an example of "2.9 Pasting each WS submitted by each team/group in the above format table" for "1.5 AL Interim Results Report".

The instructor prepared a concept map format involved in one of miro's templates, for the results presentation of the "SDGs/CE Business Scheme" at the final class. Then, the instructor instructs all members of each team/group to place each "deliverable WS" within the "SDGs/CE Business Scheme" into this concept map. The intention of using this concept map format was to represent visually the interrelationship structure of various deliverable WSs related to team common, inter-group, and specific group collaborative learning.

Moreover, as a creative way to use miro for this results presentation, a separate "new board for results presentation" was newly established instead of the usual their own miro's "work board". In this "new board for results presentation", the instructor instructed learners to arrange the deliverable WS of the "SDGs/CE business scheme" for each team in the same concept map format. As a result, instructors/TAs and all learning members could observe each other's business scheme proposals on the miro platform while comparing the characteristics of each team/group.

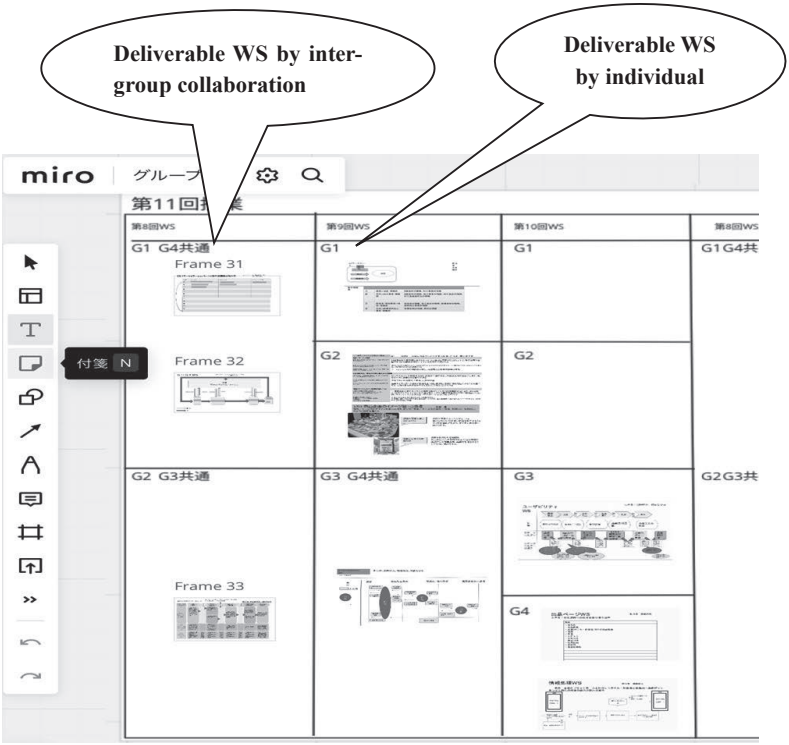

Figure 5.1: Example of "3.9 Paste the WSs of SDGs/CE Business Scheme on the 2.10 concept map format"

6. Question-and-Answer (Q&A) system using Knowledge BOMs and AI chatbot

Since 2020, AI chatbots had been introduced in a PBL class to support students in planning their businesses. This research was focusing on digital marketers G2 (Arame and Tamaki, 2019, ZHENG et al., 2021, Tamaki et al.,2022).

6.1 AI chatbot structure

The terms related to the AI chatbot were registered for the common classes: G1, G2, G3 and G4. The terms were classified into four levels according to the depth of the content to be handled, and table listed up to the second level (from H1 to H7) of terms related to G2. The second layer of G2 was divided into seven categories and 105 items were registered. In 2021, 286 items would be registered across G1-G4. The structure of a learning BOM specialized for G2 is as follows **(Table 6.1)**, and other knowledge BOMs specialized for G1/G3/G4 had been prepared.

Table 6.1: Knowledge BOM for Group2

G2-H1: Consumer Behavior

G2-H1-H1: Defining consumer behavior
G1-H1-H2: Factors affecting consumer behavior
G1-H1-H3: Defining consumer psychological processes
G1-H1-H4: Defining purchasing decision making process

G2-H2: Segmentation (market segmentation)

G2-H2-H1: Defining market segments
G2-H2-H2: Criteria to categorize market segments

G2-H3: Persona Analysis

G2-H3-H1: Defining Persona Analysis

G2-H4: Product Service Planning

G2-H4-H1: Product concept-oriented merchandising (commercialization planning)
G2-H4-H2: Physical utility of “product architecture”
G2-H4-H3: User environment utility of "usage TPO scene" (TPO: time, place, occasion)
G2-H4-H4: Human internal utility of "customer's feelings,

psychology, and sensibility"

G2-H4-H5: Product concept-oriented merchandising (commercialization planning)

G2-H5: Service Process

G2-H5-H1: Defining service processes

G2-H5-H2: Service quality corresponding to service process

G2-H6: Content Marketing

G2-H6-H1: Defining content marketing

G2-H6-H2: Customer journey

G2-H6-H3: New customer journey (A5 Framework)

G2-H6-H4: Defining marketing 4.0

G2-H6-H5: O Zone (O3) for marketing 4.0

G2-H6-H6: Content design methods

G2-H6-H7: A step-by-step approach to content marketing

G2-H7: Digital Marketing

G2-H7-H1: Definition of digital marketing

G2-H7-H2: Defining data driven

G2-H7-H3: Data obtained from POS (Point Of Sale)

G2-H7-H4: Omnichannel

G2-H7-H5: Defining social listening

G2-H7-H6: Characteristics of data-driven digital marketing

G2-H7-H7: Realizing omnichannel marketing step by step

G2-H7-H8: How to draw a channel shift matrix

G2-H7-H9: Amazon case study of omnichannel matrix

G2-H7-H10: One to one marketing with digital marketing

G2-H7-H11: Retargeting advertising

G2-H7-H12: Real-time experience tracking (RET)

6.2 Three devised ideas for building AI chatbot "Q&A System"

When constructing this Q&A system, the following three ideas have been devised.

First, a rule was proposed to add a **"code number"** according to individual cell in each level tree structure included in the knowledge BOM. A question sentence regarding a technique term/concept were matched and stored in the one cell with the code number in the knowledge BOM.

The second idea was to instruct individual learners to first enter their "name and student number" before using the AI chatbot, and then use the "Q&A system" **(Figure 6.1)**. As a result, it became possible to collect and accumulate Q&A data with **"learner ID"** in the AI chatbot, and to analyze system usage history that identified individual learners.

As a third idea, assuming that the learner wanted to ask a more in-depth question after finishing one question, there was no need to write all the question sentences in the AI chatbot. The question term groups included in the lower layer of BOM were enumerated with the keyword button, and it was designed to display and paste the URL link (Figure 6.2).

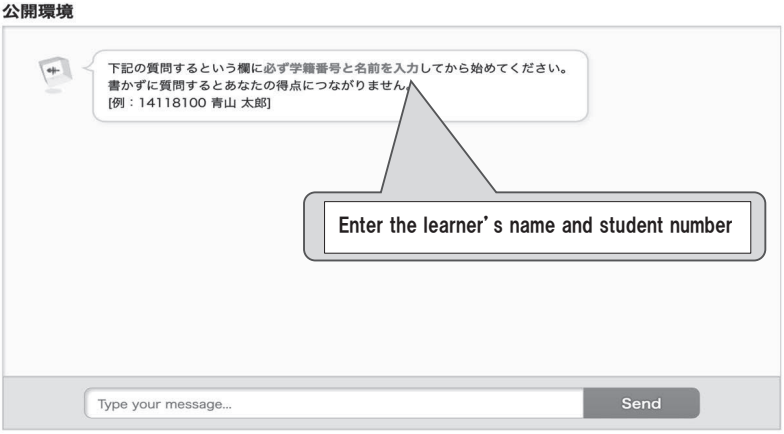

Figure 6.1: First screen of the AI Chatbot "Q&A System"

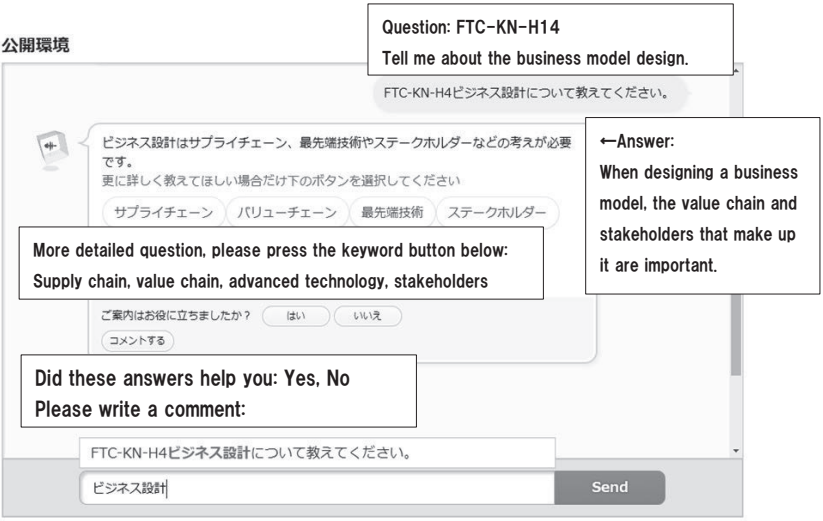

Figure 6.2: Listing question keyword button groups in the BOM lower hierarchy

6.3 Results of analysis

In 2021, there were 45 students in six teams (A-F). **Table 6.2** summarizes the G1, G2, G3, and G4 individuals in charge of each team. The 11 students were in charge of the G2.

Table 6.2: Membership composition by groups per team (Arame and Tamaki, 2023)

Team	G1	G2	G3	G4
A (9 people)	2	2	2	3
B (8 people)	2	2	1	3
C (7 people)	1	2	2	2
D (6 people)	2	1	2	1
E (7 people)	1	2	2	2
F (8 people)	2	2	2	2

This table summarized the SDGs/CE oriented product planning goals and product outlines for which G2 was responsible for each team. Each team envisioned a new supply chain and planned the SDGs/CE oriented product with originality; thus, the class was somewhat effective. However, only Teams B and C considered collecting and accumulating data on their own websites, corresponding to the consumption models of stakeholders.

Furthermore, even the teams that had envisioned digital marketing were not clear about how they wanted their stakeholders to get involved **(Table6.3)**. This table shows the results of classifying the number of times the group members of each team used the AI chatbot and the content of inquiries into common classes, G1, G2, G3-G4, and others. It can be seen that G2 members made many inquiries about the contents of G2 that they were in charge of.

Table6.3: AI chatbot usage count by team (Arame and Tamaki, 2023)

Team	total number	common classes	G1	G2	G3-4	other
A (2 people)	59	5	0	18	0	6
B (2 people)	22	4	1	8	0	4
C (2 people)	51	9	2	9	0	7
D (1 people)	22	2	0	3	2	3
E (2 people)	47	8	4	14	1	2
F (2 people)	64	19	3	4	0	23

6.3 AI chatbot usage history

Regardless of the group, the number of inquiries related to H7(digital marketing) was high in previous **Table 6.1**, followed by H4(product service planning). In the third layer of H7, 70% of the total comprised H7-H10: One-to-One marketing through digital marketing, H7-H11: Retargeting advertising, H7-H12: Real-time experience tracking. **Figure 6.2** shows the contents of the inquiries from G2 members in chronological order. It can be identified that the number of inquiries related to the work in charge increased as the PBL class progressed.

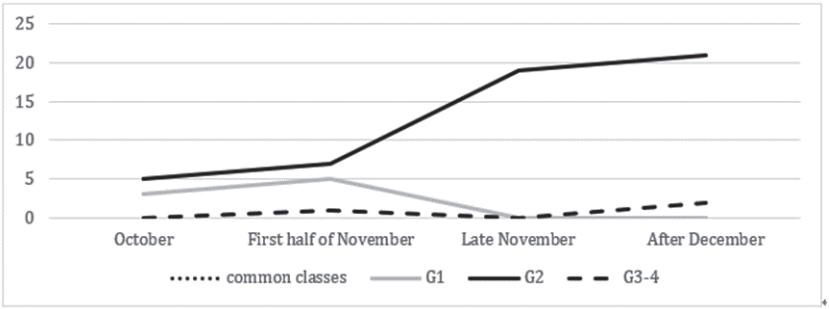

Figure 6.2: Time-series analysis of inquiry content (Arame and Tamaki, 2023)

7. Conclusion

As a countermeasure against the post-coronavirus era, by considering the characteristics of each departmental curriculum and educational policy throughout the university, each department should successfully combine on-demand, real-time, and hybrid types in online classes based on the various class formats of online classes and their characteristics. When instructors engage in lesson design, teaching material production, and class management, they should consider the advantages, disadvantages, and examples corresponding to the characteristics of each class format, as shown in **Table 2.1**.

As a part of the DX subsidy project promoted by the MEXT in 2021, advanced institutions of higher education in Japan will be further accelerated in terms of the realization of learner-oriented education (Initiative 1) and improving the quality of learning (Initiative 2) in the post-coronavirus era. Future challenges with the DX project concept concern whether each university can continue its business activities even after the subsidy period ends.

Chapter 5 introduced how to manage class operation before, during, and after the group work exercises corresponding to **[regular class times]**, and how to use the DX learning environment platform (DX learning EP). Next, it is necessary to conduct further empirical research on the class management method and DX learning EP related to **[special class times]**.

In Chapter6, this study analyzed usage learning logs to see what kind of questions and answers the learners made by using AI chatbot during the collaborative learning process of hybrid group work exercises. The usage history data of the AI chatbot was collected and analyzed. Focusing on the G2 members, who oversaw SDGs product service planning and digital marketing, it

was found that each team was able to create SDG product service plans with originality, base on the AI chatbot usage history, not only G2 but also G1, G3 and G4.

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