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Analysis of the Effectiveness Provided by a Learning Environment for Community Disaster Prevention: A Case Study of Practice in the Nishikino Area of the Town of Kuroshio, Kochi Prefecture

Wataru Omoto[1*] and Takashi Sugiyama[2]

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Abstract This study aimed to analyze the key factors that facilitate discussion of vehicle tsunami evacuation from the perspective of learning-environment design. Specifically, a banner was created for guidance on vehicle evacuation in the Nishikino area of the town of Kuroshio, Kochi Prefecture, Japan. The activity led to progress in the discussion, such as about drills being conducted in the community. A questionnaire survey was then conducted to identify key factors. As a result, the impact of each element was identified based on the four aspects of learning-environment design. In this practice, the discussion seems to have progressed as a result of the improved balance among various aspects of the learning environment.

Keywords: vehicle tsunami evacuation, disaster-prevention education, learning-environment design

1. RESEARCH BACKGROUND

This section explains the research background, defines the term “learning-environment design,” and outlines the research approach in this paper.

1.1 Status of Vehicle Tsunami Evacuation

In recent years, disasters have been causing increasingly more damage all around the world, and consequently, there has been an increased demand for countermeasures. In particular, in

[1] Graduate School of Integrated Frontier Sciences, Kyushu University, Japan
[2] Faculty of Human-Environment Studies, Kyushu University, Japan
* Corresponding author email: omoto.wataru.038@s.kyushu-u.ac.jp

2011, the Great East Japan Earthquake and tsunami caused significant damage and affected policies for future countermeasures in Japan. From the experience of the Great East Japan Earthquake, it became clear that not only is there a risk of secondary disasters caused by vehicle evacuation, but also that the necessity of using vehicle evacuation remains. In response to this disaster, the international framework for disaster response was also established. At the United Nations World Conference on Disaster Reduction held in March 2015, the "Sendai Framework for Disaster Reduction," which set policies for future measures, was adopted (Sakurai et al., 2016). Certainly, it is important to establish such a framework, but in this case, the issue of "vehicle tsunami evacuation" is not discussed in detail. Therefore, it is necessary to discuss this issue additionally and the present study aimed to examine "vehicle tsunami evacuation" under such a disaster management plan.

In Japan, "vehicle tsunami evacuation" has not been recommended, mainly because it involves the risk of secondary disasters. For example, it has been pointed out that large-scale vehicle evacuation can cause traffic jams and interrupt the movement of large numbers of people, including those evacuating on foot. Therefore, people have been encouraged to evacuate on foot, except in situations when they can evacuate smoothly or where pedestrian and vehicle paths are separate.

However, some people still choose to evacuate by vehicle. For example, after the 2011 Great East Japan Earthquake, many people were caught in the subsequent tsunami because of the traffic congestion caused by evacuating vehicles (NHK WORLD-JAPAN, 2024; Asahi Shimbun, 2011). However, interviews with individuals who had attempted to evacuate by vehicle revealed reasons such as "I thought I would not make it if I walked" and "I used the vehicle to support others in evacuating" (Cabinet Office, 2012). Similarly, in 2024, the Noto Peninsula earthquake caused traffic congestion, but some people were found to have been saved owing to the use of a vehicle (Yomiuri Shimbun, 2024). These reports imply that it is necessary to remind people of the advantages of vehicle tsunami evacuation.

The benefits of vehicle tsunami evacuation can be divided into two main categories: "during evacuation" and "after evacuation." Owing to its quick mobility, the first benefit of vehicle tsunami evacuation is that it can assist evacuees with walking difficulties due to aging or physical disability during an evacuation (NHK Archives, 2019). The second benefit, advantages after evacuation, includes being able to use the space inside the vehicle and, especially in the case of electric vehicles, being able to use the car batteries. Due to this balance of advantages and risks, vehicle tsunami evacuation is being considered by increasingly more communities in Japan (Asahi Shimbun, 2023; Yomiuri Shimbun, 2023). However, to date, few regions in Japan have implemented vehicle tsunami evacuation plans.

1.2 Issues in Promoting Consideration of Vehicle Tsunami Evacuation

The first issue associated with vehicle tsunami evacuation is that region-specific plans need to be implemented. For example, in Japan, based on past experiences such as the Great East Japan Earthquake, it is generally not recommended to use vehicles when evacuating.

Specifically, this is because traffic jams caused by vehicles during disasters have prevented many people from evacuating. Therefore, it is important that the introduction of vehicle tsunami evacuation be not only considered a top–down operation by the government but also implemented bottom-up for each area so that local conditions can be considered.

The second factor is the cost of hardware measures. For example, it is important to promote discussions starting with local stakeholders and consider soft aspects such as evacuation plans. On the other hand, problems that are anticipated when vehicles are used, such as traffic congestion, require hardware improvements such as the installation of guide signs. However, because these measures need to be implemented on a large scale, it is difficult to deal with them quickly. In other words, although vehicle tsunami evacuation needs to be considered from both software and hardware perspectives, relevant discussions will likely stagnate, especially in situations where hardware measures are being considered.

The third factor is the lack of a community basis. In each region, including disaster-stricken areas, even if issues related to vehicle tsunami evacuation are identified, it will be necessary for local stakeholders to discuss how to respond to them. However, if no community basis has been fostered in the region, discussions may also stagnate without providing opportunities for meeting and sharing perspectives.

Finally, the reason why discussing vehicle tsunami evacuation is difficult is the fact that it is generally not recommended. For example, it is easy to start discussions on specific measures for evacuation on foot or evacuation shelters because their need is taken for granted. On the other hand, in the case of vehicle tsunami evacuation, people strongly recognize the premise that “it should not be used.” However, in the event of an actual disaster, they feel the need to use it and end up doing so.

These factors are causing delays in the consideration of vehicle tsunami evacuation in Japan. Therefore, it is implied that measures will not progress unless the necessity of such measures is thoroughly discussed in advance and the understanding of vehicle evacuation in each region is properly organized. Based on the above, various factors can lead to the stagnation of discussions by local stakeholders, and a major issue in facilitating consideration is support in a format suitable for such factors. Accordingly, this study aims to address this issue by using a “learning-environment design” approach. The next section describes the characteristics of this study in comparison with previous studies.

1.3 Characteristics of “Learning-Environment Design”

In previous studies on vehicle tsunami evacuation, Hasegawa and Takabatake (2024), Takabatake et al. (2020), Kameda and Takahashi (2017), and Kansha et al. (2012) developed a tsunami evacuation model that considers both pedestrians and vehicle evacuees and studied planning for vehicle tsunami evacuation using simulations. In a similar study, Nishihata et al. (2012) and Fujiu et al. (2016) conducted simulations to examine the impact of vehicle congestion on on-foot and vehicle evacuees. Next, Kawai et al. (2022) conducted a survey of vehicle tsunami evacuation for the 2021 earthquake in Miyagi Prefecture and verified the needs

for vehicle usage and assumed damage in the case that on-foot evacuation is facilitated. As a similar example, Fujiu et al. (2022) conducted simulations on appropriate introduction methods based on a survey of the actual status of vehicle tsunami evacuation for the Great East Japan Earthquake in 2011. Sekiya (2012) also conducted a study focusing on the soft aspects of disaster preparedness in Japan, and during his analysis of escape delays, mentioned people's awareness of vehicle tsunami evacuation and their need for it as a realistic means of evacuation. In another example, Terumoto (2015) proposed a basic draft policy for tsunami evacuation measures through workshops in the town of Minabe, Wakayama Prefecture.

As described above, previous studies supporting the study of vehicle tsunami evacuation in various regions include case studies focusing on simulation-based evaluations, surveys of the actual conditions during disasters and residents' awareness, and support through workshop-style activities. On the other hand, there are currently no examples of proposals based on learning environment design for community disaster prevention measures, such as the vehicle tsunami evacuation plans discussed in this study. However, as Lave and Wenger (1991) point out, considering that learning environments can be applied to various communities of practice in society, it is suggested that it would be useful to consider disaster prevention activities in local communities from the perspective of learning environment design.

In addition, the previous study by Omoto and Sugiyama (2024) supported the consideration of vehicle tsunami evacuation from the perspective of "participatory design" to promote discussion. Based on the results, this study applies the perspective of learning environment design to develop further consideration. For instance, participatory design-based analysis has been effective mainly in practices that design elements of the physical environment. On the other hand, learning environment design enables analysis of the whole environment, including the design of the social environment.

Especially, the advantage of using learning environment design is that it can suggest a framework for discussion. Specifically, by analyzing various local practices from common perspectives such as "space," "artifact," "activity, and "community," it is possible to organize the elements that influence the promotion of discussion. Based on these results, it is possible to construct a framework that can be referenced other regions. It is the usefulness of learning environment design. Based on this point, it seems useful to analyze the discussion of vehicle tsunami evacuation from the perspective of learning environment design to create a more effective environment for discussion.

Furthermore, Omoto and Sugiyama (2024) conducted the practical work that preceded the present study, and the present study summarizes the results of continuing the practical work mentioned in that paper. Specifically, activities and surveys conducted after May 2024 have been added, and interviews with officials and the results of vehicle evacuation drills conducted in May have been analyzed as additional data.

Learning-environment design is a literal approach that takes "the environment surrounding learning" as a designable object. This theory is primarily based on "situational cognitive theory" (Lave & Wenger, 1991). One of its characteristics is that it considers learning, an activity that

constitutes knowledge, by focusing on the interaction between people and environments. Yamauchi (2020), a leading learning-environment design researcher, defines the learning environment in terms of four aspects: space, artifact, activity, and community (Figure 1). Space and artifact are classified as “physical learning environments,” while activity and community are treated as aspects of the “social learning environment.” In previous research related to disaster prevention, Nakamura (2017) studied a learning-environment design that enables the continuation of disaster prevention programs in junior high schools. In addition, Mima (2024) and Tsubakimoto et al. (2013) examined learning environments in relation to a variety of subjects, such as the educational use of computers and peer tutoring.

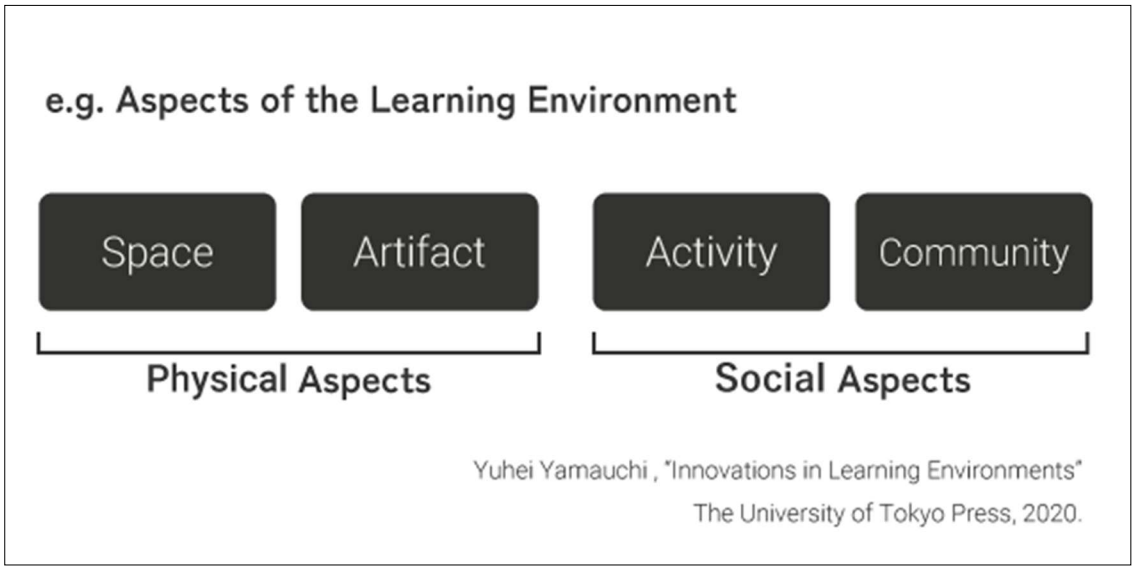

Figure 1. Aspects of the learning environment

As described above, there are a certain number of cases in which the learning-environment design perspective has been applied to disaster prevention efforts, and their usefulness has been demonstrated. In contrast, only a few cases have been reported in which the learning-environment design perspective was applied to the study of vehicle tsunami evacuation. Given this background, the present study aimed to summarize the components of the environment used to study vehicle tsunami evacuation in the community by considering it as a “learning environment for vehicle tsunami evacuation,” and to analyze the requirements for promoting relevant discussions.

As such, the following research question (RQ) was set for this study: “What are the factors that promote the consideration of vehicle tsunami evacuation?” Furthermore, to evaluate the main RQ from the perspectives of “space", "artifact", "activity", and" community” in learning environment design, the researchers set four sub-research questions. Specifically, the following four questions were presented:(i)“What kind of space promotes discussion?”, (ii) “What kind of artifacts facilitate discussion?”, (iii) “What kind of activities encourage discussion?” and (iv) “What kind of community design influences discussion?” To validate these RQ, the next section explains the selection of the target area as well as the survey and analysis methods.

2. RESEARCH METHODS

This section explains the selection of the research participants and the analysis methods.

2.1 Research Subjects and Interview Methods

In this study, the town of Kuroshio (population 9,908 as of November 30, 2024), located on the southwestern coast of Kochi Prefecture, was selected as the target area for considering a learning environment to support discussions of vehicular tsunami evacuation (Kuroshio-Town, 2024). In this area, the massive Nankai Trough earthquake of 2012 caused a maximum seismic intensity of level 7 and a maximum tsunami height of 34.4 m (Cabinet Office, 2012). The Nankai Trough is an area and trench formed by the Philippine Sea Plate to the south of Shikoku and the Eurasian Plate to the north. Figure 2 shows the location of Kuroshio and the Nankai Trough. Since the announcement of this assumption, Kuroshio has been promoting various disaster prevention-related projects, such as the construction of tsunami evacuation towers and the creation of individual evacuation charts. Consequently, studies have been conducted that focus on relevant efforts in this region (Sugiyama & Yamori, 2020). In the present study, the Nishikino area of Kuroshio (population 685 as of December 3, 2024) was specifically selected as the target area because of these characteristics.

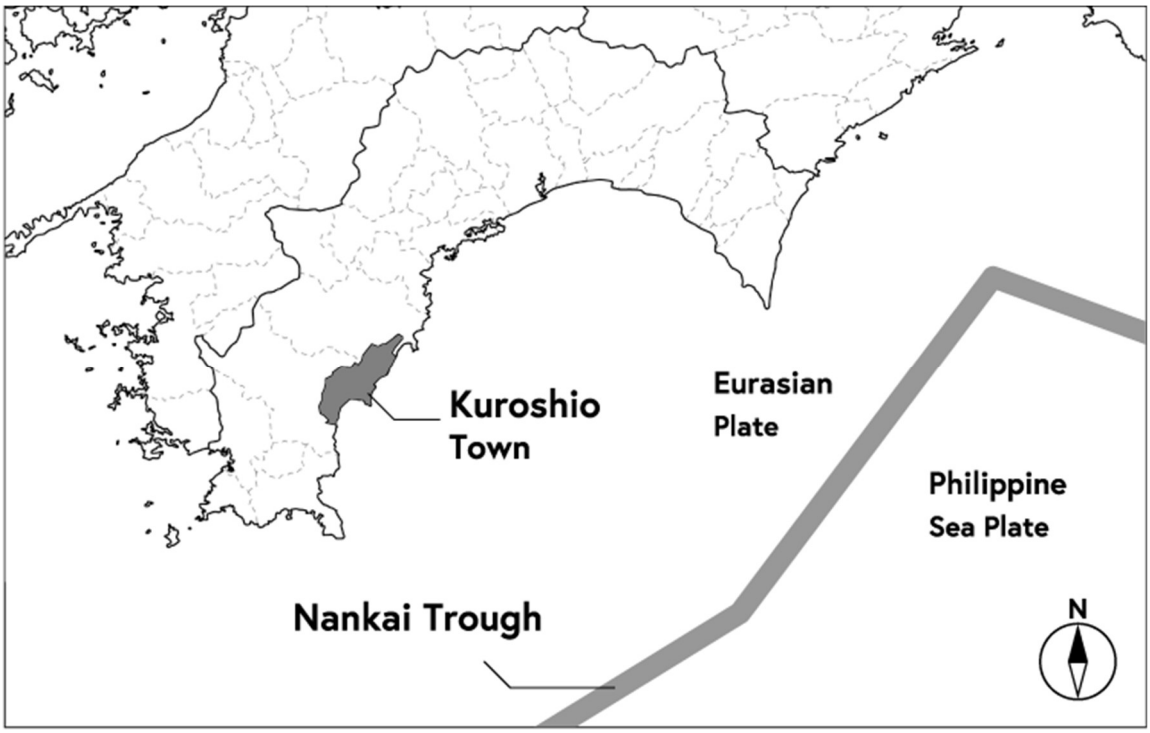

Figure 2. Location of Kuroshio town and the Nankai Trough

The Nishikino area is being studied in regard to “how to solve the traffic congestion caused by evacuation vehicles.” As a background, during the 2014 Iyonada earthquake, vehicles on roads leading to evacuation sites in the Nishikino area caused a number of traffic jams. This was thought to be partially the result of multiple turns on the evacuation route. In essence,

evacuees had to follow the evacuation route to arrive at the evacuation site as quickly as possible. However, when approaching turns in the road, the evacuees became discouraged because of the slow progress and as a result, repeatedly slowed down and changed direction, leading to traffic congestion. Although no significant secondary disaster was triggered at that time in the Nishikino area, the risk of vehicle tsunami evacuation became apparent, and discussions about vehicle guidance during disasters arose. Since that time, in the Nishikino area, community residents and town officials have been continuously proposing countermeasures through discussions, but no concrete measures have been taken. Therefore, this also aims to support the realization of and promote further discussions on the "installation of banners to guide vehicles," which has been proposed as a countermeasure in the area.

Regarding the approach taken for this study, banner production was positioned as a learning opportunity regarding vehicle tsunami evacuation and implemented within the community. For the banner production, "Kochi Prefectural Ogata High School" was selected as one of the collaborators in the Nishikino area because it is located on an evacuation route and expected to operate as a tsunami evacuation site (Figure 3). Ogata High School is the only high school in the area and participates in many community activities. For the present study, among 189 students from April 2024 (93 full-time, 13 part-time, and 83 correspondence course students), 11 who were enrolled in the community creation course were selected as collaborative practitioners. It is because that "the Community Creation Course" is actively involved with community disaster prevention activities, and students in the course build relationships with the community through their participation in these activities. In addition, 11 students had participated in activities for more than one year and would be able to remain active for a certain period in the future.

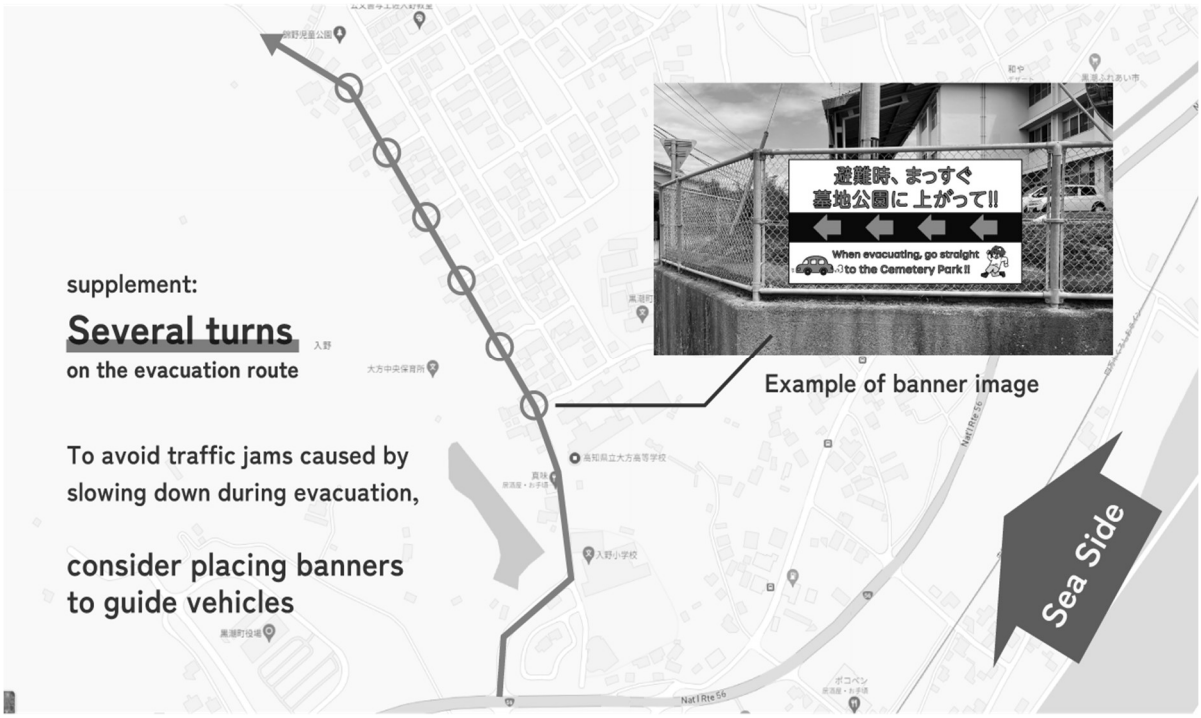

Figure 3. Evacuation routes in the Nishikino area and their associated problems

In this study, these 11 members are referred to as "students" unless specifically noted otherwise. The banner production was planned as part of a class for high school students and carried out in collaboration with the author, high school teachers, residents, and town officials.

2.2 Analysis of the Interview Results

In this study, several surveys, including questionnaires, interviews, and an ethnographic survey, were conducted on the main individuals who participated in the practice banner production. Based on the results, the effects of the banner production on discussions of vehicle tsunami evacuation in the Nishikino area were analyzed, as were the requirements of the learning environment that are important for facilitating discussions in the community.

The first target group consisted of "students." In this practice, students participated in discussions in the community through the banner production process at the request of the authors. Based on this relationship, the present study focused on changes in awareness of vehicle tsunami evacuation during the survey. Specifically, the participants were surveyed using Google Forms before the first class and after all classes, and the results of each class were compared to analyze the changes in the students' attitudes.

The second target group consisted of "high school teachers." As with the high school students, two teachers in charge of the Community Creation Course participated in this project on an ongoing basis at the request of the authors. In addition, the teachers had many opportunities to be involved in discussions on local disaster prevention plans, and their participation included involvement as part of their duties. In consideration of this, the teachers were interviewed to obtain background information on the high school students and their thoughts on vehicle tsunami evacuation, in addition to their evaluation of the high school classes.

The third target group consisted of residents of the Nishikino area. People with an awareness of local issues, mainly wardens and officers, voluntarily participated in classes at the high school and drills in the area. In the survey targeting these residents, reactions to their participation in each practice were collected through questionnaires and ethnographic surveys.

Finally, the fourth target group consisted of "town officials," who have been involved in the formulation of the community disaster management plan and in discussions about vehicle tsunami evacuation in the Nishikino area. They were mainly involved in the current practice as part of their duties, but also took part in classes at schools and drills in the area. In the survey, these town officials were interviewed about the flow of past discussions on vehicle tsunami evacuation, their evaluation of current practice, and their prospects for the future. In conducting this study, the author spent a total of about 156 hours (about 50 days) in the target area for various activities related to the surveys and banner production. In addition, studies have continuously been conducted in this area, and during this process, relationships have been forged with the participants (Yamori & Sugiyama, 2020; Sugiyama & Yamori, 2023). It should be noted that the survey was conducted after building rapport with each subject through these activities.

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In this study, the researchers are conducting various surveys of participants in the field through their participation. Therefore, they have taken sufficient ethical considerations regarding the data collected in the survey, the content of the questions, and the privacy of the survey participants. As an additional note, the ethical considerations of this study are described. This research had been ongoing since the co-researcher was affiliated with an institution with no ethical guidelines established, therefore it had not obtained research ethics reviews. Based on this point, as an alternative measure, this research was planned and conducted in accordance with the ethical regulations of the current affiliated university, such as the "Kyushu University Ethical Guidelines" and the "Kyushu University Regulations on Appropriate Research Activities." For example, the researchers explained this study to the participants before the survey, and made sure they understood they could choose not to participate without any negative consequences, and that their responses would be kept anonymous in any research reports. Based on this, the researchers got their consent before doing the survey.

In the present study, the data obtained through these surveys are analyzed both quantitatively and qualitatively. Specifically, this study conducted questionnaire surveys, interviews, and ethnographic research targeting people who participated in banner production activities. Based on these results, it analyzes the impact of banner production on discussions regarding vehicle tsunami evacuation in the Nishikino area and examines the requirements for creating a learning environment that promotes discussion in the community. To evaluate the production of banners and consider important factors in supporting discussions on vehicle tsunami evacuation, this study applies the perspective of "learning environment design" proposed by Yamauchi (2020) in analyzing the data obtained through the above surveys.

3. FIELDWORK OVERVIEW

This section explains the current practice in the target area, detailing the classes and events conducted during the banner production process, as well as the evacuation drills planned for afterwards.

3.1 Summary of the Banner Production Process

The banner production process was conducted as part of a class at Ogata High School. Table 1 shows the outline of the classes. In the first class, students listened to an explanation of the issues related to vehicle tsunami evacuation in the Nishikino area as a background for the banner production. Next, they thought about the feelings of drivers in order to evoke images of vehicle tsunami evacuation. In the second class and thereafter, the main task was to discuss design plans for the banners. The students created a rough design on paper and then examined how it would look outside to determine areas for improvement, such as font size and color. Figure 4 shows part of the class scene.

Table 1. Outline of banner production classes

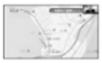
Flow of Banner Production (2023.9.22~2024.5.27)					
Date	Contents	Pictures	Date	Contents	Pictures
2023-09-22 1st activity	Overview of the banner production was given. And developed the image of vehicle evacuation through work .		2024-1-19 6th activity	Based on feedback from the event, students worked with residents to improve their designs for the final proposal.	
2023-10-16 2nd activity	The students were divided into three groups and then drew full-scale designs on model papers.		2024-2-9 7th activity	Students review the banner production, and reconsider the vehicle evacuation.	
2023-11-13 3rd activity	Students displayed their ideas outdoors and evaluated them for visibility and suitability of content.		2024-5-14 8th activity	Students prepared to conduct a vehicle tsunami evacuation drill.	
2023-12-08 4th activity	Students considered points for improvement in their designs and redrew to reflect these points.		2024-5-24 9th activity	A vehicle tsunami evacuation drill was conducted in the Nishikino area.	
2023-12-15 5th activity	Students displayed the banners at school events, and discussed their designs with residents and other students.		2024-5-27 10th activity	A review of the evacuation drill was conducted at the Oogata High School.	

Figure 4. Evacuation routes in the Nishikino area and their problems

Thereafter, three design drafts, which were revised and completed through December, were exhibited at an annual disaster prevention-related event at Ogata High School called “Disaster Prevention Day”. Specifically, these drafts introduced the background and process of the banner creation and displayed three mock-ups with captions. The students, teachers, residents,

and town officials who participated in this event discussed and collected opinions on each proposal. The students used sticky notes and recorded the discussions to collect the opinions

of the participants. More details about the Disaster Prevention Day event and banner exhibition are provided in the following section.

3.2 Discussions Through the Exhibition

During Disaster Prevention Day, various drills based on evacuation center management, such as cooking, dealing with injured people, and setting up “shelter tents,” which are stocked for use as emergency shelters, are conducted at Ogata High School for about half a day. Although the drills are led by students from the high school, the event is open to community residents, town officials, local media, and outside school officials.

Because Disaster Prevention Day is an opportunity for various people from both inside and outside the community to visit the school and discuss disaster prevention, this study planned to exhibit the banner as a project at the event, which was conducted on December 15, 2023, during the banner production period, and facilitate a discussion on vehicle tsunami evacuation. Figure 5 shows a picture of the exhibition. Below, in the figure, each banner is numbered (1), (2), and (3) from left to right. In the exhibition, documents explained the issues related to vehicle tsunami evacuation in the Nishikino area as a background for the banner production, as well as the mock-up of the banners and the captions describing the concept of each banner. Comments on each design were collected in two formats: free-form writing using sticky notes and voting using stickers. As for the purpose of each format, sticky notes were mainly used to collect impressions of each design proposal and specific suggestions for revisions. Sticker voting was also used to select one proposal as the basis for the final banner design, and as a means for participants to share their opinions more easily. Both methods have their own unique functions, but they have the common role of introducing various perspectives into the community by encouraging many people to participate in discussions. On the day of the event, many visitors, including residents, the mayor of the Nishikino area, town officials, and the local media, were in attendance (Kochi Shimbun, 2023; Kochi Prefecture Industrial Education Association, 2023).

Figure 5. A view of the exhibition space displaying 3 banners

Figure 6 shows an image of a discussion with visitors at the actual banner exhibition space. In addition to high school students who did not participate in the banner production, individuals from outside the school also attended the exhibit and shared their opinions using the formats described above. Table 2 shows the final opinions gathered for each proposal and the voting results. The opinions collected through the exhibition at the event were refined into a final draft (Figure 7), which was based on a design drawn on paper, and the data for the printing was created by the author. With the cooperation of the town office, banners (including one signboard) were installed in five locations in the area. The period from the first class to the installation of the banners was about 6 months (September 2023 to March 2024). After the banner installation, practice vehicle tsunami evacuation drills were conducted along the evacuation route in the Nishikino area.

Figure 6. Students discussing with residents

Figure 7. Final version of banner design

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Table 2. Final opinions for each proposal and the voting results

Banner ①：24 votes	Banner ②：8 votes	Banner ③：48 Votes
- The arrows were easy to see. - If you want people to be more aware of the park, why not include some photos of it? - Will only people in cars see this banner? - The messages written in Japanese and English seemed to differ, but is there a risk that foreigners will misunderstand the content? - Elementary school students can't read kanji. - Simplicity is best! - Is it only for adults? I don't think children can read it.	- It's easy for children to understand, too. - It's hard to read because the letters are too close together. - It's not clear what situation you're assuming. - It's certain that making it harder to read might get people to pay attention for longer. However, I think it's a waste of time if it takes them longer to understand. - It has a good fish illustration. - The fish illustrations are cute. - Even if you are only shown this word, it makes people wonder.	- It's easy to read! It's perfect! - It's easy to understand. - The letters are easy to read. - I think the design of this banner is good. But why is the arrow red on a black background? - There is no need to draw so many arrows. - If you put it on the corner of the elementary school, it will be easy to see. - It's hard to understand what situation it's for, why not add words like “in case of evacuation”? - It's easy to read because it's a large size. - It's good that not only the vehicles, but also the pedestrians are illustrated. - It's easy to read. - It is easy to read and understand overall. - Why not change the color of the arrow to green? - The arrows make it easy to understand. - Red on a black background is good. How will it look at night? - The combination of red and black is very striking. - It felt like the target was set very clearly. - It's really easy to read and very good. - It uses colors well, such as black. - It's difficult to see these arrows at night.

3.3 Vehicle Tsunami Evacuation Drills in the Nishikino Area

This section outlines the activities that occurred after the banner installation, mainly a "collaborative drill" in which vehicle tsunami evacuation was tested. This "collaborative drill" is an annual program conducted jointly by four schools in the Nishikino area: Ogata Chuo Nursery School, Kuroshio Municipal Irino Elementary School, Kuroshio Municipal Ogata Junior High School, and Kochi Prefectural Ogata Senior High School. The usual flow of events is to evacuate on foot from each facility to Nishikino Children's Park, which is located on higher ground, based on a common disaster scenario involving the Nankai Trough earthquake. Until 2023, it was assumed that evacuation on foot would be carried out during these drills. However, because of the banner production with Ogata High School and town officials, the parties involved in the discussions decided that a vehicle tsunami evacuation would be attempted in 2024. After repeated discussions with local officials, including high school teachers, it was decided that the residents and town officials would evacuate by car in parallel with the evacuation on foot by the school students.

Subsequently, on May 24, 2024, a combination drill was held with four schools, residents, and town officials. On the day of the drill, those who had to evacuate on foot went to Nishikino Children's Park, whereas those who had to evacuate by car followed the route taken by those on foot and evacuated to the cemetery park, which is located on higher ground. Figures 8 and 9 show actual scenes from drills. After arriving at Nishikino Children's Park, the on-foot evacuees took part in various activities, including listening to comments from local officials and high school students and creating a message with human forming the distress signal "S-O-S." The conduct of such drills was considered to have progressed the discussion of vehicle tsunami evacuation in the Nishikino area.

Figure 8. Vehicles evacuating to the cemetery park

Figure 9. People evacuating to the children's park

For this reason, it investigated what factors were related to banner production and the discussion, and if there was a relationship, what factors influenced the promotion of discussion. The next section describes the impact of the production of the banner and past discussions on the study of vehicle tsunami evacuation in the Nishikino area, based on the results of the survey and analysis of each participant.

4. RESEARCH RESULTS

This section summarizes the results of the questionnaire, interviews, and ethnographic surveys conducted with the participants of the practice drill in the Nishikino area. Table 3 shows an overview of participant involvement in each practice.

4.1 Survey of High School Students

First, this paper describes the results of the surveys conducted with the 11 high school students who participated in the vehicle tsunami evacuation practice in the Nishikino area through the banner production classes. To analyze the changes that occurred in the students through the banner production, a questionnaire survey was conducted during the class process shown in Table 1. In addition to the survey conducted before the first class, a total of eight surveys were conducted after each class. The questionnaires were created using Google Forms, which the students answered from their own tablet computers. The student surveys were based on the present author’s previous paper (Omoto & Sugiyama, 2024).

Table 3. People evacuating to Nishikino Children's Park

	Students	Teachers	Residents	Workers
Past discussions in Nishikino area	Not strongly associated	Not strongly associated	including the mayor of Nishikino area, they had participated in the discussion continuously.	As part of their duties, they had mainly discussed measures for Nishikino area.
Banner production	They played a central role in its production.	They had supported high school students in class.	They participated in some of the classes and had discussions with the high school students.	They participated in some of the classes and had discussions with the high school students.
Disaster Prevention Day	They discussed with visitors as the banner creators.	They participated as the main organizers of the event, and also provided support for discussions by high school students.	They participated in the event and held discussions with high school students.	They participated in the event and held discussions with high school students.
Joint drill	They participated in the drill as evacuees on foot and surveyed evacuation sites.	They participated as the main organizers of the event, and also provided support for discussions by high school students.	Following requests from town office workers and the mayor, they participated in this drill as vehicle evacuees.	They were engaged in discussions from the planning stage, and also participated in the drill as vehicle evacuees.

In this study, the analysis focused on changes in attitudes toward tsunami evacuation as an indicator for analyzing changes in the students. Specifically, changes in attitudes before and after the class were analyzed using the results of the questionnaire from two perspectives: "interest in signs regarding tsunami evacuation" and "degree of consideration regarding vehicle tsunami evacuation."

First, to evaluate the effects of the disaster prevention activities, a questionnaire survey was conducted with high school students, the core participants in the banner production. The questionnaires were collected before and after each activity using Google Forms. For the analysis, the statistical and analytical software HAD was used (Shimizu, 2016).

As an example, this section presents answers regarding interest in tsunami evacuation signs. The questions were rated on a five-point Likert-type scale, and then the answers before the first and after the seventh activity were compared. The analysis included answers from 10 high school students who responded to both questionnaires. For these answers, a Wilcoxon signed-rank test was conducted, with the level of significance set at the 5% level. As shown in Figure 10, a significant difference was found between the two groups ($n = 10$, $Z = –2.240$, $p = .025$). This finding indicates that participation in the activity affected interest in tsunami evacuation signs among the students.

4.2 Survey of High School Teachers

This section summarizes the results of the interview survey conducted with two teachers in charge of the Community Creation Course at Ogata High School. The interview survey was conducted with the aim of ascertaining the reliability of the survey results from the perspective of teachers, as well as to hear what teachers felt as participants in the practice. This interview was conducted for about an hour on February 9, 2024, at Ogata High School. A face-to-face, semi-structured interview method was used. The participants were Teacher P (male, 20s) and Teacher Q (female, 40s), who were overseeing the Community Creation Course at Ogata High School. This section explains the results of the survey for each topic.

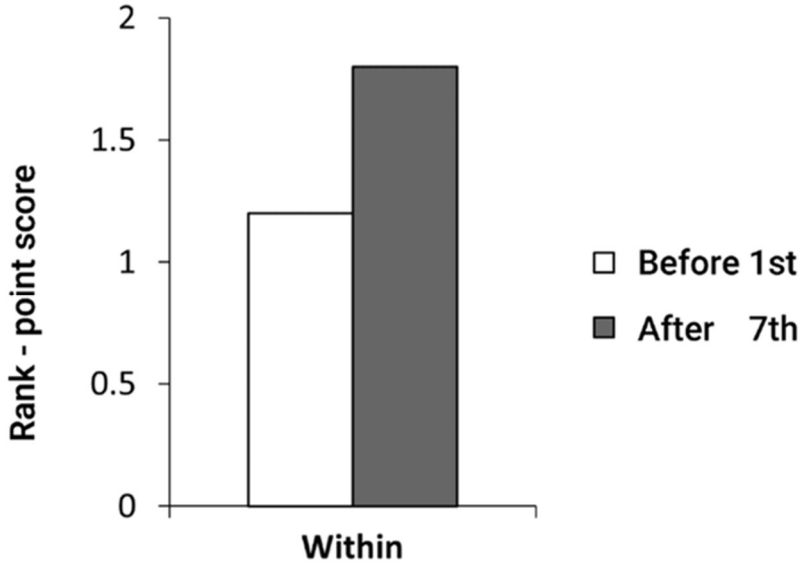

Figure 10. Results of the Wilcoxon signed-rank test

First, Teacher Q gave the following response regarding the class discussion.

Teacher Q:

"For example, when he gave an online class this time, there was a time when he showed us the color of the banner while changing it on the spot. I thought that method was very effective because there are many things you can't understand unless you see them for yourself. The students also saw the banner and said things like, 'Ah, that's it!' or 'Can't we do it like this?' So, I think it was great that he was able to make changes to the banner design on the spot and show us the one that reflected everyone's opinions right away."

This comment refers specifically to the sixth class. For this class, Nishikino area leaders and town officials visited the school and participated in the final plan review based on the opinions collected on Disaster Prevention Day. In addition, the authors participated remotely, using the videoconferencing application Zoom to hold discussions with the people gathered in the high school. Figure 11 shows a scene from the actual class. Inside the classroom, the editing screen for the banner data, which the author was operating, was projected on the screen at the front of

the room. This was intended to support the discussion by sharing the banner reflecting the participants' instructions in real time. From the response of Teacher Q, it was confirmed that the above method, which was planned, was effective for promoting the discussion.

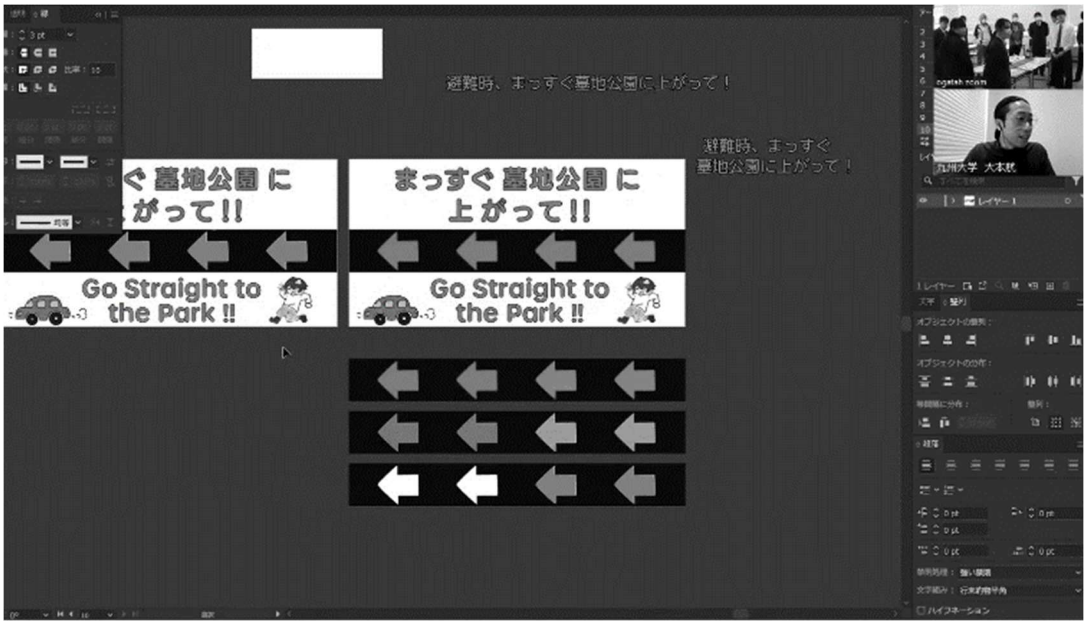

Figure 11. A scene showing the author sharing the editing screen for the banner

In addition, the following response was received from Teacher P regarding the attitudes of high school students toward the banner production.

Teacher P:

"I think the students enjoyed the banner production. For example, there was a group discussing whether to draw a picture of a fish on their banner. That seemed to be an unnecessary and pointless discussion. They also might have been enjoying the discussion as a casual chat with their friends. However, if they had not been taking part in the activity to some extent, that kind of discussion would not have occurred. Based on these points, I think that some if not all of the students enjoyed the production."

This answer is related to the discussion that the high school students had during the banner production process. Specifically, it is related to the discussion about how to utilize the fish illustration that was used characteristically in the design of one of the groups' proposals in the improvement plan while the banner was being produced in three groups. The actual before and after improvement plan is shown in Figure 12. This discussion continued throughout the relevant class. As a result of the revisions, the banner shown on the right-hand side of Figure 12 was completed. If the role of the banner is assumed to be that of only guiding people to safety, it seems that there is no need for this discussion. However, as Teacher P said, the fact that such a discussion occurred suggests that, in some cases, the high school students' active participation in the project was achieved.

As a result of the interview survey of high school teachers, it was found that the reactions of high school students and teachers to the practical activities at the high school could be understood.

Figure 12. Changes in the design of a banner

4.3 Survey of Local Residents

This section summarizes the results of an interview and ethnographic survey conducted on residents of the Nishikino area who participated in the project. In the fifth class, as part of Disaster Prevention Day, a discussion about the banners was held by the participants. The results of observing the participants' discussions during the activity showed that the production of the banner had some impact on the consideration of vehicle tsunami evacuation in the Nishikino area. The results also revealed changes among the participants. For example, the following discussion took place between residents and teachers.

Resident A:

"If the earthquake is strong enough, some walls may collapse and block the evacuation route."

Resident B:

"First of all, we have to think about a route that can be used to escape safely. If we tried to escape and the route was unusable, it would be terrible."

Teacher A:

"For example, this road is narrow and there are many walls. Therefore, in such an emergency, it is better not to pass through by car."

From these conversations, it seems that the participants discussed the issue with a concrete image of what would happen in the event of a disaster, based on the actual situation of the space. Figure 13 shows a scene from the actual activity. In addition, the mayor of the Nishikino area, who participated in the discussion, said the following.

Mayor of Nishikino area:

"Until now, I had felt that we had to guide vehicles to safety in the event of tsunami, but we had not been able to do so. However, by designing the banner, that image has finally become more concrete."

Figure 13. A discussion among various participants

This comment and others indicated that the residents had some thoughts about vehicle tsunami evacuation, but seemed to have difficulty putting them into practice. Through the created banner, it was clear that they felt as if their vague image had changed into something concrete. This suggests that the effect included both the part given by the banner, an "artifact" designed by participants, and the part given by participation in the "activity" of making it. In addition, when the participants saw the banners in the school exhibition, they were able to confirm the following opinions about the ward mayor and residents of Nishikino area.

Mayor of Nishikino area:

"I think that people in the area have various opinions. So, I would like to hang this banner... "

Resident A:

"If we put this up and check the contents... "

Resident B:

"Even if it turns out to be useless, that's not a problem. The actual problem is that it won't be discovered until the time of the disaster."

Author:

"That's right. It might be important to first complete and verify this banner."

Mayor of Nishikino area:

"If residents come up with any suggestions for revisions, I think it would be good to reflect them."

Author:

"In that case, it would be fine to fix it each time."

Mayor of Nishikino area:

"That's right. We can just make it again. Anyway, it's hard to imagine that the banner would be used for decades without being changed."

Resident A:

"It is also possible to make several and use the best one."

In the conversation above, it seems that the participants were continuously considering the use of banners to guide people. This kind of attitude suggests that the existence of the banners was the trigger for them to consider how to implement vehicle tsunami evacuation.

This section has presented outlines of the survey targeting residents who participated in the practice in the Nishikino area. The results indicated that the residents' vague images of vehicle tsunami evacuation were made concrete through the banner production.

4.4 Survey of Town Officials

This section summarizes the results of interview surveys conducted on officials in Kuroshio who were involved in the discussion of vehicle tsunami evacuation in the Nishikino area. Two people who worked in the Irino region, including the Nishikino area, were interviewed: Official S (male, 50s) and Official T (male, 30s). Regarding the survey format, the interviews were planned in a semi-structured format. For specific information, on November 13, 2024, a face-to-face interview with official T was conducted at the Kuroshio Town office, where official T works, for about one hour. Afterward, an online survey of both of official S and official T was conducted for about one hour on November 25, 2024. The results of these interviews are categorized by relevant content and presented below.

4.4.1. Details of Previous Discussions in the Area

First, the results of the interviews conducted to clarify what kinds of discussions on vehicle tsunami evacuation had been taking place in the Nishikino area before September 2023, when this study was conducted, are shown. As mentioned above, in the Nishikino area, discussions on vehicle tsunami evacuation began in earnest after a traffic jam occurred on a road in the area during the 2014 Iyo Nada Earthquake. Regarding this point, the interviews asked about the

background to the focus on the situation and the issue of vehicle guiding at that time. As a result, the following response was obtained from Official S.

Official S:

"As we have seen with the traffic jams that occurred, there are risks involved in evacuating by car, but we have found that many choose to do so. For this reason, we think it will be difficult to continue to treat it as a method that is not recommended in principle. In other words, I think it is necessary to consider rules and other matters under the assumption of vehicle tsunami evacuation under certain conditions. **(omitted)** However, it is difficult to implement vehicle tsunami evacuation immediately. I think it is important to consider how to accept cars that evacuate to the Nishikino area and how to prevent traffic congestion in preparation for the future. Within the Irino region, the possibility of people evacuating from areas other than the Nishikino area must be considered, and vehicle tsunami evacuation urgently needs to be considered. From this perspective, I think the discussion about vehicle tsunami evacuation started in this area."

From the answers of Official S, it was considered that discussions about how to guide evacuation vehicles began after the experience of traffic congestion during past earthquakes, and the geographical characteristics of the Nishikino area, which is outside the flood zone, made residents in the area aware of its role as a place to accept evacuees from outside.

4.4.2 Effects of the Banner Production

Next, the evaluation of the banner that was produced was considered a solution to the problem of vehicle guidance in the Nishikino area. In the interview with Official T, the following response, which focused on the role of the banner as an example, was obtained. Following is some dialogue between the author and Official T.

Official T:

"I think that the banners will only be effective if everyone in the community has a common understanding of vehicle tsunami evacuation. If everyone understands the rules of vehicle tsunami evacuation, then there should be no problem even if the banners are not used."

Author:

"That's probably true. I think so too."

Official T:

"In other words, I think we should expect secondary effects from banners. Certainly, when considering vehicle tsunami evacuation in the Nishikino area, banner production is a feasible measure, and I think it is significant that it was realized. However, I think what is important is that people from both inside and outside the area understand and act based on the rules set out for vehicle tsunami evacuation. If people have this kind of common

understanding, it will help resolve problems in the event of a disaster. And if that is difficult, this banner will be helpful. For these reasons, I think it is necessary to hold discussions involving people from outside the area to create a common understanding of vehicle tsunami evacuation."

From the above, it was found that it is important for the residents of the Nishikino area to have a common understanding of how to respond in the event of an evacuation, such as the formulation of rules, to solve the problem of vehicle guidance. In addition, given that the importance of formulating rules and achieving a common understanding was reaffirmed through the production process, it was suggested that the banner functioned as a medium for visualizing the discussion on vehicle tsunami evacuation and organizing the content that needed to be addressed.

4.4.3 Impact of Discussions with High School Students on Residents

Next, the impact of high school students participating in discussions about vehicle tsunami evacuation through banner production was evaluated. In the interview with Official T, it seemed that the following points were recognized.

Official T:

"It may have been difficult for high school students to imagine the problem of vehicle tsunami evacuation. However, for residents, especially the board members, it was an opportunity to reflect on their own roles and actions, as the high school students were working on the issue. For example, if the town office took the initiative in making the banners, residents probably wouldn't be interested. In principle, residents should take the initiative, but there is a certain number of people who think that 'if we ask the government, it will be realized.' In other words, it is important to think about how to get residents to take the initiative in addressing local issues. **(omitted)** Based on these points, I think that the participation of high school students in this activity may have helped to stimulate the initiative of the residents."

From this answer, it was clear that the participation of high school students influenced the initiative of the residents in the Nishikino area. Specifically, students who participated in the study of vehicle tsunami evacuation at the request of the authors gradually began to change their awareness of the issues through the banner production, and some students began to take the initiative in the discussion. This was thought to have influenced the awareness of residents, including the board members. This point could also be organized from the perspective of the role of the government in initiatives within the area.

From the above results, it was possible to organize the impact of past initiatives in the Nishikino area and banner production around the discussion of vehicle tsunami evacuation. In the next section, through an analysis of these results from the perspective of learning-environment design, insights into the requirements that promote consideration of vehicle tsunami evacuation are provided.

5. GENERAL DISCUSSION

This section examines key elements in supporting discussions on vehicle tsunami evacuation by reorganizing the results with perspectives on learning-environment design. This paper specifically discusses the impact of the banner production planned by the authors and the effects of the consideration that has previously been carried out in the area. In the following, the results are summarized from four aspects of learning-environment design: space, artifact, activity, and community.

5.1 Aspects of “Space”

First, from the perspective of “space” in the learning environment, the important elements in the discussion of vehicle tsunami evacuation are summarized, particularly the impact of space when the banner was placed on the actual evacuation route in the practice planned by the authors. From the survey of the participants, it was inferred that the fact that the discussion on the subject of “vehicle guidance” was conducted on an evacuation route where a traffic jam had occurred was important for advancing the discussion. For example, in their interviews, the high school teachers responded that conducting actual experiments in addition to classroom discussions contributed to the formation of concrete images among the participants, including the high school students. In addition, in the interview survey of town officials, they responded that discussions and verification were necessary to create a common understanding as they proceeded with their deliberations; it seems that the use of spaces related to the issues also had an impact on forming a common image of the issues.

From these points, it is suggested that in the design of learning environments for studying vehicle tsunami evacuation, the “verification in spaces closely related to the issues” in each region has some impact on the progress of discussions. In this case, it was suggested that this impact was not the result of practices that had been ongoing in the area, but rather the result of new practices introduced by the authors. In other words, one of the factors contributing to the stagnation of discussion in Nishikino area was the aspect of "space", and it can be inferred that the discussions progressed because this factor was resolved through the practices of the authors in this study.

5.2 Aspects of “Artifact”

Second, from the perspective of the “artifact” in the learning environment, the important elements in the discussion of vehicle tsunami evacuation are summarized.

In the local practice including the banner production, the artificial object was a major element designed by the author. For example, in the series of classes conducted at the high school, the banner production process was facilitated by providing various artifacts such as class materials and worksheets. Among these, it seems that the most distinctive artifact in the practical application was the banner produced as a vehicle guidance tool. In the ethnographic

survey, it was confirmed that various discussions took place during the banner production process, and as indicated by the narration by the mayor of the Nishikino area, it was understood that the vague images about vehicle tsunami evacuation held by residents were transformed into concrete ones through the banners produced mainly by the high school students. In addition, after installing the banners on the evacuation routes in the area, the joint drill was used to test the vehicle tsunami evacuation. From this perspective, it seems that introducing new artifacts as spatial elements helped support concrete discussions about what was being discussed in the Nishikino area as well as what needed to be discussed in the future.

In the case of the Nishikino area specifically, the interview survey with town officials showed that discussions about vehicle tsunami evacuation had been continuing even before the present study, so the residents were clearly aware of the need for vehicle tsunami evacuation. However, it was confirmed from the survey of residents that their image of vehicle tsunami evacuation had been ambiguous. In this regard, the banner was created to reflect the traffic congestion issues in the Nishikino area, as well as discussions on solutions and future policies. It was suggested that these opinions were not limited to the conventional written format, but shared and made visible by being displayed in the form of banners in the area, and it seems that this was a characteristic of the banners as an artifact.

As described above, in this practical exercise, it seems that the artifacts may have influenced the development of the discussion by functioning as a “medium for visualizing” the main points and opinions regarding the issue when supporting the discussion.

On the other hand, if there is no continuous involvement or updating of artefacts, it is possible that their influence will gradually decline. For example, Sato et al. (2017) surveyed residents' awareness of the tsunami monument before the Great East Japan Earthquake in the devastated areas. It was reported that the existence of the monuments was known, but few people were aware of the lessons inscribed on them, and that those lessons had not been passed on to younger generations. These findings suggest that it is not enough to just install artifacts, and it is important to keep engaging with them and updating the information to make them effective. In the case of this study, the local mayor's statement that “banners can be updated every year” seems to imply that it is important for discussions in the local community to continue engaging with the banners to promote progress.

In addition, surveys of high school students confirmed that their interest in tsunami evacuation signs increased in the short term through the banner production. However, from a long-term perspective, it has been pointed out that this interest may remain temporary, as in the above example. Therefore, it is necessary to consider the limitations of the effects of short-term practices, and it is important to take measures such as conducting surveys to determine whether high school students maintain their interest after the practices have ended. By considering changes in the environment over time through such surveys, it seems that there is a new perspective that has not been focused on in previous studies on learning environment design, and this could lead to new proposals for expanding the theory.

5.3 Aspects of "Activity"

Third, from the perspective of the "activity" in the learning environment, the important elements in the discussion of vehicle tsunami evacuation are summarized.

For example, in an interview with officials, it was suggested that the issue of vehicle guidance cannot be solved simply by putting up banners, but it might be solved through discussions on the softer side of the issue by local stakeholders. In the Nishikino area, there has been sufficient discussion on repeated evacuation drills, and it was indicated that it would have been difficult to verify the specific vehicle tsunami evacuation process if there had been no accumulation of such discussions. For example, Kuroshio, which includes the Nishikino area, has been working toward achieving a goal of "zero victims" by building evacuation towers, improving evacuation routes, and holding drills. These measures have made it possible to identify difficulties in the final evacuation plans as well as people who require special consideration. It has also been possible to identify the residents who really need to use a vehicle. This consideration is important for avoiding the secondary disasters that could occur if the evacuation of vehicles were allowed in all cases. It is precisely because these activities have been carried out in the Nishikino area that it is possible to achieve the realization of specific measures and the progress of discussions in this practical implementation.

In addition, it is suggested that the implementation of drills is also important as an opportunity to form a common understanding among the parties involved, as mentioned above. In particular, evacuation drills which provide opportunities for all people in the community to participate, are suggested to be important for building a common understanding among them.

Based on these points, it is thought that in the learning environment for vehicle tsunami evacuation, the design of "regular verification through drills" in terms of activities could have an impact on the progress of the discussion.

5.4 Aspects of "Community"

Finally, from the perspective of the "community" in the learning environment, the important elements in the discussion of vehicle tsunami evacuation are summarized. Based on the results of the previous section, it is possible that the progress of the discussion in the Nishikino area was strongly influenced by the participation of high school students and the banner production. In this regard, it is necessary to make a reference from the perspective of "collaboration with surrounding parties."

Specifically, this refers to the fact that high school students participated in the study of vehicle tsunami evacuation through the production of banners. This impact was particularly clear through the interviews with the town officials. The discussion of vehicle tsunami evacuation in the Nishikino area has been a topic of debate between the ward head of the area, residents, and the government. On this point, high school students, who had not been thought of as being closely related to vehicle tsunami evacuation, played an important role in the realization of vehicle guidance measures through the production of banners. The town officials

responded that this situation may have been an opportunity for residents to reexamine their own roles in considering vehicle tsunami evacuation. On the other hand, the high school students who were the driving force behind this process were involved in the discussion of vehicle tsunami evacuation because they were carrying out banner production as a class project.

In addition, another issue required consideration in the Nishikino area: the discussion of how to guide evacuees from outside the area. For this discussion to proceed concretely, it needed to involve the residents of not only the Nishikino area, but also neighboring areas. Based on the above, in terms of the community, it is important to consider the positions of the people involved in each region and how to design “collaboration with surrounding parties” that affects the progress of the discussion. As an example in this practice, the authors designed a plan to involve high school students as new stakeholders in the community for discussions on vehicle tsunami evacuation, which had previously been centered on residents and officials.

5.5 Interrelationships among Elements of the Learning Environment

Finally, this study examines the effects that arise from the interrelationships between the elements of the learning environment. As an example, the results of this study observed that “space” and “artifact”, as elements of the physical environment, are interrelated. Specifically, approaches to an artifact also influence the space that constitutes it. In this case, the banners created by the authors were installed on the actual evacuation route, suggesting a relationship between the impact of the banners themselves and the impact of the changes in the space caused by the banners.

Furthermore, the elements of social environment, such as "activity" and "community", are also interrelated. For example, through the class activity involving the banner production, high school students joined a community that had been discussing vehicle tsunami evacuation, and it led to changes in the community itself. Therefore, it can be suggested that the four elements that form the basis of the learning environment influence their targets while simultaneously influencing other elements, resulting in different complex effects.

In this section, to facilitate discussion on vehicle tsunami evacuation, the results of the survey were organized from the perspective of learning-environment design. In the next section, after presenting the final conclusions, an explanation of prospects and other topics is provided.

6. CONCLUSION

This study aimed to organize methods for promoting local discussions in the process of supporting areas considering the introduction of “vehicle tsunami evacuation” from the perspective of learning-environment design. In this section, the conclusions of the study and prospects in response to the main RQ “What factors promote consideration of vehicle tsunami evacuation?” and following 4 sub research questions (i) “What kind of space promotes discussion?”, (ii) “What kind of artifacts facilitate discussion?”, (iii) “What kind of activities

encourage discussion?" and (iv) "What kind of community design influences discussion? " are discussed.

6.1 Requirements to Facilitate Discussion

Based on fieldwork conducted in the Nishikino area of Kuroshio, Kochi Prefecture, it appears to be important to promote discussion on vehicle tsunami evacuation by "holding discussions in spaces that include real issues," "using artifacts as tools to visualize local discussions and create a shared understanding," "repeating activities such as training as opportunities for verification," and "including not only the central parties, but also a wide range of people related to the issue as a community."

In this case, it is thought that the discussions progressed because of the improved balance of the four aspects of the learning environment. Specifically, in the Nishikino area, the elements of "activities" and "community" had already been sufficiently considered through the continuous efforts of local stakeholders. As a result, discussions on the necessity of vehicle tsunami evacuation and issues in the Nishikino area had already made some progress by the time this research was conducted.

On the other hand, it is thought that discussions had stalled as a result of issues in the "space" and "artifact" aspects, such as the need to improve the hardware required to verify vehicle guidance. On this point, through the banner production project, some improvements were seen in the "physical learning environment," including space and artifacts, that helped to meet the requirements for promoting discussion. As a result, it is possible that specific verification could be realized and issues that need to be addressed in the future could be identified.

6.2 Future Issues

This study concludes by explaining prospects for continuing to support considerations of vehicle tsunami evacuation. In considering vehicle tsunami evacuation, there are two important aspects: "consideration of needs," and "consideration of measures that can be safely and reliably implemented," which comes after the consideration of needs. If each region were to carry out these considerations, it would be ideal for local stakeholders to take the initiative in the discussions. However, there are some regions where the foundations for discussion have not yet been established. For this reason, it is important to explore methods of supporting discussions among local stakeholders to promote consideration of vehicle tsunami evacuation. In this study, to examine the requirements for effective support, the analysis was conducted from the perspective of learning-environment design. According to the surveys in the Nishiki area, Kuroshio, Kochi Prefecture, some progress was seen in discussions in the area, and it was possible to organize the elements affecting the discussions based on four aspects of the learning environment: space, artifact, activity, and community.

Regarding prospects, support methods to promote discussion in Nishikino are expected to continue to improve, with the aim of creating learning-environment design models that can be

applied more widely. In this study, the surveys and analyses were conducted in a specific region with local stakeholders as the main subjects. Therefore, when applying the present findings to other regions, it will be necessary to reorganize them based on more extensive case studies while considering the characteristics of each region. Future studies will aim to expand the scope of research, such as conducting surveys on cases led by the government and fieldwork in other regions that have already been examined. Based on the results of these surveys, it is hoped that the present findings can help solve the issues related to vehicle tsunami evacuation by proposing ideas that reflect the concept of "inter-locality" in learning-environment design.

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