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Examination of the Learning Effects of Creating Disaster Prevention Maps Outdoors Using ICT Devices as a Learning Activity

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Abstract: In this study, we conducted a learning activity with high school students on creating disaster prevention maps using tablet devices, in order to improve learners' awareness of disasters through experiential activities. The learners moved around outside the school premises and recorded locations such as dangerous places, evacuation sites in the area, and useful facilities for disasters in the disaster map creation support system. They then learned about local characteristics and disaster preparedness through classroom activities that used the information they had gathered. It was confirmed from the learning records that the students recorded freely at various places within the learning area. Those who used the system frequently evaluated their operation experience positively. A subjective survey revealed that the learner's awareness of disaster prevention, and their understanding of the area where they live, changed following the learning activities. The students who participated in the learning activity by actively using the system had a better learning experience, and could better understand local characteristics.

Keywords: Disaster prevention, mobile learning, classroom practice

1. Introduction

Disasters occur frequently in Japan, making it important to prepare for disasters on a daily basis. Disaster prevention education is being implemented in various environments, including schools. Experiential activities are one way for students to actively participate in disaster prevention learning. Most experiential activities are classified into Local and Individual activities according to the Global-Local-Individual (GLI) model of disaster prevention education (Mitsuhara, 2018). However, because the number of hours of safety education is limited in school environments in Japan, many of the basic contents regarding disasters are classified into the Global activities. For example, according to a survey conducted by the Shizuoka Prefectural Board of Education, in addition to evacuation drills, most of the activities implemented as disaster prevention education are limited to lectures on disaster prevention.

We focus on creating disaster prevention maps as a hands-on activity. This corresponds to the Local activities, and is implemented to create knowledge of general disasters that is specific to the region. The creation of disaster prevention maps has been adopted in local communities. In recent years, there have been some practical cases of disaster prevention education using Information Computer Technology (ICT) (e.g., Okazaki et al., 2016). However, there few studies have focused on learning effects.

2. Objectives

In this study, we examined the learning effects of disaster prevention learning, incorporating disaster prevention map creation. Learners learned local disaster prevention knowledge through disaster

prevention learning. We expected this to increase learners' regional understanding and awareness of disaster prevention. Through questionnaire surveys, we will examine how the understanding and awareness of learners have changed.

As a specific learning content, we conducted lessons themed on creating a disaster prevention map, following an assumed earthquake. Records of information gathered in the area were collected on a disaster prevention map using a learning support system. The map was used for reflection, based on the records and the learners' experiences.

3. Methods

A disaster prevention map is a collection of disaster prevention information presented as a map. There are no rules regarding the information that can be included, but it often includes dangerous places, evacuation sites, facilities, and useful articles. In this study, we aimed to improve learners' local understanding and disaster prevention awareness by getting them to create disaster prevention maps.

In this study, we incorporated "Town Watching" (Shaw and Takeuchi, 2009) into disaster prevention learning, and created a disaster prevention map through outdoor activities. Small group activities are desirable when learning outdoors. In this case, the information collected and recorded by each group needed to be aggregated and shared, which could be done smoothly using a system that supports learning through creating disaster prevention maps. The local understanding of learners was promoted by reflection learning activities using an integrated disaster prevention map.

To realize these learning activities, we used a system, "Sonael," that supports the creation of disaster prevention maps (Hatakeyama, Nagai and Murota, 2017). Sonael is a client application that runs on Android devices. The recorded information is collected on a dedicated online server. The aggregated information can be viewed via a browser, and via the client application.

4. Classroom Practice

We conducted five classes at prefectural high schools in Chiba Prefecture from September to November 2018. Classes were conducted as a unit of comprehensive class time for first-year high school students (96 students in 4 classes). The students were divided into a total of 34 groups of around 3 people, and the home-room teachers taught each class.

4.1 Learning Basic Knowledge

At the beginning of a series of classes, students learned basic knowledge about earthquake disasters (Global activities). They watched video footage detailing the damage caused by earthquakes and the characteristics of their region. They learned about disasters in the area around the school using an original textbook, which compiled information such as past regional disaster cases and hazard maps.

4.2 Outdoor Learning Activities

Outdoor learning activities were twice conducted for each group in the area around the school. Each group was lent one Android device and one portable Wi-Fi source, so that Sonael could operate outdoors. We decided to leave and then return to each school carrying a terminal with each group. We used a different area for the second outing to prevent repetition.

The school in question is located in the Uchibo district of Chiba prefecture, Japan. We set up a learning area that the students could return from within the time period of one class. In Sonael, information can be inputted as three classes: "dangerous place in case of disaster," "useful place in case of disaster," and "other." The students were instructed to move freely within the area and record what they noticed in the event of an earthquake disaster in three categories.

4.3 Reflection Learning Activities

The records of outdoor learning were collected for each class, and reflection learning activities were conducted after each outdoor learning activity under the initiative of the homeroom teacher. Each group was lent Android devices so they could view the records collected by Sonael. The teachers explained that the regional features that could be understood from records and outdoor activity experiences using group-specific worksheets.

At the second reflection learning, the students played a paper-based simulation like Disaster Imagination Game (DIG, Komura and Hirano, 1997), corresponding to the Individual activities. Based on the assumptions of disasters in the area, students were asked to consider what actions they should take based on the regional features and specific places that they had recorded. They then held group discussions and each group gave presentations.

5. Results

5.1 Records of Outdoor Learning Activities

In total, 364 records were collected in the two outdoor leaning sessions, including 163 dangerous places at the time of a disaster, 138 useful places at the time of a disaster, and 63 others. The results are shown in Figure 1. These records include duplication of the same object because fieldwork and recordings were done for each group. It is important to discuss ways to measure aspects of disaster situations that cannot be assumed. The field of disaster prevention must value diverse viewpoints because there are no certain answers for protecting against disaster. Therefore, these records did not make judgments about the levels of importance and validity.

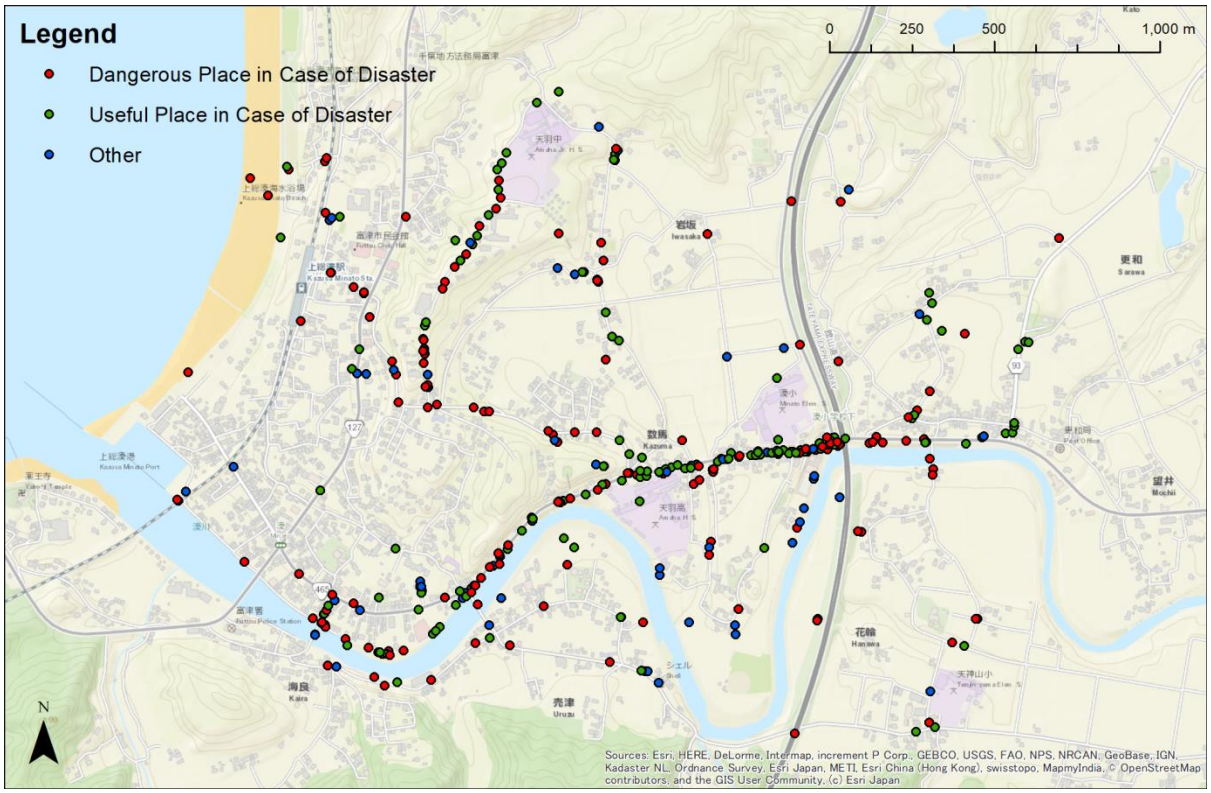

Figure 1. Distribution of Records in the Learning Area.

5.2 Subjective Survey

Subjective surveys were conducted before the first class and after the last class. In the questionnaire, 10 items related to disaster prevention awareness were set, with reference to the supplementary book on

disaster prevention education published by the Tokyo Metropolitan Board of Education (2017): Yes (1 point), No (0 points). The total scores (up to 10 points) were prepared as a disaster preparedness score. T-tests revealed a significant difference between the two surveys.

The 6 items related to local understanding as a learning objective and self-efficacy during disasters were set originally. The items corresponding to imagination during disasters are from Shimazaki and Ozeki (2017). In all cases, the answer was based on the six-point scale. There were significant differences in all items, as shown in Table 1.

Table 1

*Subjective Survey Before and After Learning (M : Arithmetic Mean, S.D. : Standard Deviation, ** : p < .01)*

	N	Before		After	
		M	S.D.	M	S.D.
Disaster Preparedness Score					
Total score**	81	3.33	2.608	4.28	2.972
Learning Objectives and Self-efficacy					
A. I can explain the geographical features of the school. **	84	2.48	1.359	3.85	1.256
B. I can specifically explain the damage that may occur around the school when an earthquake occurs. **	83	2.66	1.337	3.90	1.144
C. I can specifically explain disaster preparedness around the school. **	84	2.21	1.152	3.81	1.146
D. I think I can judge dangerous places by observing the surroundings when a big earthquake occurs. **	82	3.26	1.225	3.95	1.121
E. There is a specific image of what actions I should take when a disaster occurs. **	83	3.22	1.105	3.93	1.187
F. There is a specific image of what happens to the town when a disaster occurs. **	82	2.95	1.304	3.82	1.287

After each outdoor learnings, the operability of the app was rate on a six-point scale. The first score was 3.75 and the second was 3.94.

6. Discussion

6.1 System Evaluation

The Sonael system used here was modified to record information more freely. The records are spread throughout the learning area, centering on the school, as shown in Figure 1. In particular, many places tended to be recorded along the main street that would be used for evacuation.

The operation evaluation of the Sonael system was similar in the two field studies. As only one device was lent per group, teachers advised students to use them evenly. However, the time using the system in the learning activities varied per member. We classified students into one group that frequently used the device, and was another that did not, based on students' self-evaluations. Table 2 shows the average evaluations of frequent users was highest in both the first and second survey in both cases. The users who did not use the device frequently could not evaluate the system.

Table 2

Operation Evaluation of the Sonael System

	Frequently used			Not frequently used		
	N	M	S.D.	N	M	S.D.
The application was easy to operate. (first)	31	4.26	1.182	60	3.48	1.420
The application was easy to operate. (second)	45	4.53	1.100	43	3.33	1.322

6.2 Disaster Awareness, Self-efficacy, and Imagination

Learners' awareness of disaster prevention improved through disaster prevention learning, as shown by our subjective survey. In addition, changes occurred in their local understanding, self-efficacy, and imagination at the time of disaster.

To discuss this difference, we again classified students into two groups based on how frequently they used the system. We calculated the average self-evaluation scores in the two outdoor learning activities and compared them between a group larger than the average (3.5) on the 6-point scale, and a smaller group. In addition to the items shown in Table 1, a learning experience evaluation item was also added to the analysis; the results are shown in Table 3. The evaluation of the group using the system frequently was high for every item. There were significant differences between the two groups for items A-C, and for learning experience. This shows that students who actively used the system during the activity had a better learning experience and, could better understand local characteristics. Learners who used the system frequently seem to have verbalized what they saw and thought by recording information in the system. It is suggested that active participation in learning activities led to improved awareness. However, there was no clear difference in self-efficacy or imagination. Creating disaster prevention maps encourages students' local understanding about the Local activities. It may not have promoted the learning activity as an Individual activities, to help students to foster disaster awareness for themselves. We approached linking learning from the Local activities to the Individual activities using reflection learning activities, but we think that the content for this approach needs to be reexamined.

Table 3

*Subjective Survey After Learning Grouped by the Usage of Self-Evaluation (** : $p < .01$, * : $p < .05$)*

	Frequently used			Not frequently used		
	N	M	S.D.	N	M	S.D.
Learning Objectives						
A. I can explain the geographical features of the school. **	28	4.39	1.100	43	3.37	1.215
B. I can specifically explain the damage that may occur around the school when an earthquake occurs. **	28	4.50	1.036	43	3.42	1.139
C. I can specifically explain disaster preparedness around the school. *	27	4.04	1.055	43	3.44	1.181
D. I think I can judge dangerous places by observing the surroundings when a big earthquake occurs.	26	4.15	1.223	43	3.58	1.139
E. There is a specific image of what actions I should take when a disaster occurs.	27	4.00	1.109	43	3.58	1.277
F. There is a specific image of what happens to the town when a disaster occurs.	27	3.89	1.281	42	3.55	1.400
Learning Experience						
I enjoyed a series of learning activities for disaster prevention. *	26	4.85	1.255	43	4.05	1.214

7. Conclusion

Various disaster prevention education efforts are being carried out at school environments. However, few studies have focused on disaster prevention learning effects using ICT. In this paper, we held a disaster prevention learning activity themed on earthquake disaster prevention at a high school, using a tablet device. The purpose of this learning was to deepen regional understanding and raise disaster prevention awareness, using learning disaster prevention knowledge that matches the region. The learners used "Sonael" to record and collect information outdoors.

The students freely recorded at various places within the learning area. The learners who used the system frequently rated their operation experience of the application highly in both the first and second outdoor activities. Subjective surveys recorded students' awareness of disaster prevention and improvement of local understanding before and after the learning activities. The students who actively used the system had a better learning experience, and could better understand local characteristics. However, it is possible that students did not reach the level of thinking of disaster as oneself, because the reflection learning activities were insufficient. Based on these, future studies are needed to guide class design, especially regarding reflection learning activities to lead more effective learning activities.

In this study, only the self-assessment from the questionnaire survey was considered. However, these questionnaire surveys are not sufficient for describing participants' disaster comprehension. It remains a challenge for future research to analyze the records and learning logs to confirm that the learner properly understood the regional features through the learning activities properly.

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