International Journal for Educational Media and Technology
2018, Vol.12, No. 1, pp.6-17

Development and Practical Use of e-Learning to Support Students During Fieldwork in the Local Community

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Our research question is whether we can nurture students' self-efficacy and problem finding and solving skills with the least interference from teachers, with a help of the ICT in PBL and fieldwork as the university classes.
In the previous research, we found a desirable PBL should be a one which has least teachers' interference, such as providing goals or leading the discussion by the teachers. But in our PBL classes conducted in the previous year, we found no interference tends to lead students fail in the project. So, we developed a Learning Management System which contains the following three components; 1) Enabling students to make well-structured fieldwork plans by themselves. 2) Visualizing the procedure of the interaction between the students and field residents. 3) Visualizing the students' moving on site.
With this LMS we succeeded to reduce the number of project failure and increased good actions of the students.

Keywords: e-Learning, Fieldwork, LMS, Project-Based Learning (PBL)

Introduction

The ultimate goal of this research is to find what is the best kind of support for students and to nurture students' problem finding and problem solving skills through the actual fieldwork and Project Based Learning. We have developed a system which enables students to learn by doing (and not teaching) through the problem solving process – students find the problems by themselves, research and think to find their own answers, check the answers critically and present them to the people to whom they are related.
For the first year of the project (which was in 2014), we developed a PBL program, called the "Shimanabi Program". The PBL course is a mandatory class and all the students of the University of Nagasaki participate in it to solve the problem of the Nagasaki rural area, which consists of a lot of islands. At first, we (the teachers) designed this program based on a learner-centered model in which we prioritize the students' autonomy as much as possible. But the result of the first year was not as good as we expected, such as poor fieldwork plans, inconsistency of goals and results, and unattained plans caused by the lack of previous research.
Of course, we could have changed our syllabus and program design to strengthen teachers' role and interference, but, instead, we added some features to the original LMS "manabie" which guides students to design the project by themselves and lets the teachers observe the process of the project based on the previous research results.

Literature review

In the first year of our "Shimanabi Program" in 2014, the LMS only contained project life cycle management, setting and submitting the group report and final reporting. But, as we mentioned, many of the students' projects failed in

vain. So, we thought we needed to add some more features to the LMS which controls the quality of PBL and studied the previous research. At first, we reviewed the paper by Thomas (2000) to decide how to modify the LMS, as this paper reviews the previous papers related to PBL. Thomas defines five criteria of the PBL as centrality, driving question, constructive investigations, students' autonomy and realism. The "centrality" means, in the PBL, that the "project" should be the center of the curriculum. A project should be "focused on questions or problems that drive students to encounter the central concepts and principles of a discipline". For the students, they should keep attaining new knowledge and skills to solve the problems. And, finally, the project needs to be "student-driven" and "realistic, not school-like" to the students. Also, according to Thomas (2000), "Using technology in project-based science makes the environment mode authentic to students, because the computer provides access to data and information, expands interaction and collaboration with others via networks, promotes laboratory investigation, and emulates tools experts use to produce artifacts" (Krajcik et al.,1994).
Hmelo-Silver (2004) define more precise conditions which leads the PBL to success. Table 1 shows the six conditions of the project-based science approach. According to this table, "Problem" is defined as the "driving question", and other criteria are largely in common with Thomas's criteria. Hmelo-Silver also mentions "computer –based tools support planning, data collection and analysis, modeling and information gathering."
Based on these previous reviews, we redesigned the PBL "Shimanabi Program", especially focused on the "driving questions" and process control introducing some features to the LMS tool.

Table 1

Approaches to Learning Situated in Problem-Solving Experiences (Hmelo-Silver, 2004)

Problem	Driving Question
Role of problem	Focus for scientific inquiry process leading to artifact production
Process	Prediction, observation, explanation cycles
Role of teacher	Introduce relevant content before and during inquiry Guides inquiry process
Collaboration	Negotiation of ideas with peers and local community members
Tools	Computer-based tools that support planning, data collection and analysis, modeling, and information-gathering

Methodology

Our research is to substantiate the revised syllabus of PBL and LMS are effective through actual PBL classes of the "Shimanabi Program" which was not successful in the previous year.
In the first program, conducted in 2014, we used commercially available LMS "manabie" for submitting reports of the group discussion. But we found many of the projects failed because of the inconsistency between goals and methods, unachieved goals expected in the plan and lack of previous research. We used the Hmelo-Silver table (Table 1) to analyze the cause of failure, and we found the actual problems of the first "Shimanabi Program", as shown in Table 2. In the first practice, we lacked a system to promote collaboration between students and local residents. Also, we did not define the role of the teachers, and the teachers did nothing or over interfered. To solve these problems, we set up a local coordinator who could bridge the students and local residents, defined the role of teachers and developed a material which explained how to do PBL through students own thoughts and decisions.
In addition to the overall modifications, we decided to develop our own LMS based on the existing "manabie" to reduce the interference of teachers and promote the autonomous actions of the students without scarifying the quality of the project result. The new functions of the modified LMS are the following:
- Visualizing and guided problem setting tool for students to make well-structured fieldwork plans
- Visualizing and checking the interaction between students and local residents
- Schedule planner for fieldwork (teachers can check it remotely)
- Travel planner (reservation of transportation to the island)
- Budgetary control

Table 2

PBL Approaches in the "Shimanabi Program"

	In 2014	In 2015
Problem	Teacher provided the problems to solve	Teacher encourages students to find their own problems, but does not present them concrete ones. The actual problems were provided by the local coordinator, but they are not the only ones to solve. Students can find their own problems.
Role of Problem	What the teachers want students to learn	Themes for the students to think over to solve for the future
Process	Planning->Do ->Presentation The plan is revised and added to the worksheet made at the start	Plan -> Presentation of the Plan -> Obtain feedback from teachers ->Do -> Presentation of the result -> Obtain feedback Structured the plan and showed the process leading from the overview to detailed action
Role of teacher	Administration of the students. Answering the questions, if any	Observation and check of the procedure of the reports submitted by the individual student and groups Teachers interferes only the communication between the students and local residents fails
Collaboration	Group work of the students	Collaboration by the communication between the students and local residents in the community
Tools	A worksheet to put the plans down	Visualizing tool show the structure the plans Promoting the communication between the students and local residents Travel planner, Budget control Searching and referring to the previous samples of PBL

What is the "Shimanabi Program"?

The "Shimanabi Program" is a mandatory course of the University of Nagasaki consisting of two classes, "Learn in the islands in Nagasaki" and "Fieldwork in the islands" (Figure 1). This program was implemented with the aid of the Ministry of Education, Culture, Sports, Science and Technology (MEXT, 2014). The country thinks that young people deeply understanding the attractiveness and challenges of the region will be a means to solve the problem of rural population decline.

The "Shimanabi Program" basic procedure, A – D, has not been changed over 2014 -15, but we have modified the detailed process, such as how to provide the problems, the way to plan the fieldwork and the presentation, as shown in Table 2. The detailed modified schedule of the class is shown in Figure 2.

A group consists of around 10 students, and a teacher supervises the group as the facilitator. Each group travels to one of the remote islands of Nagasaki by ship and conducts fieldwork for about a week in the island. The fieldwork is aimed at finding the problems of the island and solving them. After the fieldwork is finished, students get the feedback from the residents about the analysis and plans proposed to them for the revision. The final result (student report) will be presented to the local government.

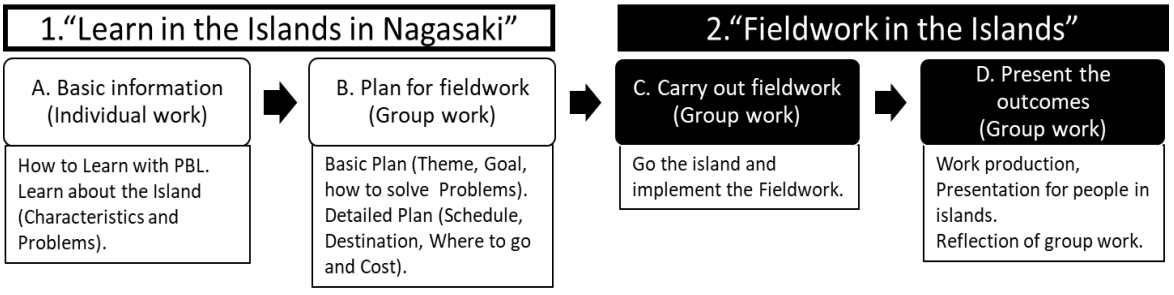

Figure 1. The courses in the "Shimanabi Program"

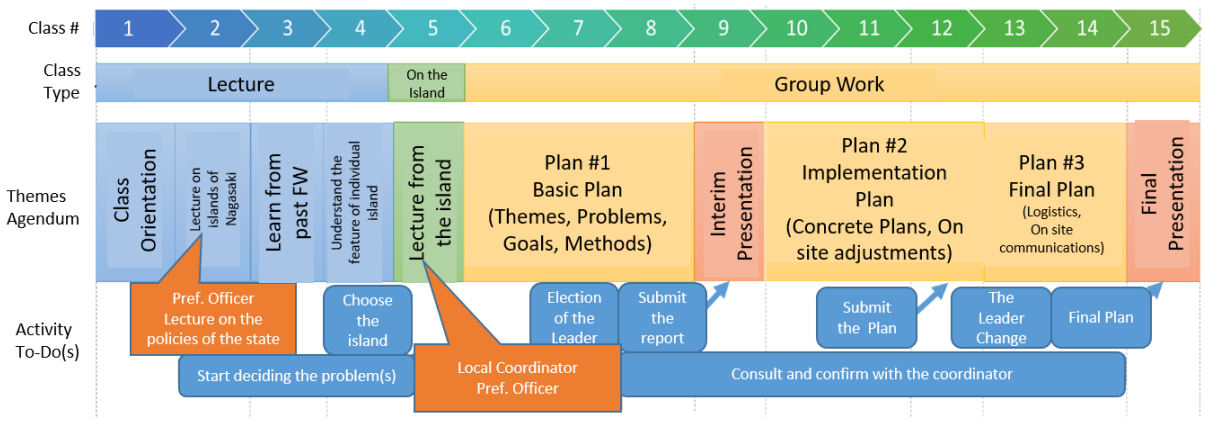

Figure 2. Course schedule of Learn in the islands in Nagasaki

Our original LMS "manabie"

Our original LMS "manabie (Figure 3)" is a system developed based on the idea that a new framework of e-learning is needed considering support for fieldwork. The trial in 2014 was implemented by combining "manaba course2", a ready-made LMS, and Google Document and Spreadsheet. After we distributed a template (with entry examples) of a worksheet and explained how to advance discussions, students created their group plans. However, because the template was assumed to be used for output on paper, the following problems arose: relations between the columns of purpose, goal and method of achievement are difficult to see visually (e.g., even if irrelevant sentences are mixed in, students are only slightly aware of it). Also, even when a means of transportation is incorrect, if students or teachers are not aware of it, then they go to fieldwork without correction (e.g., even when the order of visits was changed and, consequently, the distance lengthened from 1km to 10km, the mode of travel remained "walking"). Some groups had situations in which discussions were stagnant and moved forward only slightly. The university as a whole wants to grasp destination arrangements and transportation expenses related to fieldwork. Therefore, a list must be made manually. Because it was assumed that the burden would become too heavy for teaching staff if fieldwork for 600 people was implemented in 2015, we investigated functions and earlier studies related to "support for fieldwork." Collaborative learning online includes those realized with existing tools, such as those described for a study by Ohsaki and Fukawa (2015), and with plug-ins running on LMSs, such as those described by Nagaoka, Niwa, Hiraoka, and Kita (2015). However, we found no function to break PBL and fieldwork into small steps or to check them automatically. For that reason, we developed an LMS "manabie" specialized for fieldwork support. The "manabie" has been used since 2015. Although it was the first e-learning operation at the University of Nagasaki overall, all students were able to create their fieldwork plans. All conducted fieldwork without confusion. The "manabie" is used not only for planning of "Learn in the islands in Nagasaki", but also in "Fieldwork in the Islands", for tasks such as data accumulation, submission of daily reports, communication during fieldwork and for creation of works after returning to the university. The state of individual work and group work to be submitted can be understood at a glance (Figure 3). We also produced screens for teachers clarifying the states of various students. Additionally, we made available multi-dimensional evaluation, including Assessment of Fundamental Competencies for Working Persons (self-evaluation) and mutual evaluation, using evaluation tools other than conventional tests and reports.

Assigning importance to the intent of the program, in that students identify issues and create and execute a plan, we developed the system to minimize deficiencies in plans to the greatest extent possible by students themselves ascertaining the big picture of their plans: by grasping the state of progress and by becoming aware of deficiencies through automatic calculation of the consistency of transportation and time. The following five functions were particularly difficult to realize using existing LMSs.

1. Visualizing and guided problem setting tool for students to make well-structured fieldwork plans
2. Visualizing and checking the interaction between students and local residents
3. Schedule planner for fieldwork (teachers can check it remotely)
4. Travel planner (reservation of transportation to the island)
5. Budgetary control

We describe implementation of the respective functions of "manabie" in the next section and thereafter.

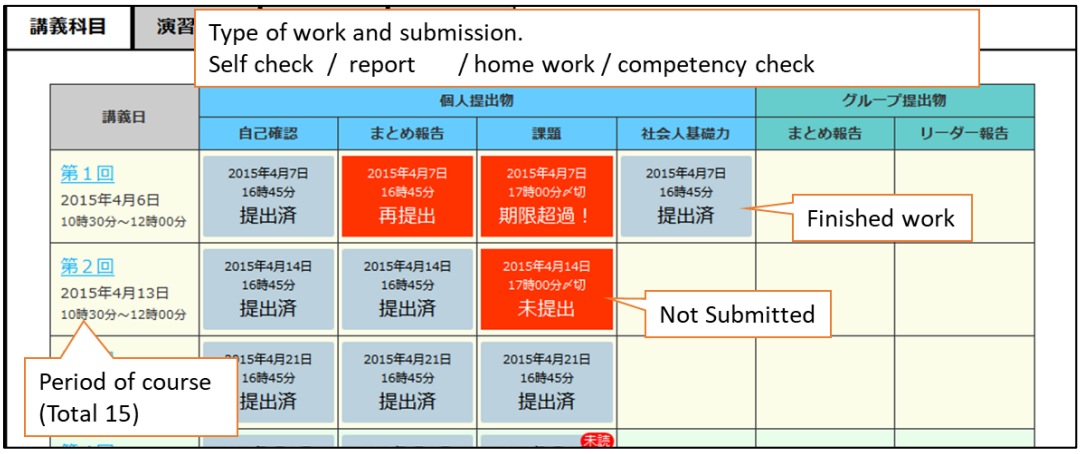

Figure 3. Front page for students from "manabie"

Visualizing and guided problem setting tool for students to make well-structured fieldwork plans

Using the worksheet that has been used since the beginning of group work in "Learn in the islands in Nagasaki", students think about "Theme", "Meaning for the Islands" and "Novelty and differences from previous ones" individually. They then come together, each bringing their own ideas. After examining the ideas using KJ method, they submit it as a group report. This is done in the sixth through seventh classes of "Basic Plan (Plan #1)" in the lesson plan shown in Figure 2. Following the eighth class, students gather together in groups to check issues that students considered and submitted individually in the seventh session by all members of a group in terms of "goals to be achieved" and "methods of achievement" based on their theme (there is a list screen). They organize the goals and methods as a group after having a discussion. Then, they make a report (Figure 4).
The work up to this point is called the "Base Plan", which represents the planning stage in the context of a project. Although "Theme", "Meaning for the Islands", "Goals to be achieved" and "Methods of achievement" were arranged separately in a trial version of the worksheet, "Goals to be achieved" and "Methods of achievement" were structured into the "manabie." In doing so, we gave consideration to enable students themselves to check visually whether the methods are satisfying the goals.

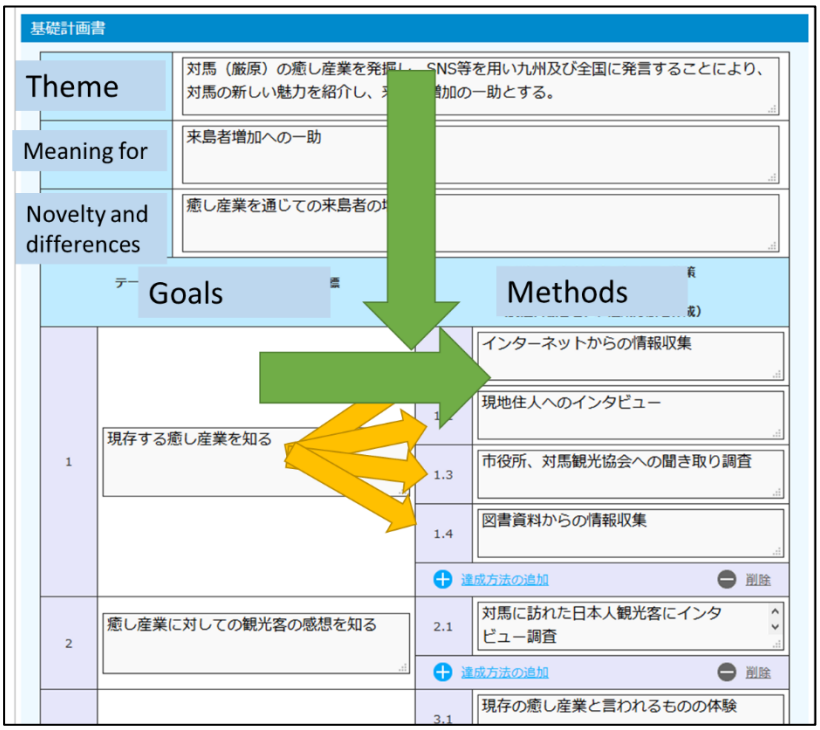

Figure 4. Group report screen for the Basic Plan(Plan #1)

Visualizing and checking the interaction between students and local residents

The screen shown in Figure 5, which is to be used for "Implementation Plan", has a function for students to find

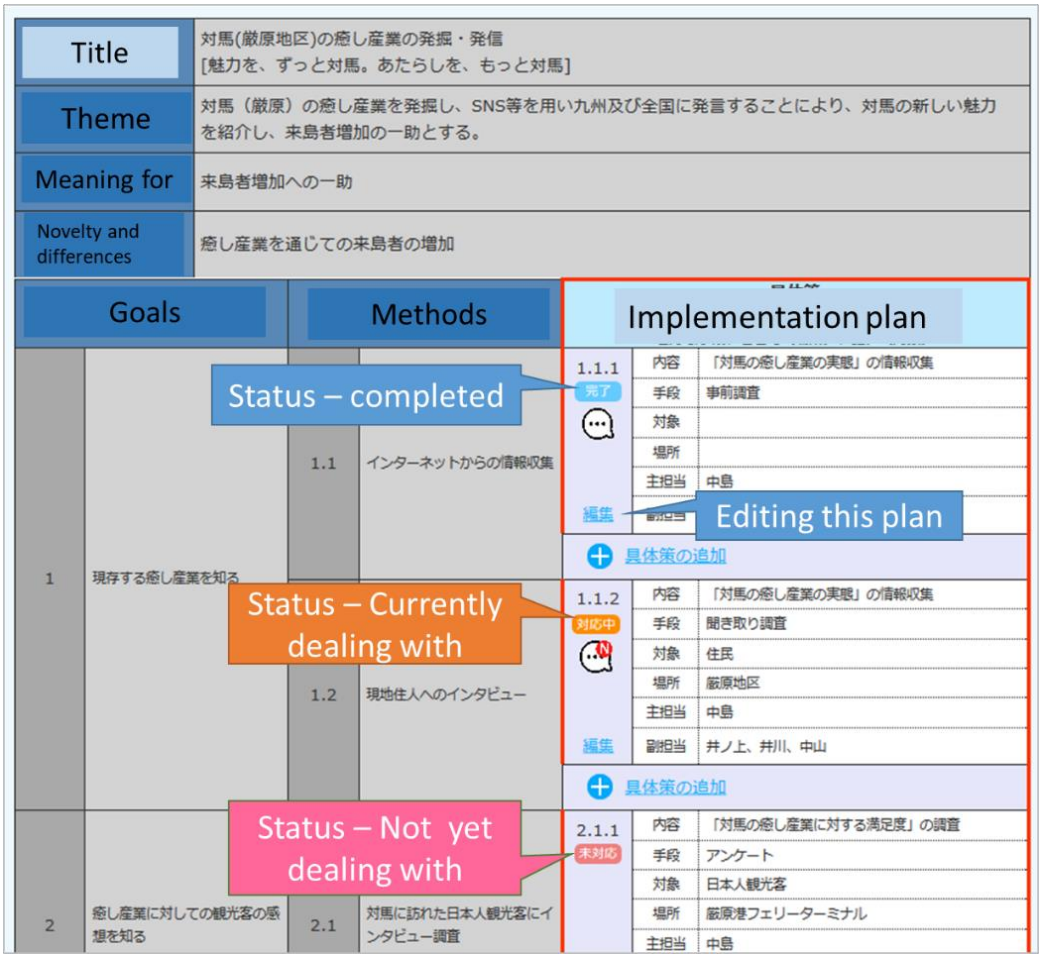

Figure 5. Group report screen for the Implementation Plan(Plan #2)

local cooperators by themselves or ask local coordinators to introduce them, as needed. "Completed" and "Not yet dealing with" shown in "Concrete measures" in Figure 5 indicate whether local coordinators have arranged local cooperators for each concrete measure. For local coordinators, we prepare a screen that is specialized in handling the arrangement apart from the screen to enable them to check concrete measures that students have input, including whether they must be dealt with or not. When checking each concrete measure and thinking that the content is incomplete or has an ambiguous part, local coordinators can ask students questions or make comments. The condition can be understood by balloon icons under "Completed" and "Not yet dealing with" on the screen for students (Figure 5). When a balloon part of each concrete measure or "Editing" is opened, a detailed editing screen (Figure 6) is displayed to check the content of comments and to edit concrete measures, as needed. If a comment has arrived from a local coordinator, students must send back the response status (from three statuses of "Dealing with completed", "Currently dealing with" and "Not yet dealing with"). (By selecting the status in the lower right part of the comment and closing the screen, the status is sent back to the local coordinator.) The mutual confirmation of the status serves to prevent oversights in the following routine: students rewrite the content of concrete measures, responding to questions from a local coordinator as comments, and send "Dealing with completed"; then, the local coordinator checks the contents once again and arranges cooperators. To avoid overlooking important information because of information overload in the comments section and to be able to conduct mutual exchange (revised plans and comments) without confusion, we intentionally removed comments from students.

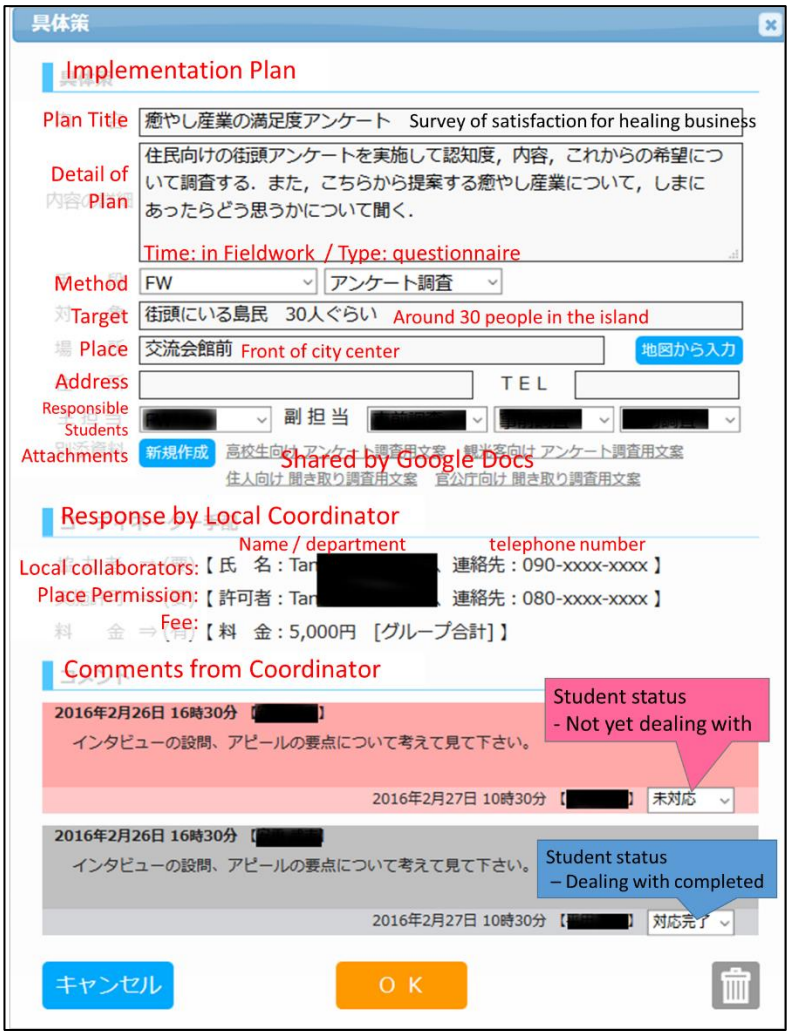

Figure 6. Editing screen of the Implementation Plan

Schedule planner for fieldwork

To set a schedule, various elements, including a geographical sense of the site, appointments with local cooperators and physical constraints, are needed. It is a very difficult activity under the circumstances, in which many students who have never been to "the Islands" are involved. By structuring the elements and establishing the order, we gave educational consideration to students to be able to advance scheduling independently.

A schedule is to be set in two stages, in the 12th session and in the 13th through 14th classes. In the former ,12th class, students create a rough action plan and divide roles in each concrete measure. The 13th and 14th classes are, as a "Final Plan, to create a plan for means of transportation and accommodation within the islands and accompanying materials (in a form of questionnaire survey in the case of Figure 6).

With regard to the "Final Plan", we present an explanation in the next section. Figure 7 presents a screen to build up a rough action plan. By the session, the plan has been advanced to a condition in which concrete measures are almost solidified with the worksheet as shown in Figure 5. The session is to check, with a bird's-eye view, whether the schedule is reasonable or not, dividing it into preliminary investigation, fieldwork (first day to fifth day) and post investigation work. If local cooperators designate time, then the schedule will be fixed. Otherwise, students can decide for themselves. Merely dragging "Concrete measures" on the left to "Itinerary" on the right changes the order, etc., immediately. Students can share such information with local coordinators and grasp advice to gather near sites together to make a visit on the same day (improved transportation efficiency). Moreover, they can grasp incorrect inputs and inconsistency in taking advice.

For the 12th session, we prepare a setting screen to allocate tasks to group members in addition to the screen shown in Figure 7. It visually displays who is in charge of which concrete measure for each member, which can prevent an imbalance of roles within a group.

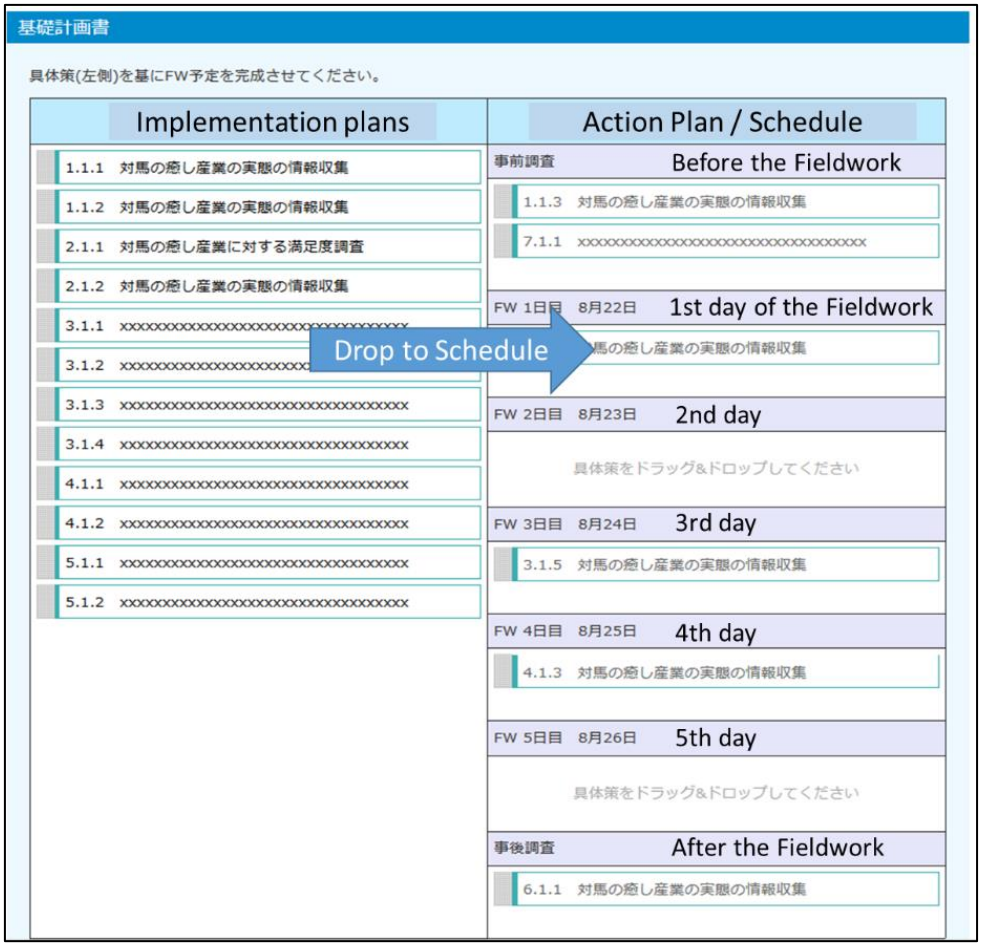

Figure 7. A screen to build up a rough action plan

Travel planner (reservation of transportation to the islands)

During the 13th and 14th classes, students access a screen to input details of itinerary, such as transportation within the islands, accommodation and lunch (Figure 8), as a "Final Plan."
In the classes, in addition to concrete measures (fieldwork) from the first day to the fifth day, as shown in Figure 7, students set up transportation within the islands, meals, accommodation, and drop-by spots (to use for short-time activities, such as rest). The university has a rule that rental cars driven by students will not be used as transportation on the islands. Students can choose a means of transportation at the island from six alternatives: route bus, taxi, pick-up service, walking, short-distance ferry and chartered bus. In the case shown in Figure 8, the part displaying a few lines and placed between "India Port" and "Ice City Hall" represents the means of transportation. (Walking to a bus stop is attached to before and after the transportation by bus, which produces three itineraries.) Clicking the part takes the user to a detailed editing screen (Figure 9).
The screen portrayed in Figure 9 is used to input and change the means of transportation, which displays an example of "route bus" in the figure. When changing the means of transportation to any other service, students can choose another mode of transportation described above by clicking the lower right button.
As an input support function for "route bus", the "manabie" is equipped with timetables and bus stop maps. It displays a bus stops map covering the starting and arriving addresses (Figure 10) to enable students to choose bus stops to get on and off from near bus stops. Having chosen bus stops both for getting on and off, students can automatically search and input the route between the two stops. The bus stop map displays open data (bus stops and bus routes) released by the Ministry of Land, Infrastructure, Transport and Tourism (2017) on Google Maps in a layered fashion. The mechanism itself is available for route buses across the country. However, because home pages of local route buses often have no function for transfer guide, the input function was equipped with the system.

Figure 8. A Screen of the final plan (Plan #3)

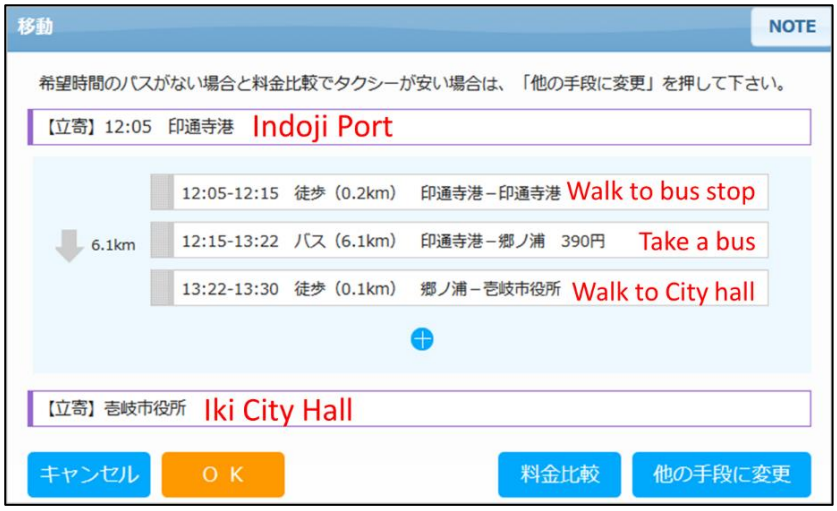

Figure 9. A screen of editing transportation

Figure 10. A screen of choosing bus stop

Budgetary control (costs for plans)

The program has a system in which expenses related to transportation to "the Islands" (ferry, etc.), transportation within the islands and accommodation are borne by the university. There is an upper limit on costs for transportation on the islands during fieldwork not to exceed the budgetary ceiling and to maintain impartiality among students. Students must plan, grasping the costs which have been incurred.

For that reason, the "manabie" has a function for students to estimate roughly how much in costs will be incurred for the itinerary in the final plan that they are creating. Figure 11 portrays a screen to check the differences in the amounts between a taxi and route bus. Because a taxi is sometimes cheaper, students check it and do planning. The amounts are estimated roughly based on fares for respective bus companies and fare charts of taxi companies. Although the choice of route makes a difference in the case of a taxi, the function enables students to get a rough grasp. In addition, the total amount for five days can be checked on a screen for students.

A function for administrators enables teaching staff to download data of the total amount for each group to check whether there is any budgetary problem before implementing fieldwork.

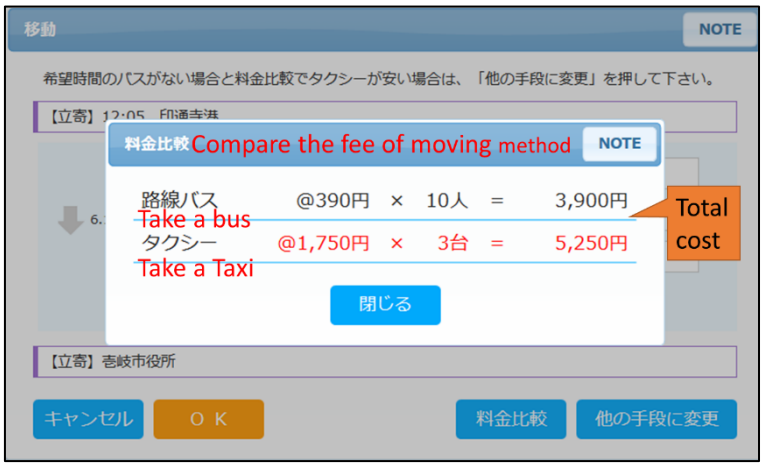

Figure 11. A screen to compare the fee and cost

Evaluation

We evaluated how the 2015 implementation, which used "manabie", changed from its trial version of 2014, based on the results of a questionnaire administered after fieldwork (Figure 12).
Items 1 and 2 are items related to preliminary planning. Items 3 through 5 are those related to fieldwork. Item 6 is presented by dividing free descriptive answers into three clusters and others. We tested differences between the two years for each item and placed an asterisk where a significant difference was found.
With regard to planning, "Preliminary investigation/ Securing means of transportation" accounted for nearly half of Item 6 responses in 2014. However, in 2015, "Did not have communication/ Did not consider a means of transportation" decreased to a large degree for Items 1 and 2; in fact, few problems arose. Consequently, we infer that the function of the "manabie" was useful.
Regarding Item 3, most students were "Positive". Fieldwork became compulsory in 2015, although it was only offered to students who wished to do so in 2014. Still, the percentage increased. We consider this occurred as a result of the following influences: giving autonomy to students and preventing discussions from becoming stagnant by breaking them down into small steps.
Although it was a small increase, a significant difference was found in the achievement of goals and transportation in Items 4 and 5. We think that, even as fieldwork became compulsory and various students participated, the program presented enhanced certainty by a check function of "manabie" and with local coordinators.
Functions to visualize the plan structure, to visualize communication and to check the consistency of transportation on the islands might help students who undertake group work while improving their autonomy.

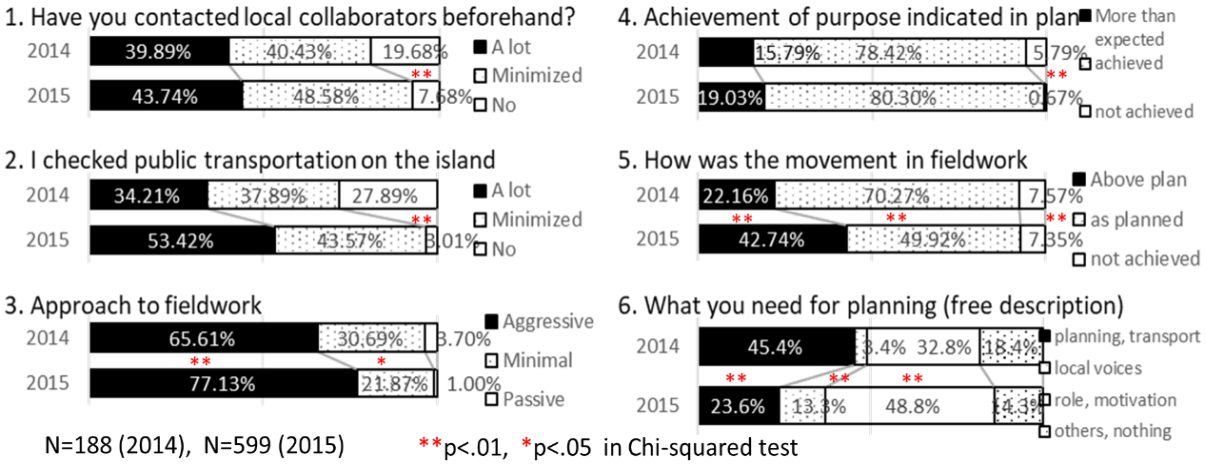

Figure 12. Results of a questionnaire

Conclusion

In our previous project, we carefully designed the curriculum and used LMS, but the project didn't go well. This means that, even if you use the technology for PBL, it does not guarantee the students learn what the teachers intend. To withdraw the autonomous actions of the students, the less interference of the teachers, the better. It's very important to reduce the direct interference of the teachers, but it can easily cause project failure because of poorly organized plans and spontaneous activities without the teachers' care. To solve this ambivalent requirement, we revised materials, project procedure and LMS to guide students to develop their own plans and promote communication. We proved such a "watch over, but not interfere" system leads the PBL project success, as we set in the research question.
PBL classes like the "Shimanabi Program", which are conducted in cooperation with local communities, universities, and students, will increase. In such projects, LMS, which support the procedure of the fieldwork, will be inevitable. We believe that our research and the LMS "manabie" can contribute to realizing a future real-life community-based educational environment.

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