Development of a Fieldwork Support System for Group Work in Project-Based Learning

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Abstract. This paper describes the Fieldwork Support System (FSS) for project-based Learning. The FSS is an essential tool for students who are new to fieldwork activities. They need to take notes on events that occur in the field and reflect on what people did and what they talked about in interviews. In addition, students should collaborate to learn using the data they collected. Therefore, we developed the FSS, which was constructed to use a combination of portable terminals during the students' time in the field and a Web-based management application upon their return. We also conducted a practical experiment on PBL in which students explored local communities. The results of a posterior questionnaire showed the students enjoyed being able to view their current locations and the locations of data they had collected on the FSS terminal map. However, they had complaints about the user interface.

1 Introduction

Amid the rapid progress in technology and diversification of individual values, people who offer services or productions should identify individuals' wants and needs. To do this, they should observe the events that occur in their field to determine what the problems are. Therefore, in the work process of value creation, such as designing production or service, designers need to have the skills of finding and solving problems. As an approach to developing these skills, a pedagogical methodology named problem-based learning (PBL)[1] is spreading in the fields of education and business.

Fieldwork has long been carried out in cultural anthropology and sociology[2]. Researchers visit a target site, called "the field," to gather firsthand data on real problems. Similarly, fieldwork is also carried out in the field of design. Fieldworkers in design collect materials about the target site through a preliminary survey before they arrive. Then, during their fieldwork on-site, they observe how people act and behave. In addition, they interview people in the field according to their data and results of observation. After the fieldwork, they organize the data collected from observations and interviews[3,4]. They posit explanations for the behavior of people observed at the field site, form hypotheses, and then return to the field for a more detailed survey.

In this sequence of fieldwork, researchers often record their field notes by hand, using a pen and paper, copy them onto notecards after leaving the field,

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and finally, arrange them on a large paper or organize the notecards for the data compilation. Recently, however, portable digital devices have become commonplace. By using such devices, researchers can easily record visual data that is difficult to describe in handwritten notes. They can also carry all the fieldwork equipment they need in a single device.

In this paper, we propose a support system for fieldwork activities in education, mostly intended for use in group work for PBL. We describe a practical experiment in which students used this system to explore local communities in PBL. Finally, we present the results of a posterior questionnaire.

2 Fieldwork Support System

The investigation seeks to answer the following two questions about the use of digital devices for fieldwork activities in the context of group work in PBL.

1. What interface is easiest for students to use? We consider important functions such as collecting field data, collaborating with other students, and organizing information.
2. What information helps teachers understand students' progress? We consider functions such as finding the students' locations and viewing the information students have collected.

Similar studies have previously explored the use of mobile devices in education. Takenaka et al. proposed a Fieldwork Support System with the same name, but different from ours, for elementary school children[5]. Children took pictures using a mobile phone equipped with a camera and emailed the pictures as attachments to the Web server. However, this system cannot follow children's locations, and the task of attaching the pictures in an e-mail requires additional work. Sugimoto et al. proposed a field research system named SketchMap for elementary school children[6]. The children were asked to create a map of the area around their school. They used a tablet PC with modules of a GPS sensor and a camera. A pen-based interaction feature allowed them to add image pictures and draw. They also took pictures for the map using the camera module. However, SketchMap specialized in creating the map. Sumi et al. developed a chatting system named PhotoChat[7] that enables users to draw anyone's pictures or pictures already drawn by people. It was designed to support users' communication through photographic pictures. Yet, although it enables greater communication, PhotoChat is not always sufficient to record and store information on the field.

Furthermore, some recent applications may make it easy to record fieldwork. Evernote[1] is a well-known cloud-based system for PCs and mobile devices. Evernote enables users to record the location of a note when it is taken. Skitch[2] is an application for drawing on pictures, including blank pictures. A Skitch picture is synchronized as an Evernote note.

[1] http://evernote.com/
[2] http://evernote.com/skitch/

We conducted a preliminary experiment to test whether the existing systems can adequately support fieldwork. We introduced a combination of Evernote and Skitch. These systems were executed on 4.3-inch smartphones and 10-inch smart tablets. The results are summarized as follows.

Skitch enables users to take pictures, and draw on the pictures to write notes. The drawings are an easy way for students to collect information. Evernote enables collaboration among students; that is, it allows them to share the information they have collected. However, Skitch requested many steps to operate for completing up to synchronization. Thus, we determined that the existing systems were not always fit for fieldwork.

We also found that display-size of the device affected the drawing operation significantly. Although the 4.3-inch smartphone was portable, its small display was less user-friendly than that of the 10-inch tablet. On the other hand, the 10-inch tablet was less portable.

Therefore, we decided to construct an appropriate system for fieldwork activities in group work of PBL. The Fieldwork Support System (FSS) was developed taking into account the above questions and experimental results.

The FSS uses a combination of portable terminals for students' time in the field and a Web-based management application upon the students' return. When students go to the field, they each carry their own FSS terminal, which they use to take pictures (using the camera module) and write notes. Using GPS, the FSS terminal displays a map with the student's current location and the locations for which he/she has taken pictures or notes. We consider the pictures and notes, along with their locations, present location, and past trajectory as the student's activity log. The terminal communicates the activity log to a server computer to store through a third-generation (3G) mobile phone network. When a student accesses the server through the Web by PC, the FSS displays his/her activity log and can also display the activity logs of other members in the same group. Teachers can see all the students' activity logs.

Based on the results of the preliminary experiment, we decided to use a 7-inch tablet, which was considered a good size for in terms of both display and portability. Also for portability in the field, we chose tablet terminals based on Android OS, which is equipped with a camera, GPS sensor, and touch panel.

As shown in Fig. 1, the terminal initially shows the map as the main screen when a student runs the FSS application. The main screen displays buttons for various activities. For example, when the student taps the "Picture" button, the terminal runs the inner camera function to take pictures. When he/she taps the "Notes" button, it runs a canvas screen for note taking. Similarly, when he/she taps the "Notes on picture" button, it also runs a canvas screen, preparing a particular picture that the student has selected beforehand. On the canvas screen, the student is able to directly draw on the screen using a finger or write notes using the touch screen system. These note-taking functions allow the student to choose a color for drawing and to erase only what has been drawn. If he/she has taken notes or pictures, it shows their location on the map on the main

screen. The terminal can also show a configuration menu to communicate with the server computer.

Fig. 2 shows the FSS's Web-based service for PCs. After logging in, every student and teacher is shown this screen. They can sort collected information by date or user. In this instance, pictures are sorted by user. A user named "Test1" has taken 7 pictures, 1 note on a picture, and 2 notes, which are sorted by the time they were taken. Each of them is shown on the map as a pin mark. The student's trajectory from 15 minutes before is also shown. When a student marks the checkbox next to a picture, the picture is downloaded into his/her local storage. Teachers, as administrators, have access to the "User Information" page, where they can view a list of all the students and their groups and edit information about them.

3 Practical Experiment

The practical experiment empirically investigated the FSS's usability for students. We used the FSS in a seminar named "The exploration of the fascinating Nishikyo," which was attended by 19 students in a design course of an art university. Nishikyo is a ward of Kyoto city, Japan, and it comprises several communities. The students were divided into three groups, each corresponding to a different local community. The seminar lasted four months. The activities using the FSS took place within the first two months. During this time, the students visited the field many times.

In total, they took 214 pictures, 9 notes, and 4 notes on pictures. For the purpose of evaluating the FSS, we administered a questionnaire after the end of the seminar. The questionnaire asked students how they used the FSS and what they felt about its usability at the time of use. Some questions were in a multiple-choice format that allowed more than one answer to be selected. The others asked for a free response.

All of the 19 students answered the questionnaire. Figs. 3–9 presents the questionnaire results. These figures plot the number of students as the axis of ordinate or abscissa.

As shown in Fig. 3, the students reported how often they took the FSS terminal to the field. No one answered that he/she had brought it more times than he/she had wanted. The answer "others" means that the student did not have a terminal because he/she had broken it early in the seminar and did not yet have a replacement. Hence, the student would be willing to carry a terminal at least that time. All but two of the students who did not carry it at all utilized the FSS.

The second question was about the terminal's usability; the results are shown in Fig. 4. The question was constructed to evaluate each function of the FSS as easy or awkward to use. The camera function and location-showing functions earned relatively good ratings. Meanwhile, the students had little appreciation for the note-taking functions, which half or more of them did not even use. The third question was about the usability of the Web-based service, evaluated

(a) Main screen: The operational buttons and a location map.

(b) Note-taking function screen: It shows the menu when the user taps the three-dot button in the bottom right corner.

Fig. 1. Screenshots of the FSS terminal application.

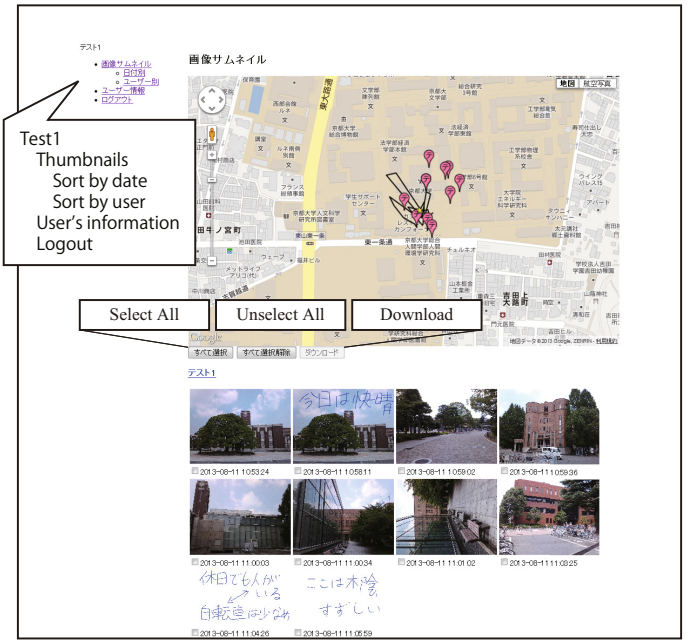

Fig. 2. Screenshot of the FSS Web-based service.

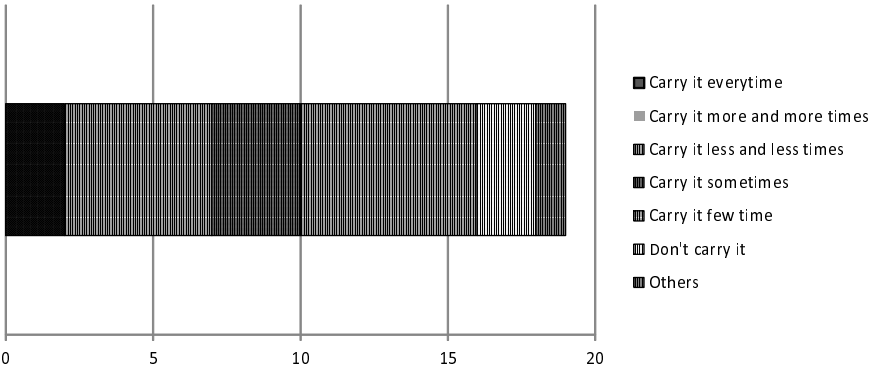

Fig. 3. Question 1: How often did you take the FSS terminal to the field?

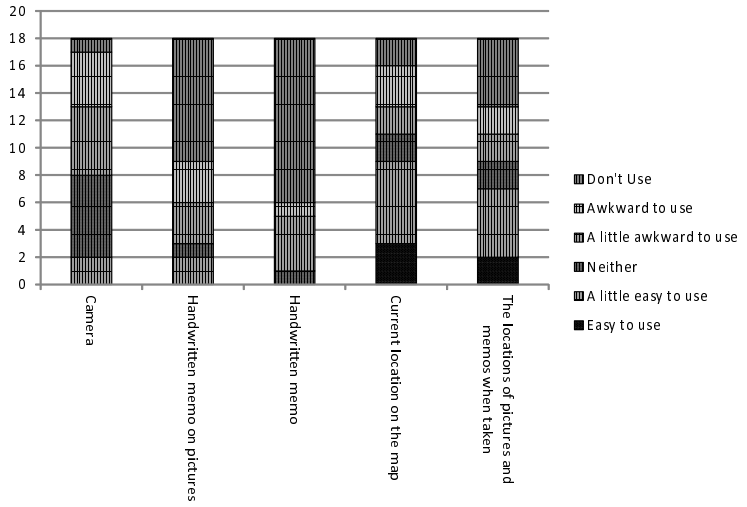

Fig. 4. Question 2: How did you feel about the usability of the FSS terminal?

in the same way as the terminals. As shown in Fig. 5, more than a third of students did not use this service. About half answered that it was awkward or a little awkward. In regard to this service, they also thought about the location functions more positively.

The fourth question asked to answer all items something recording the field when they had gone with them. As shown in Fig. 6, most students still brought notebooks and pens/pencils along. More than half also carried paper maps and their own cameras. Many brought their own smartphones. On the other hand, half of the students decided to utilize the FSS terminal. This result is related to the frequency of use as queried by the first question and is obtained similarly. The histogram in Fig. 7 shows the number of items as the abscissa and the number of students as the ordinate. Most students took more than four items with them.

The fifth question asked about when the students looked at the notes or the pictures they had taken on the PC, as shown in Fig. 8. It was a multiple-choice question. About one half of the students answered that they had looked in their group meeting, and about a quarter of them reported looking the same day they had taken the notes/pictures by the next meeting. The individual data showed that the students who answered they had looked after finishing all the fieldwork also indicated they had not looked before finishing. The students who answered they had not looked at all did not answer any other Question 5 items.

The sixth question asked what the students did with their notes, pictures, and data on their locations and trajectories. As shown in Fig. 9, about a half of them utilized their notes to recall information. In addition, about a half referred to notes written by other group members. About a third of the students returned

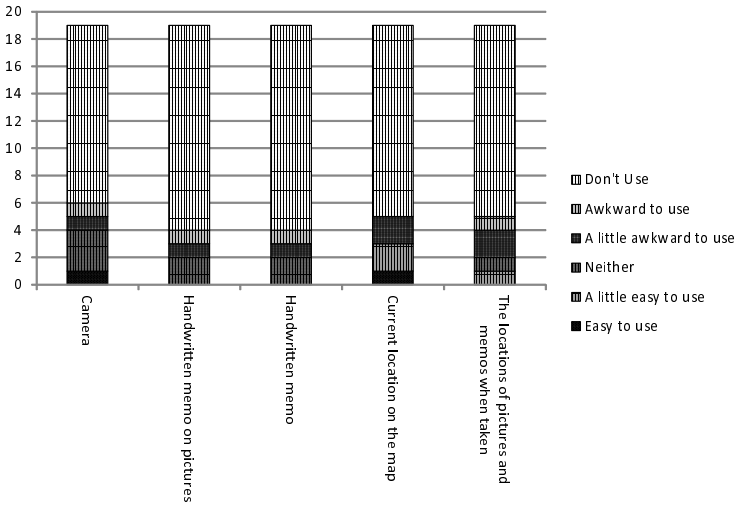

Fig. 5. Question 3: How do you feel about the usability of the PC component?

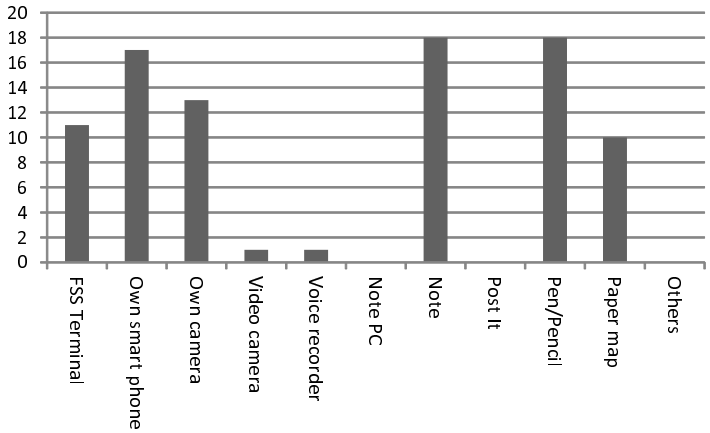

Fig. 6. Question 4: What did you bring to document your observations in the field?

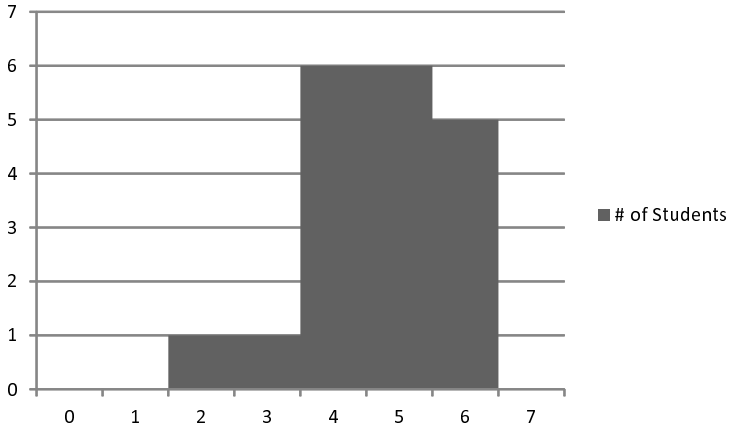

Fig. 7. This histogram shows the number of items as the abscissa and the number of students as the ordinate.

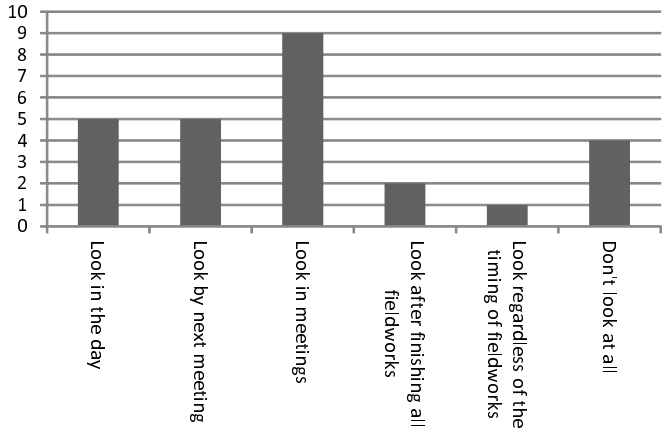

Fig. 8. Question 5: What time did you look at your notes or pictures on the PC?

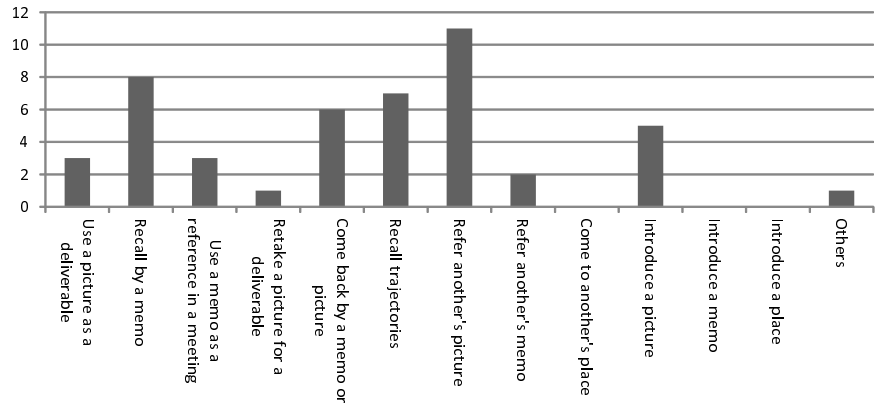

Fig. 9. Question 6: What did you do with your notes and pictures, or their locations?

to where they had taken a note or picture. Also, about a third utilized the data to recall their trajectories. However, none of the students visited a new place or another student's previous location. This result, when considered along with the result of the fifth question, suggests only a few of the students used the Web-based service.

The seventh question, which allowed a free response, was about the difference between the students' experiences using the FSS versus others method of field documentation. They preferred the FSS function for recording locations. Specifically, they described that seeing their current location and trajectories were useful because they did not read paper maps. One student commented that it was easier not having to record locations manually when taking pictures or notes. The students also expressed that the FSS enabled them to share information easily. One student described attempting to record more actively. On the other hand, another student described that operating the terminal was sometimes interfered with making observations of the field.

The eighth question asked the students to suggest ways to improve the FSS. First, one student asked for an additional function would allow users to share pictures and notes while in the field. Second, some students described that the user interfaces was not intuitive and that it required them to go through unnecessary steps. Since the current version of the FSS terminal uses Android's default camera module and photographic library application, which are delegated by the FSS application, one or more steps are required. The students also requested making it easier to switch to the note-taking function from the camera module, or vice versa. Third, although the FSS terminals meet a certain level of accuracy, the GPS sensor was less accurate in the residential areas that the students visited. Therefore, they described that the terminals did not log the correct locations. They also described that the sensor took too long to find the current location when the terminal came back from sleeping mode. Fourth, the students had to carry the terminal in their hands because it was too large to

fit in a pocket. As indicated by the responses to the fifth question, the students carried various items in their hands, pockets, or bags, and in addition, they had to take the 7-inch tablet, which could not fit within the palm of their hand. Fifth, the battery ran out quickly. The FSS application in the terminal did not take into account reducing battery drain. Turning on the display led to drain, and then the students could not view the map for as long as they wanted. Sixth, there were the problems of the thermal runaway phenomenon and difficulty looking at the display under direct sunshine. This activity began during mid-summer and late autumn of 2013, when Japan was experiencing exceptionally hot temperatures nationwide. We should reduce the problems of heat and sunlight reflection. Also related to weather, some students asked for water-proof terminals to carry in the rain.

The final question asked the students for any remaining comments. Some suggested making the FSS compatible with their own smartphone (e.g., iPhone). Others requested a carrying case for the terminal to avoid dropping or scratching it.

The results of the questionnaire indicate that the location functions were favorably accepted by the students. The idea of sharing pictures and notes was also welcomed. These functions have not yet been realized as a dedicated system for fieldwork in PBL. However, the students still used their own tools for fieldwork. Although this may be due in part to their anxiety in the unfamiliar field environment, the FSS interface's lack of intuitiveness played a role in their decision to use other tools. Especially, the interface for taking pictures and writing notes needs to be improved.

4 Conclusion

For fieldwork in group work in the context of PBL, we proposed the FSS. The FSS was constructed to use a combination of portable terminals during the students' time in the field and a Web-based management application upon their return. We also described a practical experiment on the use of the FSS in PBL, in which students were asked to explore local communities of Nishikyo ward. The results of a posterior questionnaire showed that the students enjoyed being able to view their current locations and the locations of data they had collected on the FSS terminal map. However, they had complaints about the user interface. In particular, they requested fewer steps to take pictures or notes. They also expressed concerns about the accuracy of the GPS sensor.

In our future work, we will improve the usability and user interface of the FSS. We will develop the camera module and add a function for students to adjust the location value of data on the map. We will also explore the FSS usability for teachers in future investigations.

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