Using an Outdoor Mapping Activity to Understand Geographical Features from the Perspective of Disaster Prevention

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Abstract: Preparing for natural disasters requires disaster awareness as well as disaster knowledge. An understanding of areal geographical features is necessary to prevent damage specific to a region. A study was conducted to examine the change in students' awareness and understanding of local features through an activity of creating a disaster prevention map, a method commonly used in disaster prevention studies. The learners' awareness of disaster prevention and understanding of local features was enhanced through the learning activity. The results revealed that proactive learning was effective in helping students understand the features of the region. The creation of a disaster prevention map with field observation activities showed that general knowledge was transformed into local knowledge. To investigate the effects of a disaster that had occurred before the study, we examined the change in disaster preparedness awareness among the learners. The results showed a change in disaster preparedness awareness among the groups less affected by the disaster.

Keywords: education for disaster prevention, geographical features, earthquakes, mobile learning, classroom practice

1. Introduction

Japan is impacted by various natural disasters that occur every year in different parts of the country. To prepare for these disasters, it is necessary to acquire disaster prevention knowledge. Earthquakes are an example of a disaster that can occur throughout Japan. Earthquakes cause various kinds of damage. In addition, personal circumstances such as risk perception and experience also emerged as significant factors related to damages of earthquakes. We focus on the areal environment and geographical features. For the purposes of this paper, we use the term "geographical features" as localized knowledge of the environment within the region based on topographical and geological conditions. Landslides in areas with high elevation changes and slopes, and tsunamis in areas near the sea, are some examples of geographical features that can be used to predict damage and provide information on disaster prevention.

Regional studies are widely used in the field of education to understand the features of a region, including its geographical features. This includes town-watching activities (Shaw & Takeuchi, 2009), in which people walk around an area and observe it. In addition, the results of these activities are widely used to create "disaster prevention maps" focusing on the hazards and preparedness in the community from the viewpoint of disaster prevention. We have been focusing on this learning activity of creating disaster prevention maps in combination with outdoor learning in students' classes (Hatakeyama, Nagai, & Murota, 2017, 2019). These studies show that learners' awareness of disaster prevention is enhanced through learning activities that include the creation of disaster prevention maps.

2. Objectives

In this paper, we examine whether regional learning outdoors that incorporates disaster prevention mapping can help learners understand geographical features.

The theme of the lesson was understanding the preparedness for an earthquake disaster in the area. Learners created a disaster prevention map through a town-watching activity outdoors. They recorded the information they observed in the field into a system that supports the creation of disaster prevention maps. The recorded information was used for a review based on the learners' knowledge and experiences. The system, which works on tablet devices, supports the creation and sharing of disaster prevention maps as a result of students' activities. Through this practice, we examined changes in the learners' awareness and understanding of geographical features.

3. Classroom Practice

3.1 General

In this study, we conducted a class over three sessions at a high school in Chiba Prefecture from October to November 2019 (Table 1). We used the "Sonael" system (Hatakeyama, Nagai, & Murota, 2014) to create disaster prevention maps using tablet devices, which is based on the "FaLAS" system (Hatakeyama, Nagai, & Murota, 2019). The target subject was 88 students from four first-year high school classes. The classes were conducted during the same period for the entire school grade as part of a period for inquiry-based cross-disciplinary study. The homeroom teacher taught each class, and students were divided into groups of three or four for class participation.

Chiba Prefecture, where the school was located, was hit by Typhoon No. 15 in early September 2019. Due to storm damage and extensive power outage, the school was closed for few days and thus, the timing and content of the class were revised in consultation with the school. For example, the second outdoor learning activities which were originally planned for the fourth session based on reflection learning activities were canceled as sufficient time could not be allotted for them.

Mitsuhara (2018) proposes three layers of learning for disaster education: Global for basic learning, Local for authentic learning, and Individual for personalized learning. This Global-Local-Individual (GLI) model shows how learning changes depending on the content addressed in disaster education or learning. We designed each unit of the class according to the GLI model. The learning consisted of three activities: basic knowledge learning in the classrooms, an outdoor learning activity in groups, and reflection in the classrooms using the students' records and experiences.

Table 1. *Outline of the Classroom Practice*

	Learning Objective	Contents
10/10	Learning Basic Knowledge	Watched a video, received a lecture, and study using the worksheet
11/7	Outdoor Learning Activities	Recorded what they observed in the system
11/14	Reflection Learning Activities	Reflected and discussed about areal geographical features using their records

3.2 Learning Basic Knowledge

Basic knowledge of earthquake hazards and areal features was taught on October 10 to learn the global layer in the GLI model. Learners watched a video presentation on the damage caused by earthquakes and the classroom features in the classroom. The homeroom teachers provided an overview of the school area's disaster using our original booklet and explained the importance of protecting oneself and thinking about a disaster as one's own affair, using the typhoon that had just hit the area as an example.

As a learning activity, students learned to predict the risks of earthquakes using the hazard prediction worksheet. Figure 1 shows the worksheet that presented the hypothetical situation. The illustration was quoted from a learning resource by the Yamaguchi Prefecture Board of Education (2017). The learners annotated the predicted danger on the picture in the worksheet and wrote some comments about the risks. In this activity, they confirmed their global knowledge (knowledge that is not limited to the area).

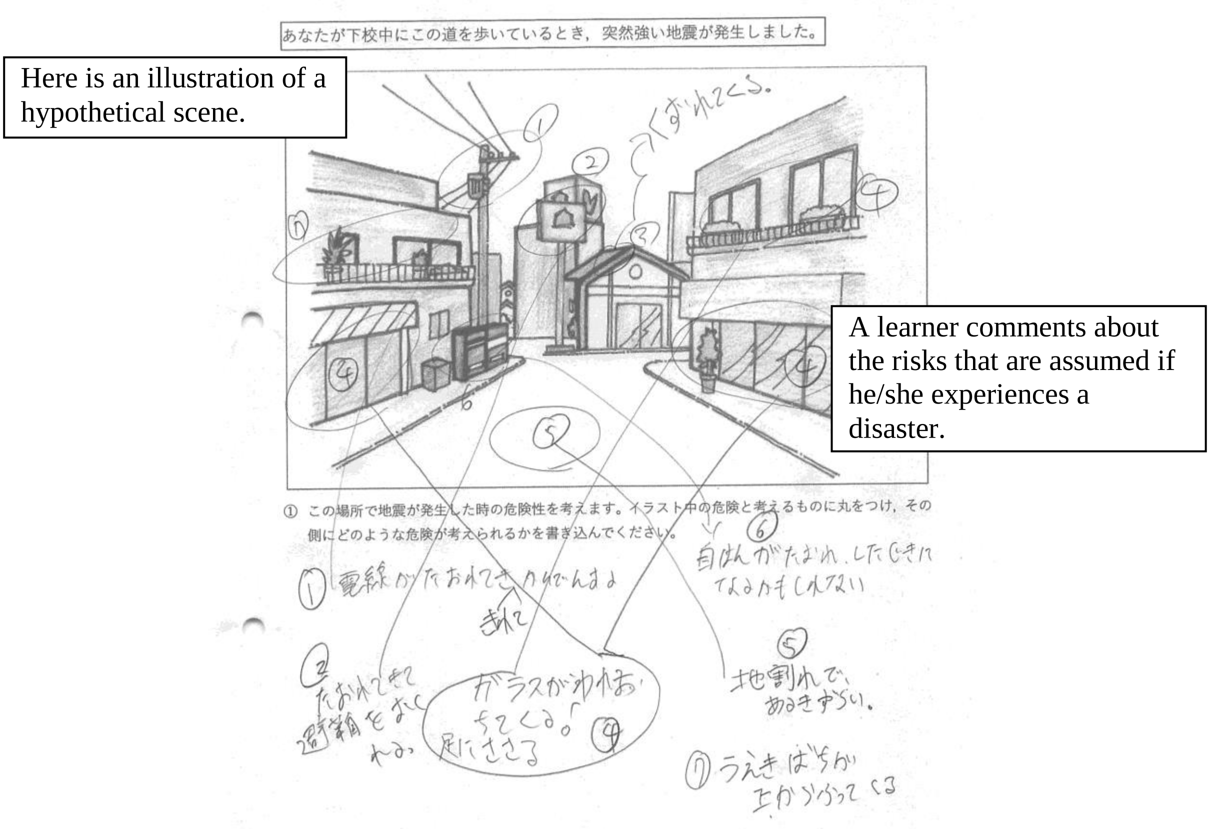

Figure 1. An example of worksheets annotated by learners

3.3 Outdoor Learning Activities

As part of the local learning layer in the GLI model, we conducted a group study of the area on November 7. The target area was 2.5 km east-west, and 1.5 km north-south, centered on the school. Each group was provided with Android tablets so that they could use the Sonael system outdoors. The tablets were connected to the server through portable Wi-Fi.

The students departed the school, learned in groups, and returned to the school. The system records three categories of information: “dangerous place in case of a disaster,” “useful place in case of a disaster,” and “other.” The teachers instructed learners to move freely within the area and actively record what they noticed in the three categories referring to an earthquake disaster event.

3.4 Reflection Learning Activities

The homeroom teachers led the reflection learning on November 14. Each group was provided with an Android device to review records of their fieldwork. The records had been aggregated by class. Each group used a worksheet to organize records that indicated local geographical features or preparedness for an earthquake disaster from their records and experiences of outdoor activities.

4. Results

4.1 Records of Outdoor Learning Activities

The learners submitted 88 hazard prediction worksheets on the first day, and the responses included a variety of hazards; some comments are considered to be less valid as the respondents are not experts on earthquake disasters. However, we decided not to make a judgment on their validity as these are assumptions that the respondents had considered. The most common risky items listed in the picture were "telephone poles," "signs," and "building windows." In all, 126 records were reported from the field study: 84 were dangerous, 29 were useful in the case of a disaster, and 13 were other. The most frequently used words in the record descriptions were "evacuation," "earthquake," and "possible." Some words related to typhoon damage such as "blue tarp" and "typhoon" were also recognized.

4.2 Subjective Survey

The first questionnaire was administered at the beginning of the first class on October 10, and at the end of the class on November 14. Table 2 reports the results. The questionnaire was based on a supplementary book on disaster prevention education published by the Tokyo Metropolitan Board of Education (2017). We calculated a disaster preparedness score (out of 10), with a score of 1 for yes and 0 for no. In all, 71 learners responded to the items related to disaster preparedness in the two surveys. We conducted a one-factor analysis of variance with correspondence to examine if their scores differed before and after the study; a significant difference was found ($F(1,70) = 10.846$, $p = .002$).

We set up three items asking about the understanding of local geographical features with a 6-point scale. We checked whether these questions differed before and after learning by a one-factor analysis of variance, and they were all significant: ($F(1, 76) = 29.554$, $p < .001$; $F(1, 76) = 23.614$, $p < .001$; $F(1, 76) = 61.392$, $p < .001$).

Table 2. *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**	71	4.30	2.509	5.69	3.671
Learning Objectives for Geographical Features					
A. I can describe the geography of the school's surrounding area in detail.**	77	2.56	1.241	3.52	1.294
B. I can describe the damage that may occur in the area surrounding the school as a result of an earthquake in detail.**	77	2.82	1.335	3.75	1.319
C. I can explain how to prepare for disasters in the area surrounding the school in detail.**	77	2.30	1.014	3.49	1.253

5. Discussion

5.1 Disaster Awareness

A significant difference in disaster prevention awareness was found before and after the learning. We set the items in a pre-study subjective survey to determine the impact of a recent typhoon on the area. In all, 84 learners reported the damage over the entire area by the typhoon: power outages (87%), house damage (40%), and water stoppage (19%). Overall, 75 people or 90% of the respondents had been impacted in some way. Power outages and water stoppage had been resolved across the region at the time of teaching the class.

We divided the 71 learners who responded to the two questionnaires into two groups: those whose houses were damaged and those who were considered to be still affected at the time of the class (sufferers of major impacts of the disaster) and those who were not affected at that time (sufferer of minor impacts of the disaster). The results are reported in Table 3. There was a significant difference between the pre- and post-learning disaster preparedness scores for the less-affected group: ($F(1, 41) = 8.899$, $p = .005$). In contrast, no significant difference was found in the group that had faced major impacts: ($F(1, 28) = 2.301$, $p = .14$). There was also no significant difference between the pre- and post-intervention disaster preparedness awareness scores between the groups: ($F(1, 69) = .002$, $p = .97$; $F(1, 69) = .621$, $p = .43$).

Table 3. *Disaster Preparedness Score 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					
Major impact of the disaster	29	4.31	2.551	5.28	3.712
Minor impact of the disaster**	42	4.29	2.511	5.98	3.659

For the group that was severely impacted by the typhoon, it is possible that the disaster's ongoing experience may have made it difficult for them to bring themselves to learn about disaster prevention. As this class was included in the school's annual plan, we conducted it as planned, although the class schedule and number of sessions had to be revised. However, it is important to implement disaster education under conditions that allow learners to engage in disaster management, such as when there is no ongoing impact of a recent disaster.

5.2 Understanding of Geographical Features

There were significant differences between pre- and post-learning on three items related to understanding local geographical features. We analyzed the results to confirm whether this was a positive factor for learning. The relationship between the learners' active engagement and their level of understanding of localness was examined. The groups were divided on the basis of the six-item method's total value asking about their interest and motivation to learn after the study. Learners who were higher than the mean (12.7) were categorized as active, and those lower than the mean were categorized as passive. Table 4 shows the results of a one-factor analysis of variance. A significant difference was found between the two groups for items 1 and 2 and for item 3.

Table 4. *Subjective Survey for Geographical Features Before and After Learning (M: Arithmetic Mean, S.D.: Standard Deviation, **: p < .01)*

	N	Before		After	
		M	S.D.	M	S.D.
Active learner					
A. I can describe the geography of the school's surrounding area in detail.**	38	2.74	1.201	4.18	1.205
B. I can describe the damage that may occur in the area surrounding the school as a result of an earthquake in detail.**	38	2.97	1.423	4.37	1.172
C. I can explain how to prepare for disasters in the area surrounding the school in detail.**	38	2.42	1.004	4.08	1.282
Passive learner					

D. I can describe the geography of the school's surrounding area in detail.**	38	2.42	1.266	2.87	1.044
E. I can describe the damage that may occur in the area surrounding the school as a result of an earthquake in detail.**	38	2.71	1.228	3.13	1.189
F. I can explain how to prepare for disasters in the area surrounding the school in detail.**	38	2.21	1.018	2.92	.941

Learners who actively engaged in the learning process were able to deepen their understanding of the region's features and the expected damage in the region through learning compared to those reluctant to learn. The school is in the Uchibo region of Chiba Prefecture, close to the sea, but is characterized by large topographical differences. In the first worksheet, we considered general hazards not limited to the region as a global learning activity. In contrast, in the field activity, we considered hazards specific to the region. One consequence of this is that the content of the worksheets differed from the content described in the records in an actual field activity. It is possible that these worksheets could have been converted to more localized knowledge of geographical features by observing what was actually localized and what was in the area.

In addition, the worksheets conducted in the reflection session also indicated that learners were able to think about the region, suggesting that lesson design that links global knowledge to local learning is useful in understanding localities.

6. Conclusion

In this paper, we conducted an experiment to examine how the learners' awareness of disaster prevention and their understanding of the regional geographical features were changed by creating disaster prevention maps, a method commonly used in disaster prevention learning. The results showed that learners' awareness of disaster prevention awareness and their understanding of geographical features was enhanced.

Regarding the understanding of local features, the results showed that proactive learning was effective. It was also observed that general knowledge was transformed into local knowledge through fieldwork activities like town watching. To increase the effectiveness of the class, it is necessary to devise a way to make the learners more proactive in learning.

Concerning the typhoon that occurred just before the study, we examined the change in students' awareness of disaster prevention. A change in disaster preparedness was observed in groups less affected by the typhoon. This suggests that it is important not to evoke more disaster experiences than necessary to implement disaster reduction education.

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