Effectiveness of Disaster Education for Elementary and Junior High School Students Incorporating Programming Education and Active Learning

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This study implemented the lesson on creating an evacuation game. It could be learned active learning, digital education and disaster education at once. Creating an evacuation game allows participants to decide for themselves how to evacuate in the event of an actual disaster. This means that they will be able to make better decisions in the event of a natural disaster. On the lesson, the aims of this study were to clarify the level of understanding, identify problems and propose ways to deal with them. The targeted grades were from 5th grade elementary school to junior high school. The period of implementation covered the three-year period 2022-2024. The lesson was conducted in two stages: the first stage, which implemented basic programming content, and the second stage, which used all aspects of disaster prevention, active learning and programming. The purpose of implementing of the first stage was to learn how to use the Scratch as the programming software used in the second stage. The first stage was implemented four times, two plus two in the second and third year. The second stage was implemented 8 times, 3+3+2 from the first to third year. National Institute of Technology (KOSEN), Wakayama College was chosen as the place to learn about disaster management using active learning, and Scratch was used for programming. The duration of the lesson was 60 or 180 minutes (including breaks). Results of the questionnaire after the lesson showed that the majority of participants answered that the lesson was easy to understand. However, some of the elementary school children answered that it was difficult. In this case, it would be desirable to mobilize personnel to assist and to be able to accommodate participants who do not fully understand the content. Many participants stated that the duration of the lesson was long. This was not resolved by incorporating different teaching methods and content, such as active learning and disaster management education. There are no particular problems with the content of the lesson, however the duration of the courses needs to be shortened.

Keywords: *disaster, active learning, program, elementary school, junior high school*

Introduction

In order to improve the effectiveness of education, it is nowadays necessary to provide not only one-way classes, but also classes in which students think and learn for themselves. In other words, there is a growing demand for classes that incorporate active learning in education. Recently information subjects have become compulsory in elementary and junior high schools in Japan. This is because of the need to acquire information literacy and programming skills. The impact of the COVID-19 epidemic has led to remote teaching not only in Japan but also in many other countries. This remote teaching can be good or bad depending on the device and internet environment, and this environment is prone to individual differences. Requiring paid applications in addition to the device resulted in many students slowing or stopping learning.

On disaster prevention, earthquakes have occurred in various parts of Japan, for example the Great Hanshin Earthquake in 1995 and the Great East Japan Earthquake in 2011. Recently, there have been concerns about a huge earthquake in the Nankai Trough, which could be bigger than the Great East Japan Earthquake. Cabinet Office and Japan Meteorological Agency of Japanese government officially announced for “giant earthquake warning” on 8 August 2024. Natural disasters are a universal phenomenon, occurring not only in Japan but also in the rest of the world. We need to be prepared for such earthquakes and one of the measures is disaster education. Disaster prevention education includes disaster prevention card game, disaster prevention games, and methods to help evacuate oneself by listening to storytellers about the situation in the event of a disaster. Other methods of disaster preparedness are discussed through local disaster management events such as an evacuation drills and community discussions in a local area. Many of the participants are often only representatives of a local area such as group leaders, town council leaders, etc. Therefore, disaster education may not reach the entire local population including students and pupils.

Delivery classes and Specialized courses to elementary and junior high school students will be important for the early identification of science and engineering personnel. The sophistication of those

lessons is always necessary to discover even more efficiently. In conducting such lessons, the content of the lessons must be understandable to elementary and junior high school students, and their comprehension must be verified.

What is the purpose

This study aims to examine the feasibility of combining active learning, digital education and disaster education with lessons for elementary and junior high school students. In addition, the aim is to use the results of the questionnaire after the lessons has been conducted to suggest ways to improve the lessons. Final goal of the lessons is to create the evacuation game for a natural disaster. Creating this evacuation game will enable people to think for themselves about evacuation routes in the event of a disaster, and they will be able to identify possible hazardous events in advance during evacuation. The game can apply any disaster education learned to individual communities because it is targeted at the area in which the student lives. Therefore, they can expect to improve their own evacuation decision-making when a natural disaster occurs in their area. Furthermore, they can then simulate in advance to work out the best way to evacuate themselves.

This study used the programming software Scratch, which is using in many elementary and junior high school in Japan. （Scratch, Programming language developed by the Media Lab at the Massachusetts Institute of Technology (MIT). , https://scratch.mit.edu/） . This software was chosen because it can be used without an internet connection and has the advantage that it can be shared with others who have an internet connection.

Details of implementation

This lesson was carried out in two stages. In the first stage, it conducted basic programming education classes. Specifically, it was the lesson on the basic use of the scratch. In the second stage, it involved the lesson on creating the evacuation game using the scratch.

The first stage of the class: Four lessons were held between 2023 and 2024 (two each in 2023 and 2024). The composition of participants (man 25people, woman 3people) was mostly elementary school students, as shown in the results by grade of participants in Figure 1.

The lessons were held to teach basic operation of the scratch and programming methods for about one hour. The impetus for this lesson was the confirmation that some elementary and junior high schools were not using the scratch in a lesson. Therefore, this course began to be implemented in 2023.

The second stage of the class: Eight times were held between 2022 and 2024 (3+3+2 times in each year). The composition of participants (man 64 people, woman 10 people) was mostly elementary school students too, as shown in the results by grade of participants in Figure 2.

This lesson was conducted for approximately three hours (including breaks) as two sessions (for two lectures). The location of the lesson was Wakayama

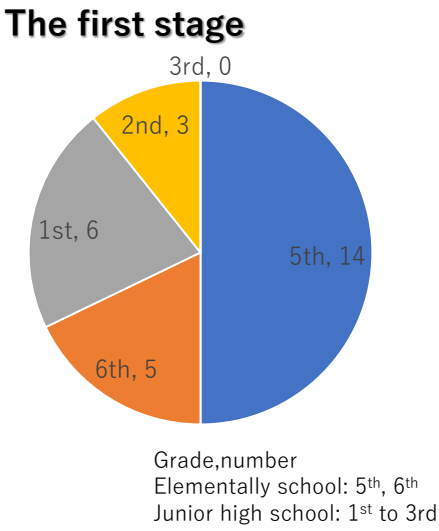

Figure 1 Number of participants on the First

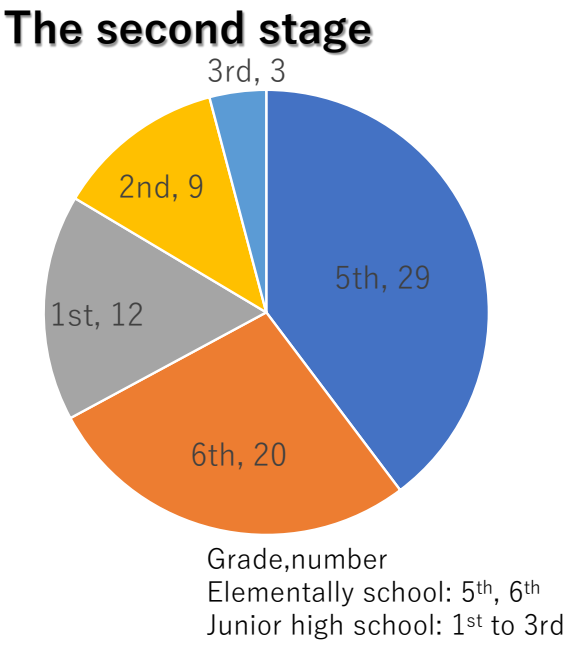

Figure 2 Number of participants on the second

Figure 3 Briefing on disaster prevention

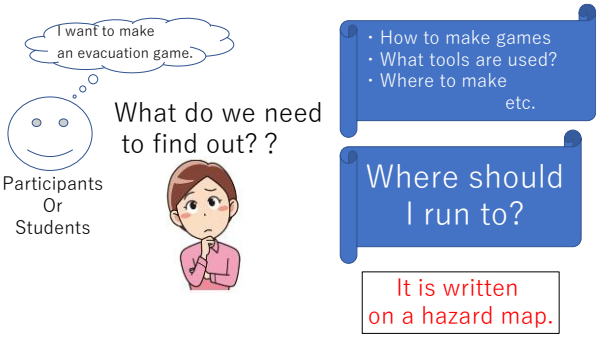

Figure 4 Explanatory material for creating evacuation game

National College of Technology. A tsunami is expected to hit this part of the Wakayama National College of Technology in the event of a huge Nankai Trough earthquake. It is also a suitable location for creating disaster prevention games, as an intensity of 7 is predicted. The lesson flow is described below.

Disaster prevention and programming explained: The following information was provided to participants as shown in Figure 3.

Description of the programming software (Scratch) used to create the evacuation game.

Description of checking for creating the evacuation game as shown in Figure 4. (The aim of combining photography and programming was to create a realistic evacuation game.)

Explanation of how to check hazard maps. (A few elementary and junior high school students had never seen a hazard map before, therefore we explained how to read it.)

Explanation of how to check a route and a dangerous spot when to evacuate. (The participants used a hazard map to identify evacuation routes and dangerous places for elementary and junior high school students before checking an actual site.)

Implementing lessons using active learning: The participants took photographs of the evacuation routes and the hazardous areas where they had just identified by using a tablet capable of taking photographs (Figure 5, Figure 6). (By checking the actual location, the participants were possible to recognize the width of the route and obstacles along the way, which are difficult to notice on hazard maps. In addition, they will be able to imagine what the possible hazards of the assumed hazardous areas were.)

Importing the photos taken by the participants into a computer.

To create the evacuation game by the scratch for programming learning: Photographs of the evacuation routes and the hazardous areas taken were imported into the scratch programmed (Figure 7).

The evacuation game was created in which arrows were used to progress along the evacuation route (Figure 8). (The system allows the selection of the best and the least suitable paths for evacuation routes to provide a gaming experience.)

Figure 5 Active learning outside

Figure 6 Identification of hazardous areas

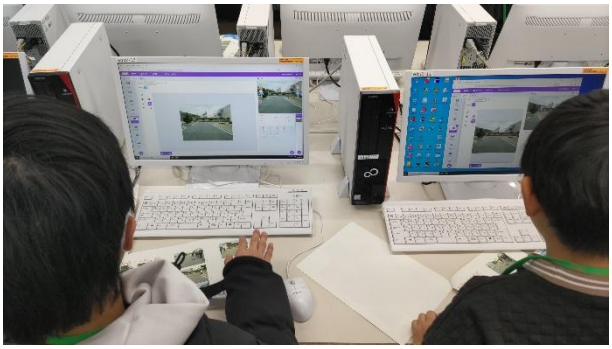

Figure 7 Programming creation (import a photograph)

Figure 8 Selection by arrows on the evacuation game

Figure 9 Showing hazardous area on the evacuation game

It created an evacuation game that also visually identifies hazardous areas (Figure 9). (Figure 8 shows that the direction of travel can be selected. In this case, going left will take to the designated evacuation area, while going right will take to the expected tsunami inundation zone. Therefore, the correct answer was to go left. The game assumes that the choice was made while looking at the hazard map.)

The evacuation game is completed with active learning and programming.

Results and discussions

All questionnaires conducted in this paper were rated on five-grade evaluation (five-grade evaluation : Excellent, Good, Fair, Poor, Very Poor or Unacceptable).

The first stage of the class: Figure 10 shows the results of the questionnaire confirming the grade of understanding of the first stage in the lesson. Many participants answered that they understood the content, so there were no problems with the content. Understandable was defined in this paper as participants who answered Excellent and Good. However, a few participants indicated that they did not understand such as fair or Poor. They were in the fifth grade of elementary school. As a general trend in Japan, programming education starts in the fifth grade. They may not have been familiar with the program of the Scratch.

Figure 11 shows the results of the questionnaire asking about the length of the lesson. Six respondents as equivalent to 20% of the total stated that it was poor or unacceptable. This means that the lesson was a little or very long for the responses. These six included three elementary school students and three junior high school students. It was found that negative responses were not only elementary school children but also junior high school students. In Japanese elementary and junior high schools, the time of a class is generally 45 or 50 minutes per session. This lesson is about one hour. It was found that some participants responded negatively if a lesson was longer than 45 or 50 minutes.

The second stage of the class: Figure 12 shows the results of the questionnaire confirming the grade of

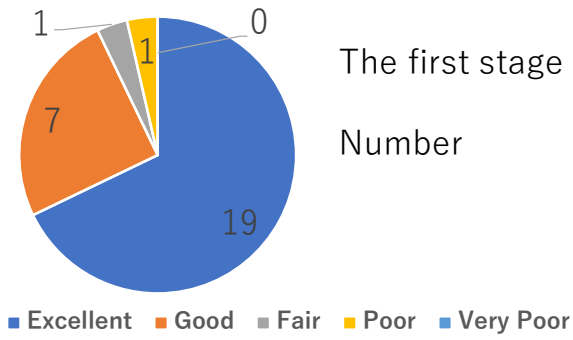

Figure 10 Results on comprehension at the first

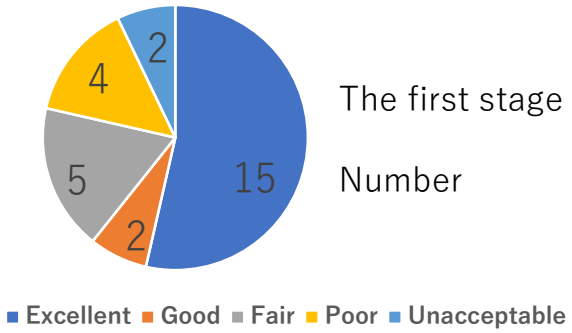

Figure 11 On the length of the lesson time at the first

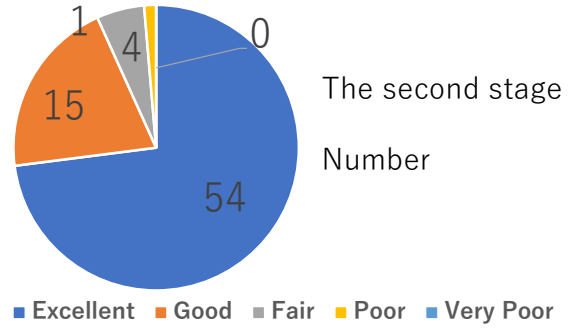

Figure 12 Results on comprehension at the second

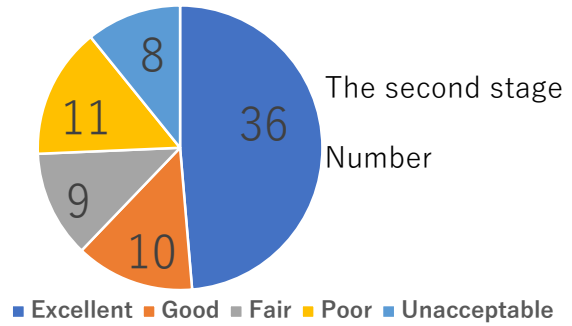

Figure 13 On the length of the lesson time at the second

understanding of the second stage in the lesson. The results show that more than 80% of the participants answered excellent or good. They understood the lesson, which means that most of them found the content of the lesson easy to understand. A small number of participants

indicated that it was difficult to understand such as fair or poor. The content was particularly difficult for some elementary school student. Many participants as elementary and junior high school students indicated that the content was easy to understand, even if it incorporated many contents such as disaster prevention, active learning and programming education. The lessons conducted in this study could be implemented in elementary and junior high schools.

Figure 13 shows the results of the questionnaire on the length of lecture time in the second stage of the lesson. From the results of the survey, 25% of respondents answered poor or unacceptable. It means that the lesson time was long. This result was considered to be due to the length of this lesson, which was three hours long including breaks. The results also show the similar trend in the percentage of response results compared to the results of the first stage of the questionnaire, as shown in Figure 11. The common feature of these two lessons was the implementation of programming. The contents with disaster prevention and active learning were not implemented in the first stage lesson. It was considered that elementary and junior high school students may be made to feel that the lesson time is too long when it is lesson. Some participants in fifth grade of elementary school students and second grade of junior high school students indicated that they did not understand this lesson even if they have received training on how to use the scratch beforehand. The measures to be taken in implementing this lesson, it is important to have someone to assist where necessary after checking students' understanding of the program. Regarding the length of the lesson, many participants stated that it was long. This was not resolved by incorporating different teaching methods and content, such as active learning and disaster management education. It is therefore advisable to conduct lessons that can be conducted in a shorter time of 45-50 minutes.

Conclusions

Education in elementary and junior high schools nowadays requires disaster education, education using active learning and programming education. This study created the lesson in which these can be learnt at the same time, and to clarify the level of understanding and problems in the lesson. The aim in this study is to propose ways to address this problem. The target groups were from 5th grade of elementary school students and third year of junior high school students. These grades were targeted because programming education is provided in schools. The implementation was carried out over three years from 2022 to 2024 for the second stage of the lesson (for the first stage of the lesson, it was 2 years of second year and third year). The lesson was conducted in two stages: the first stage, which implemented basic programming content, and the second stage, which used all aspects of disaster prevention, active learning and programming. The purpose of implementing of the first stage was to learn how to use the Scratch as the programming software used in the second stage. The first stage was implemented four times, two plus two in the second and third year. The second stage was implemented 8 times, 3+3+2 from the first to third year. The results of the questionnaire showed that the majority of participants answered that the lesson was easy to understand, however a few participants gave negative responses. Many of them were elementary school children. Regarding the length of the lesson, many participant including junior high school students answered that the lesson was too long. The daily class time in elementary and junior high school was 45 or 50 minutes and this course was 60 or 180 minutes (with a break in the middle). It can be assumed that the reason for this negative response was the difference in the daily teaching hours. Therefore, the lesson time needs to be shorter. To summaries the issues, there are no problems with the content of the lesson, however the length of the lesson time should be adjusted. This lesson was also difficult for some primary and secondary school students, it would be desirable to mobilize personnel to assist and to be able to accommodate participants who do not fully understand the content.

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