



Original paper

Long-Term Evaluation of Disaster Education: From a Survey Across Age Groups

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Abstract In Japan, large-scale disasters have accelerated discussions about disaster education, which occupies a very important position as a disaster prevention measure. Disaster education programs have been implemented with the keyword “zest for life”; however, the lifelong implications of these programs on children have not been fully discussed. Assessment of the long-term evaluation is an important issue in considering and promoting disaster education.

In this study, the authors conducted a survey of the students and parents of Nakajima Elementary School and Ise Miyagawa Junior High School in Ise City, which are engaged in continuous disaster education. The survey was analyzed through comparisons between various grades and between students and parents to determine the impacts of disaster education at school and its effectiveness as part of long-term evaluation. The survey results indicated that while the short-term impacts were significant, as students grew older, they became more aware of the importance of disaster prevention education in real-world scenarios. Hence, the influence of disaster education in schools weakens in the long-term. In the future, a long-term perspective on disaster education as lifelong education is considered necessary.

Keywords: Disaster education, Community and school, Long-term evaluation, Lifelong education,

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1. INTRODUCTION

Japan is one of the most disaster-prone countries with an average of 11.8 typhoons per year from 2002 to 2021 (JMA 2022a) and 46 earthquakes, measuring 6 or higher on the Japanese seismic scale, with human casualties, during the same period (JMA 2022b). In this context, various disaster prevention measures have been taken, including structural and non-structural measures. Disaster education is one such measure that has been particularly emphasized in recent years. The Great Hanshin-Awaji Earthquake of 1995, the Great East Japan Earthquake of 2011, and the Kanto/Tohoku torrential rains of September 2017 had a significant impact on disaster education in Japan. Hence, the government has been promoting practical, life-saving disaster education through policies, such as “Development of Disaster Education that Fosters ‘Zest for Life’” (MEXT 2013) and the “Emergency Action Plan for Rebuilding a ‘Risk Conscious and Well-Prepared Society against Water-Related Disasters’” (MLIT 2017). However, such moves are not limited to Japan. One of the goals of the Sendai Framework (UNDRR 2015) was to “substantially increase the availability of and access to multi-hazard early warning systems and disaster risk information and assessments to people by 2030.” In this framework, disaster education is particularly emphasized in Priority Action 1, “Understanding disaster risk”. Hence, this can be considered an international trend. However, there has not been a sufficient evaluation of the effects of disaster education on children in the long term. This is due to the difficulty of conducting similar surveys for all the grades and the difficulty of implementing the methodology and evaluating disaster education as lifelong education, which involves tracking the long-term changes in each individual’s awareness and discussing its relationship to the actual disasters.

This study aimed to evaluate disaster education from a long-term perspective to understand the effectiveness of the annual disaster education in a school where the authors are involved in its implementation. This was understood by comparing the opinions on disaster education and daily disaster response behaviors between grades and between students and parents.

2. RELATED STUDIES

2.1 Disaster Education in Japan

Disaster education in Japan includes conducting evacuation drills in all schools. These drills are required by the Fire Defense Law for schools, hospitals, and other facilities where large crowds enter and exit. These have been widely conducted for fire breakouts and earthquakes (99.9% (2018); MEXT 2020). Based on the Great Hanshin-Awaji Earthquake and the Great East Japan Earthquake, there have been several moves to include tsunamis and other disasters in these drills. For example, in 2018, 89.8% of the schools in expected tsunami zones conducted evacuation drills in anticipation of a tsunami (MEXT 2020). However,

schools have not conducted evacuation drills for floods since they are often closed during heavy rains.

Since 2017, due to a revision of the law, evacuation drills for water-related disasters became mandatory for schools, which act as facilities for people with special care in anticipated flood zones and landslide hazard zones. As of 2020, 71.9% of the schools in expected flood zones (20% of all schools in Japan) and 67.6% of the schools in the landslide disaster prevention zone (11.2% of all schools in Japan) have conducted water-related disaster evacuation drills (MEXT 2021a).

In addition to evacuation drills, comprehensive learning time, whereby, the teachers can set the content at their discretion, is utilized. Disaster education is being implemented by the teachers through various efforts, such as discussing disasters in regular classes such as science and social studies (MEXT 2021b).

For further development of disaster education, various educational programs have been developed (e.g., Ikeda *et al.* 2021, Nagata and Kimura 2020). The methods have been more diverse including collaboration with the local community and other entities outside the school (Nishikido 2010, Chen *et al.* 2013) and use of meteorological information monitors (Kawata *et al.* 2018). ICT-based disaster education systems such as VR are also becoming more widespread (Mitsuhara 2018, Kuribayashi 2020). While class hours are increasing (MEXT 2018), there has not been much progress in the discussions about integrating disaster education into the curriculum (Okada and Yamori 2019) and its implementation is left to the teachers. However, teachers are not experts in disaster prevention. While they understand the need for disaster education, survey results point to the challenges of its implementation (Kano 2017).

There is no clear method for verifying the effectiveness of disaster education and most evaluations at the research level are short-term. They check the progress of the understanding of disaster education after its implementation. When disaster education is considered as lifelong education, evaluation of the extent to which the effects have continued and its contribution to future disaster response is rarely conducted, as is the case in other countries.

2.2 Long-Term Evaluation of Disaster Education

It is important to understand the discussions about the long-term evaluation of disaster education. The need for such discussion has been pointed out in the past, both in the actual field and in article reviews. There have not been adequate discussions of the long-term evaluation of disaster education. In this section, we review studies to understand the role and results a study of this nature might play in such a discussion.

For example, Zhu and Zhang (2017) surveyed 16 randomly selected elementary and secondary schools about disaster education in China. They noted that a long-term mechanism

had not been formed for disaster prevention and risk reduction education, training, and drills in government departments.

Bohari and Widana (2021) evaluated a short training on basic disaster management for students, lecturers, and staff, conducted by the Indonesia Defense University. The training provided an opportunity in order to improve basic disaster management knowledge. However, the long-term evaluation for each participant would be required to examine the impact of the training on disaster resilience on community scale.

Johnson *et al.* (2014) identified and analyzed 35 studies. The results revealed that the effectiveness of disaster education programs for children is based on the results of quantitative studies with children that generally focused on measuring children's knowledge of disaster risks, protective actions, and child reports of preparedness actions. In addition, except for a retrospective survey of adults who participated in Boys Scouts as children, no studies have measured the long-term outcomes of disaster education, including the improvements in response to and recovery from an actual disaster. Hence, they pointed out that there is currently no scholarly consensus about credible evidence of the effectiveness of disaster education programs for children.

Suitable indicators for measuring the long-term impact of the project must be identified, which may be unique to each stakeholder group targeted in the project (UNESCO 2007). The impact will be evident from the extent of disaster prevention, recognition, and preparedness within the framework of Education for Sustainable Development (ESD) integrated into the policies and practices of targeted stakeholder groups.

Musacchio *et al.* (2014) point out that hazards are not addressed at an early age which decreases at later ages. However, to comply with the urge to take actions towards training and education at an early age, hands-on tools and learn-by-playing approaches are important in an informal learning environment. To reach an older population, audio-visual media may be the best and lowest cost alternative to promote risk perception, awareness, and education. Thus, for long-term evaluation, discussion from the perspective of lifelong education is required.

Studies are underway for specific long-term evaluations of disaster education. Johnson *et al.* (2016) challenged the lack of extant explorations of causality in disaster education studies and noted that a theory-based evaluation may seek to validate or disprove the assumption that short-term household preparedness actions stimulated by the program result in long-term preparedness for disasters. Based on two model case studies, this article describes the advantages of constructing program theory models for the purpose of evaluating disaster education programs for children. Juhadi *et al.* (2021) developed an indirect teaching model for students' disaster mitigation literacy based on the ADDIE model (analysis, design, development, implementation, and evaluation). This model is based on the idea that improved disaster mitigation literacy can be achieved by integrating disaster education into subjects taught in school, associating it with the local wisdom owned by the community. Thus, finding the effectiveness of a disaster education program.

Chou *et al.* (2015) empirically assessed, through observation, questionnaires, and interviews, the impacts of various factors on the learning effectiveness of disaster prevention and response training performed in Taipei. A learning satisfaction index was developed as a performance benchmark during continuous monitoring of learning effectiveness and for further analysis of the impact of various indicators on the perception of learning effectiveness. The index provided useful feedback for long-term adjustments to disaster education policy.

While such models and indicators are being discussed, there are challenges in implementing them, such as establishing data collection methods, as pointed out by Johnson *et al.* (2014).

Nakano *et al.* (2020) described the chronological development of a disaster risk reduction (DRR) education exchange program between Nepalese and Japanese students, and the progressive change in the attitude of Nepalese students from 2001 to 2015. The study clarified that learners developed a proactive attitude, which was maintained for more than 10 years throughout three phases – educational, participation, and independent action.

Sakurai *et al.* (2020) evaluated the impact of a disaster education program implemented for Grade 4 students at an elementary school affected by a tsunami, a year after the 2011 Great East Japan Earthquake and Tsunami disaster. This was called the “Reconstruction Mapping Program”. It applied a town-watching and map-making approach to disaster education in the disaster reconstruction phase. In addition, the study found that, in 2018, Grade 9 students who participated in the program in 2013, perceived the program experience positively because they found working in groups and keeping reconstruction records to be important. The program experience impacted their willingness to contribute to the community in the longer term. However, not much impact was seen on their disaster preparedness and mitigation behavior.

Chiziwa and Yamori (2020) proposed that disaster education must be implemented and evaluated from a long-term perspective rather than a short-term, one-shot type of study. Based on 10-year-long action research conducted in a small school, their study proposed more desirable methods for evaluating the impact of school disaster education, checking positive impacts on hardware or software countermeasures taken in a community, and tracking long-term personal career developments of both teachers and students after they left or graduated from a school.

As the above studies indicate, discussions of long-term evaluation of disaster education are being conducted in an exploratory manner, using various methods, and there is an urgent need to establish more accurate and general-purpose models and methods.

3. METHODS

3.1 Research Objective

The purpose of this study was to examine the effects of continuous disaster education in schools from a long-term perspective. The authors conducted a survey of the students in schools where continuous disaster education was provided and compared the results of various grades to examine the long-term effects of disaster education. In addition, this study compared two generations of parents and children by targeting elementary and junior high school students and their parents (hereafter, comparisons between the school years would include the parents unless otherwise noted). Hence, in addition to the effectiveness of the current disaster education, the direction of disaster education from a long-term perspective would be discussed by comparing current and past disaster education programs and checking their impacts on people when they became adults.

3.2 Research Methods

In this study, a survey (Table 1) was conducted on June 12, 2021, during the Community Disaster Education Program for students and parents of Nakajima Elementary School in Ise City, Mie Prefecture, to verify the effectiveness of continuous disaster education based on the differences among the grades and between the students and the parents. Continuous disaster education is provided to all the grades in this school. The survey was administered to Grades 3, 4, 5, and 6, and their parents. Grades 1 and 2 were excluded from the survey because it was deemed difficult for them to respond to the questionnaire. In addition, in July 2021, a paper-based survey was conducted for the students in all the grades of Ise-Miyagawa Junior High School where most of the graduates from Nakajima Elementary School go for higher education. In Japan, six years of elementary school and three years of junior high school are compulsory.

Table 1. Survey Questions

Question	Purpose	Content	Choices (*Single choice answers except for multiple choice answers for Question 2)
1 (0)	Opportunities for Disaster Education	(Parents only) As a child, did you have the opportunity of disaster education?	(1) Several times (+2), (2) A few times (+1), (3) Not many (-1), (4) Never (-2)
1 (i)		Did you learn a lot from disaster education xxx*?	
1 (ii)	Disaster Education Evaluation	Has your interest in disaster preparedness increased as a result of the disaster education xxx*?	(1) Agree (+2), (2) Somewhat agree (+1), (3) Neither (± 0), (4) Somewhat disagree (-1), (5) Disagree (-2)
1 (iii)		Will you act appropriately, when a disaster occurs, after receiving disaster education xxx*?	

2 (i)		Which of these do you always do when it rains heavily?	(1) Check hazard maps, (2) Think about when to evacuate, (3) Check evacuation routes, (4) Discuss with the family, (5) Stay away from rivers and mountains, (6) Help others in the community, (7) Collect information through TV and cell phones, (8) Check emergency rations, (9) Others, (10) Nothing in particular
2 (ii)	Disaster Preparedness and Recall During Disasters	Which of these do you do to prepare for earthquakes in your daily life?	(1) Check hazard maps, (2) Check what to do in case of an earthquake, (3) Check evacuation routes, (4) Discuss with the family, (5) Check dangerous things in the house, (6) Participate in community activities, (7) Collect information through TV and cell phones, (8) Check emergency rations, (9) Others, (10) Nothing in particular
2 (iii)		What do you often recall when it rains heavily?	(1) Scenes of heavy rain seen on TV or the Internet, (2) Damage in the community, (3) Disaster education at school, (4) Evacuation drills at school, (5) Things discussed with the family, (6) Things heard from non-family members, (7) Others, (8) Nothing in particular
2 (iv)		What do you often remember when an earthquake occurs?	(1) Scenes of earthquake seen on TV or the Internet, (2) Damage in the community, (3) Disaster education at school, (4) Evacuation drills at school, (5) Things talked about with the family, (6) Things heard from non-family members, (7) Others, (8) Nothing in particular
3 (0)	Graduated elementary school	(Junior high school students only) Which elementary school did you go to?	(1) Nakajima, (2) Soshu, (3) Sochi, (4) Ueno, (5) Other
3 (i)		Compared to when you were in xxx ^{**} , do you think you are more knowledgeable about disaster prevention?	
3 (ii)	Change in disaster awareness	Compared to when you were in xxx ^{**} , do you think you are more careful about disasters?	(1) Agree (+2), (2) Somewhat agree (+1), (3) Neither (± 0), (4) Somewhat disagree (-1), (5) Disagree (-2)
3 (iii)		Compared to when you were in xxx ^{**} , do you think you can take action in case of disasters?	

4 (i)		In xxx ^{***} , do you want to learn more about disaster prevention?	
4 (ii)	Views on future disaster prevention	In xxx ^{***} , do you want to pay more attention to disasters?	(1) Agree (+2), (2) Somewhat agree (+1), (3) Neither (± 0), (4) Somewhat disagree (-1), (5) Disagree (-2)
4 (iii)		In xxx ^{***} , do you want to act more carefully when a disaster occurs?	
4 (iv)	Attributes	(Parents only) Age	Fill in numerical values

Notes: *xxx: today (Elementary school students), to date (Junior high school students), in childhood (Parents); **xxx: Grade 1 (Elementary school students), elementary school (Junior high school students), childhood (Parents); ***xxx: Adults in future (Elementary school and junior high school students), future (Parents).

The questionnaire was divided into four major sections, except Question 2, which was modified to accommodate the differences among elementary and junior high schools, the parents, and the survey timing. In addition, the questionnaire included a few questions, which changed between grades due to the differences in the learning status of Kanji characters; however, they addressed the same content.

Question 1 asked about their evaluation of disaster education. For elementary school students, the questionnaire was administered after the implementation of disaster education; hence, we checked their evaluation of disaster education. Junior high school students evaluated the disaster education that they had received to date. Parents evaluated the disaster education that they had received as children. Since the target audience for the education was different, the results were handled with caution. Subsequently, the status of disaster education received by the parents was unknown; hence, they were asked to indicate the extent of disaster education received as children.

Question 2 determined how disaster education affected disaster awareness in daily life. For heavy rain, the participants were asked about their actions and preparedness for an expected heavy rain shower, and their actions during it. For earthquakes, they were asked about their daily preparedness and actions during an actual earthquake. The options consisted of a direct evaluation of the impact of disaster education at schools, such as evacuation drills (options 3 and 4), and an indirect evaluation of the impact or the lack of it.

Question 3 was designed to ascertain the awareness of disaster preparedness changes, in terms of the knowledge of disaster preparedness, attention to disaster preparedness, and behavior during disasters. In addition, since some of the junior high school students came from elementary schools other than Nakajima Elementary School, the authors recorded their elementary school, taking into account the influence of the difference in the elementary school.

Question 4 was designed to evaluate disaster education as a lifelong education. In addition, the respondents were asked to confirm their future intentions of attending disaster education, paying attention to disasters, and acting in disasters.

Thus, the long-term effects of disaster education were evaluated through comparisons between different grades and their parents, based on the following pointers:

1. Disaster education evaluation
2. Disaster preparedness and recall during disasters
3. Change in disaster awareness
4. Views on future disaster prevention

The results were analyzed by simple tabulation, the χ -square test, the t-test to evaluate the differences among the participants. The changes accompanying students' advancement to the next grade or school year were considered. As for the parents, since the environment of their disaster education differed greatly from that of the children, the authors evaluated the differences by age. In addition, through comparison with the children, the authors evaluated the differences between both generations.

3.3 Research Site

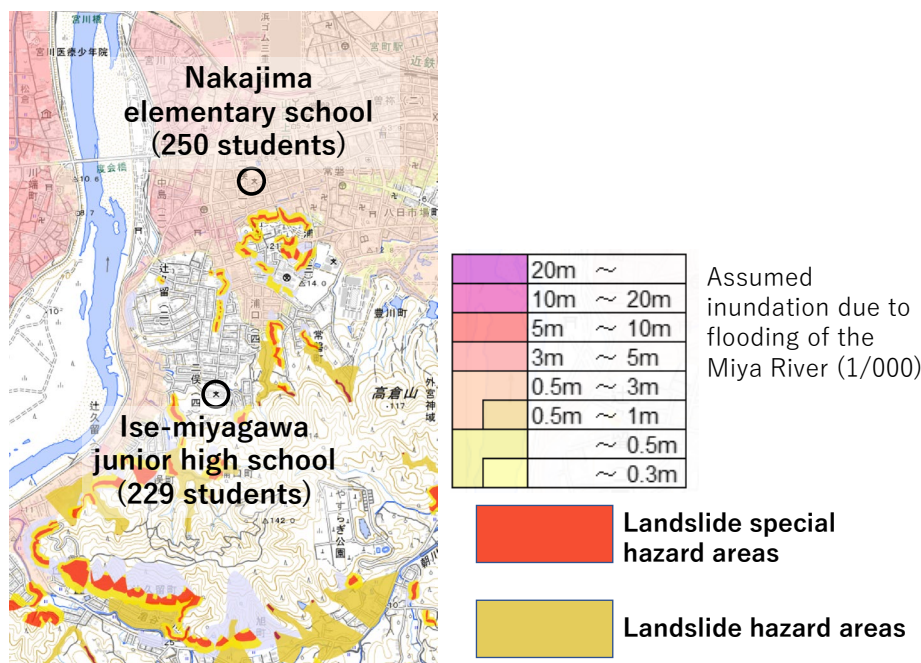


Figure 1. Expected flood inundation area of the Miyagawa River near Nakajima Elementary School and Ise-Miyagawa Junior High School.

*Author's addition to the Overlapping Hazard Map (MLIT 2022)

The targets of this study, Nakajima Elementary School and Ise Miyagawa Junior High School, are geographically located in central Japan (Figure 1). The Miya River, a first-class river, flows 1 km to the west and is expected to flood the area with 3-5 m deep water. Historically, too, the area has been plagued by floods from the Miya River. In addition, the area is threatened by earthquakes, as the Nankai Trough earthquake (expected magnitude of 9.0 or greater), a large-scale trench-type earthquake, is expected to cause tremors within 30 years with a maximum intensity of 7 on the Japanese seven-stage seismic scale.

Nakajima Elementary School had 250 students (as of April 2021) and since 2016, disaster education has been continuously conducted for all grades with the participation of the authors once a year. This takes place in collaboration with the local community, taking into account the age and understanding ability of each grade (Table 2). In this disaster education, until 2017, experts took the lead and residents participated in the classes as supporters; however, since 2018, the residents, not experts, have been providing disaster education to the children (Figure 2). In addition to the classes, Grades 5 and 6 participate in local disaster prevention events attended by the residents, providing opportunities for the children and residents to discuss the issues together. The content of this event differs each year; however, the authors coordinate the event, alternating between earthquake and weather disasters. Disaster education was canceled in FY2020 due to COVID-19; however, it resumed in FY2021 through online classes. In addition to disaster education in collaboration with the local community, the school conducts regular evacuation drills similar to other schools.

Table 2. Disaster education in collaboration with the community at Nakajima Elementary School (in 2019)

Grades	Contents
1	How to behave when a disaster occurs (Disaster Prevention Duck)
2	Think about your relationship with the disasters (Disaster Prevention Picture Story Show)
3	Discuss issues during a disaster (Crossroad Game)
4	Learn about evacuation life. Think about what you can do. (Mutual Help Matching)
5	Learn about weather information (Delivery Class by the Weather Office)
6	Think about what to do during a disaster (Disaster Prevention Timeline)
5, 6, and the residents	Disaster response switch drill (Community Disaster Prevention Event)



Figure 2. Disaster education at Nakajima Elementary School (photographs by the authors)

Ise-Miyagawa Junior High School had 229 students, including students from Nakajima, Soshu, Sochi, and Ueno Elementary Schools (as of April 2021). The authors had been cooperating with Ise-Miyagawa Junior High School to provide disaster education, focusing on weather and disaster prevention, to first-year students (second-year students from 2012 to 2016), approximately four times a year since 2012. Disaster education at this school was characterized by a “sense of disaster, which is related to ourselves”. The educational content was designed to make disasters seem familiar, with particular emphasis on the relationship with the community and the family. Table 3 presents a specific example for the 2019 school year. In addition, the local weather monitor was placed in the school in 2012 which has provided real-time weather information to the students during their regular school days. In addition to the weather maps and the water level of the Miya River, radar rainfall with a resolution of 250 m and a blog about daily school life was provided (Figure 3). The students checked the provided information on their way to and from the school and during club activities, leading to the daily use of the information.

Table 3. Disaster education at Ise Miyagawa Junior High School (in 2019)

Classes	Contents
1st class	Where are the local hazards?
2nd class	Let’s learn about weather information, warnings, and advisories.
3rd class	Let’s think about our home preparedness.
4th class	What happens when a disaster occurs? Summary of Disaster Prevention Lesson.

Thus, all the students, except the junior high school students from elementary schools other than Nakajima Elementary School, received continuous disaster education. Therefore, this study verified the long-term effects and impacts of continuous disaster education through a survey to ascertain the current status of the students receiving such education and the thoughts of the students and the parents about disaster education and actual disasters.



Figure 3. Classes and local weather monitor at Ise Miyagawa Junior High School
(photographs by the authors)

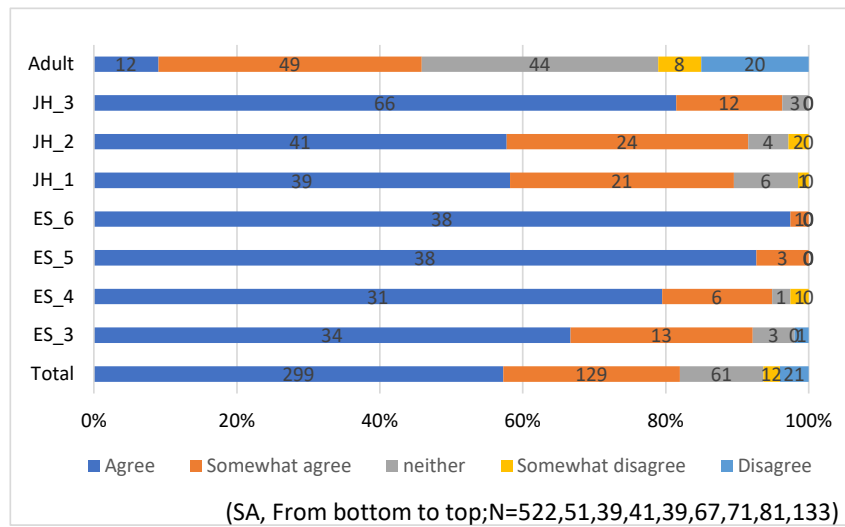
4. RESULTS

A total of 528 responses included 51 responses from Grade 3, 39 from Grade 4, 41 from Grade 5, and 39 from Grade 6 in the Nakajima Elementary School, 67 from Grade 1, 72 from Grade 2, and 81 from Grade 3 in the Ise-Miyagawa Junior High School, and 138 responses from the parents.

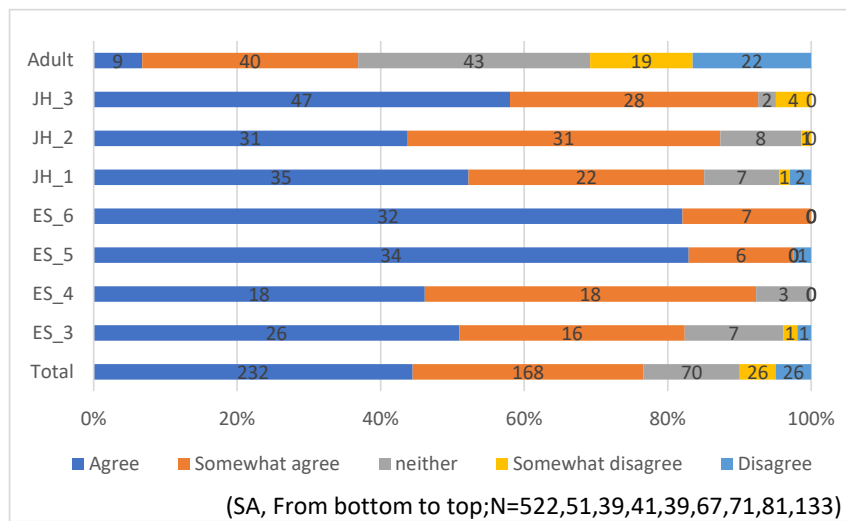
The following sections compare the results of each question between grades and between students and parents from the perspective of long-term evaluation of disaster education. As shown in Table 1, "Disaster education evaluation" will be confirmed from the results of Question 1, "Disaster preparedness and recall during disasters" from those of Question 2, "Change in disaster awareness" from those of Question 3, and "Views on future disaster prevention" from those of Question 4, respectively.

4.1 Disaster Education Evaluation

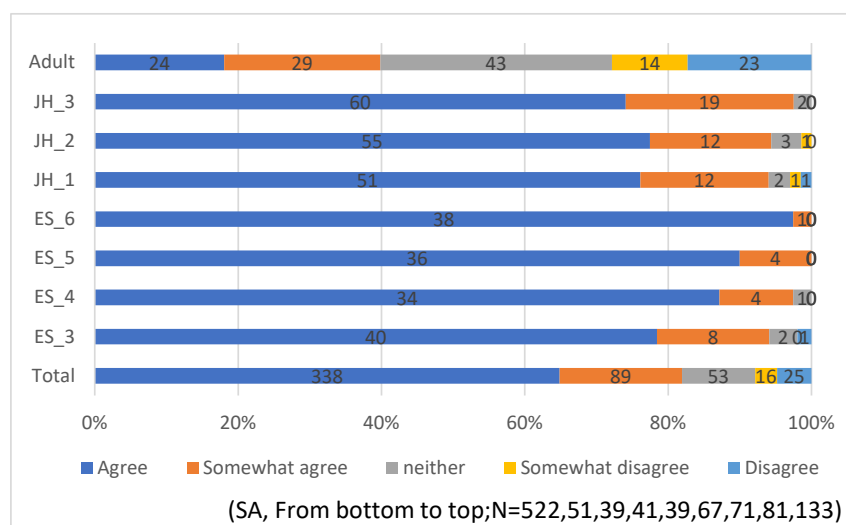
The results of Question 1 indicated similar trends among the three questions— (i) disaster education evaluation, (ii) increased interest in disasters, and (iii) influence on the awareness of actions to be taken due to disasters (Figure 4). Specifically, among elementary school students, the number of children who responded positively (total of +2 and +1) increased from Grade 3 to Grade 6, reaching 80-100% in each case. In junior high school, the number of students who responded positively reached around 90%, although the change was not as high in each grade as in elementary school.'



(i) Disaster education evaluation



(ii) Increased interest in disasters



(iii) Awareness of actions to be taken during disasters

Figure 4. Disaster education evaluation

(ES_xx: elementary school students in Grade xx, JH_xx: Junior high school students in Grade xx)

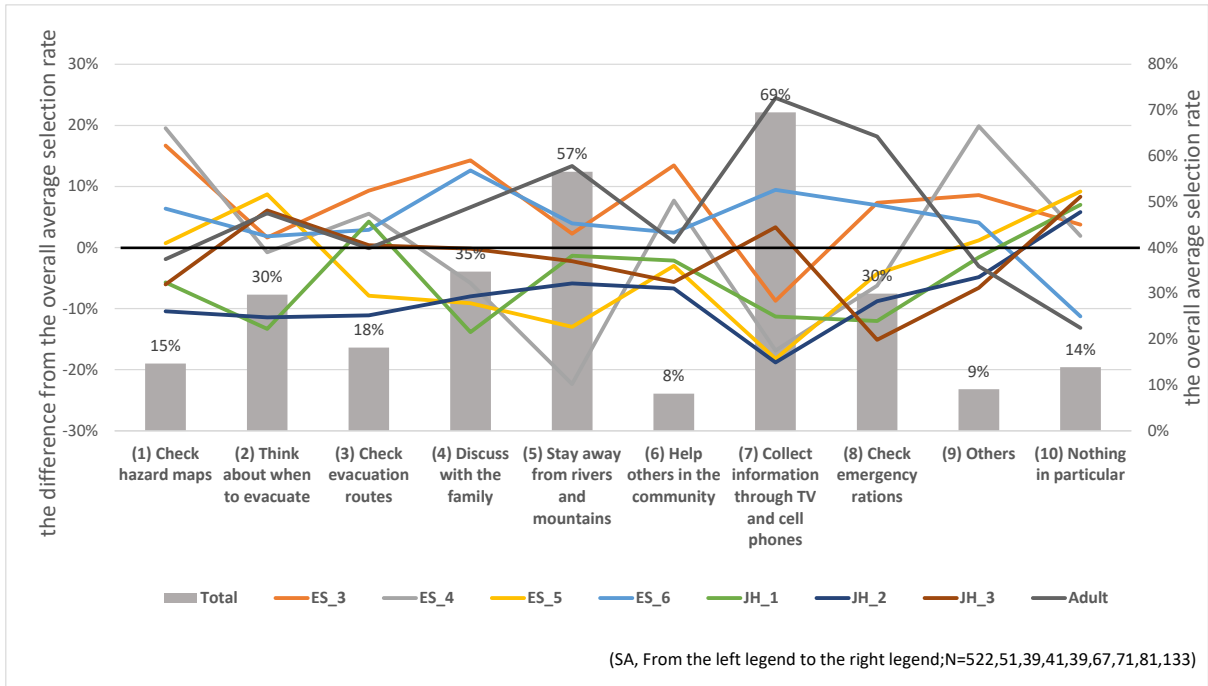
However, unless there is a problem with the educational content, such questionnaires do not generate a large number of negative opinions which support previous class evaluations and surveys. Therefore, focusing only on the junior high school students who answered “agree (+2),” the results indicated (i) around 60-80% for disaster education evaluation, (ii) around 50% for the improvement of interest in disasters, and (iii) over 70% for the awareness of how to act during disasters. These results were similar to or lower than those for elementary school students.

The elementary school students rated their disaster preparedness education higher than the junior high school students since they completed and evaluated the education on the same day. However, since the junior high school students gave positive evaluations long after completing the disaster education, it suggested a higher positive impact of the education.

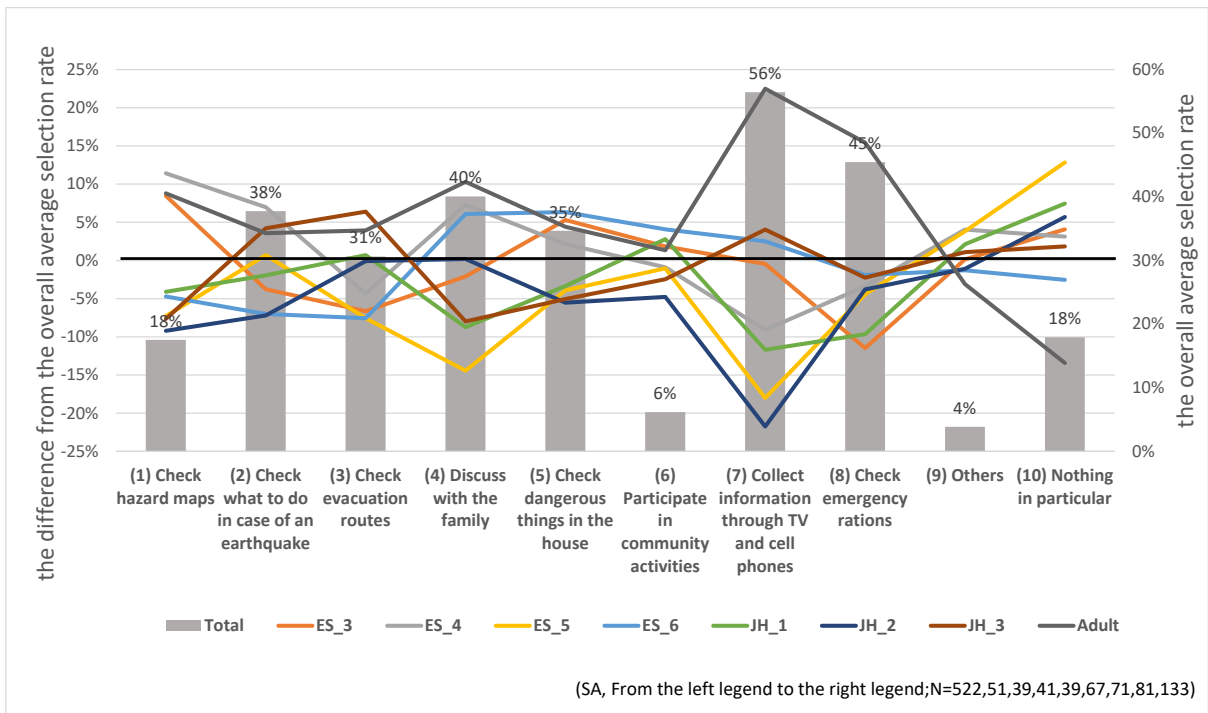
The results for the parents were different from the students. Less than 50% of the parents responded positively to each evaluation, which is neither low nor sufficiently high. Regarding parents’ participation in disaster education as children, 7% of the parents answered “several times,” 37% answered “a few times,” 45% answered “not many,” and 11% answered “never.” At 56%, more than half of the parents had not received sufficient disaster education, which may have influenced the results. Hence, it can be concluded that disaster education has been enhanced in recent years.

4.2 Disaster Preparedness and Recall During Disasters

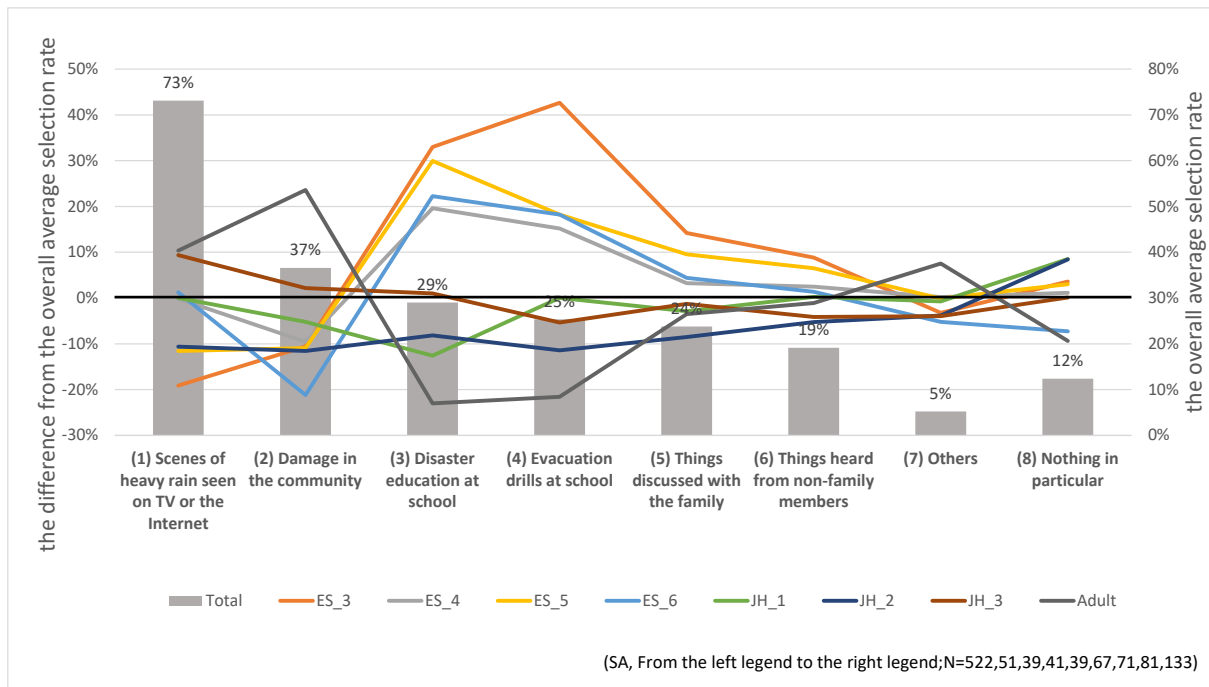
The results of Question 2 are shown in Figure 5. For ease of comparison and evaluation, Figure 5 presents, for each option, the selection rate for each grade as the difference from the overall average selection rate. In other words, “+” means a higher rate of implementation compared to the overall average. Confirming the actions to be taken during heavy rain, 69% of the respondents “(7) Collect information through TV or cell phones” while 57% “(5) Stay away from rivers and mountains”. However, only 8% of the respondents “(6) Help others in the community”, which was lower than the other items. When compared among grades, the rate of “(1) Check hazard maps” decreased with increasing age, while the overall implementation rates were lower than the overall average among Grade 5 in elementary school, and Grades 1, 2, and 3 in junior high school. Parents were more likely (+69%) to use TV or cell phones to gather information. When looking at the usual preparations for earthquakes, 56% of the respondents “(7) Collect information through TV and cell phones”; however, only 6% “(6) Participate in community activities”, which are similar trends as during heavy rain. No characteristic points were identified during grade comparison, except +56% of the parents “(7) Collected information through TV and cell phones”.



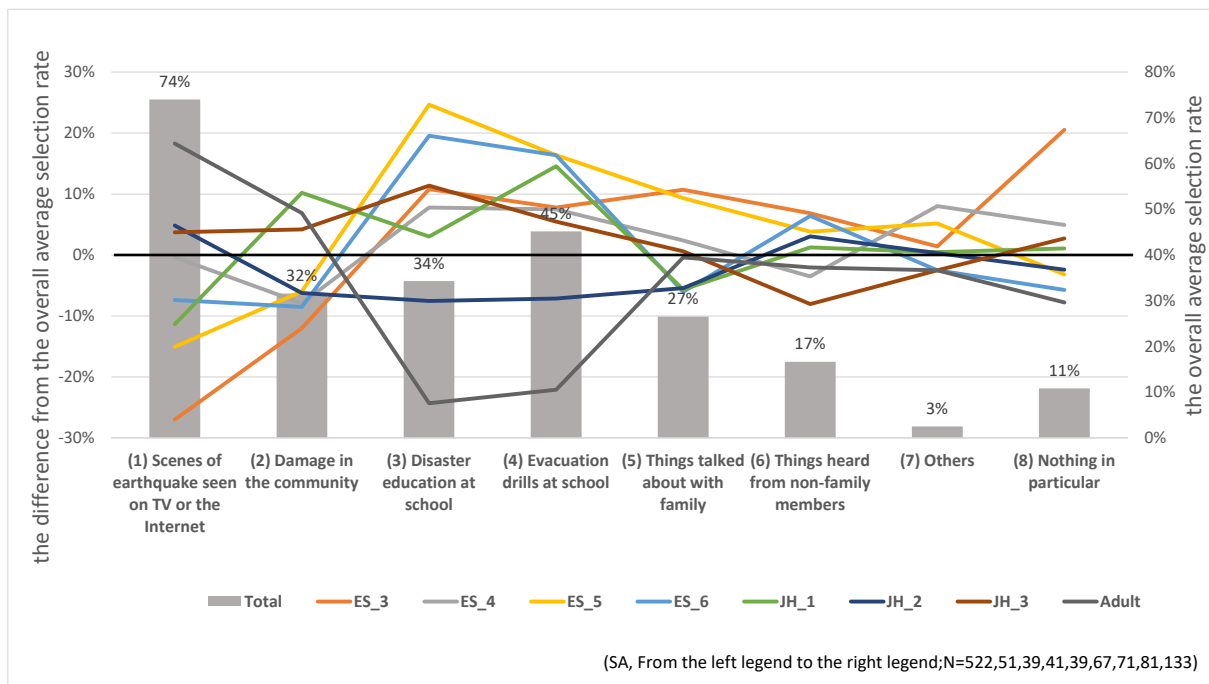
(i) Actions to be taken during heavy rain



(ii) Usual preparations for earthquakes



(iii) What to remember during heavy rain



(iv) What to remember during earthquakes

Figure 5. Disaster preparedness and disaster recall in disasters

(ES_xx: elementary school students in Grade xx, JH_xx: Junior high school students in Grade xx)

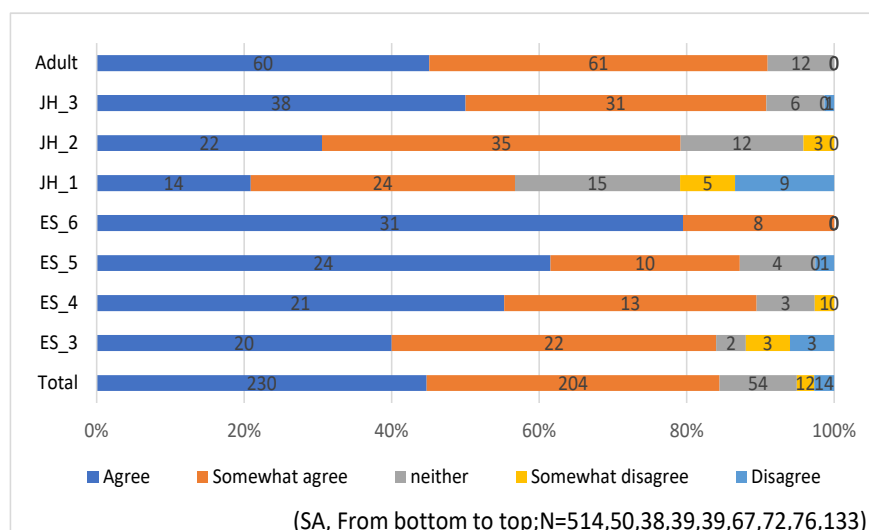
When recalling things during heavy rainfall, 73% of the respondents thought of “(1) Scenes of heavy rain seen on TV or the Internet” while only 19% recollected “(6) Things heard from non-family members”. Comparison between the grades indicated that “(3)

Disaster education at school” and “(4) Evacuation drills at school” decreased significantly from elementary school to junior high school to parents. However, “(1) Scenes of heavy rain seen on TV or the Internet” increased significantly, indicating that as children grow older, the impact of disaster education at school declines and they become more dependent on information from external sources.

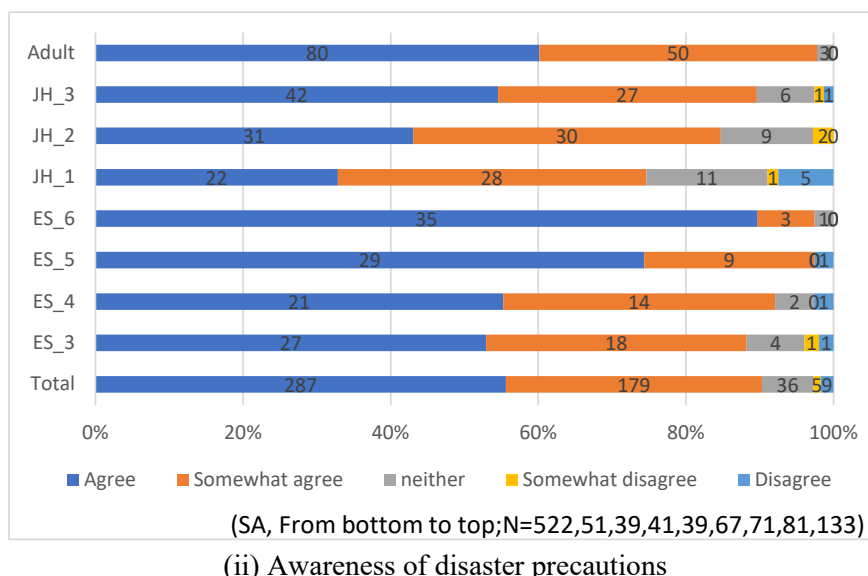
Regarding recalling information during an earthquake, 74% of the respondents recollected “(1) Scenes of earthquake seen on TV or the Internet” and only 17% recalled “(6) Things heard from non-family members”. Comparisons between grades revealed similar characteristics to recalling things during heavy rainfall.

4.3 Change in Disaster Awareness

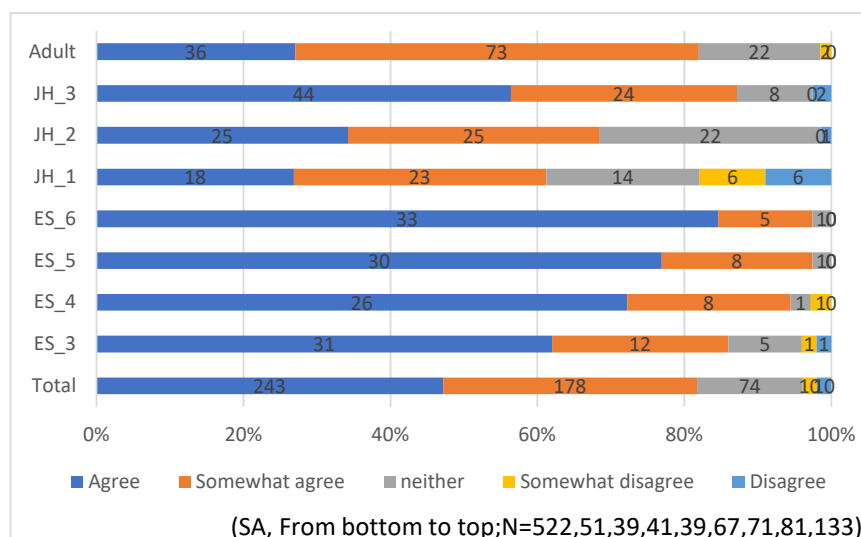
The results of Question 3 indicated similar trends across all the questions, with improvement in each grade level of elementary and junior high schools (Figure 6). However, there was a decline between Grade 6 students in elementary school and Grade 1 students junior high school. This may be due to the survey timing or the point of comparison between the junior high school students and their elementary school counterparts. For parents, the results were similar to Grade 3 students in junior high school, except for “behavior in case of disasters”. Although a change in awareness could be attributed to external factors; however, some improvement was likely achieved through disaster education during the growth process from elementary school to junior high school. This assumption is based on the fact that students had little opportunity, other than disaster education at school, to seriously think about disaster response.



(i) Disaster prevention knowledge



(ii) Awareness of disaster precautions



(iii) Behavior during disasters

Figure 6. Change in disaster awareness

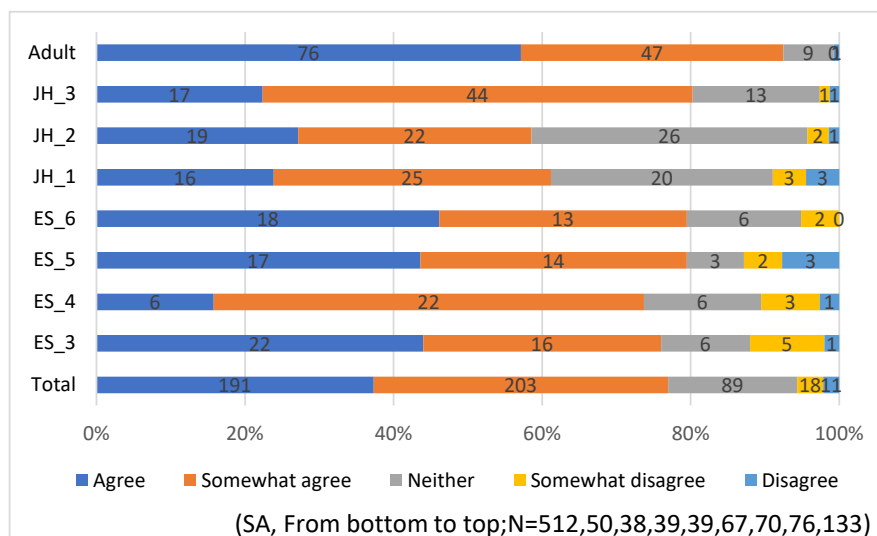
(ES_xx: elementary school students in Grade xx, JH_xx: Junior high school students in Grade xx)

4.4 Views on Future Disaster Prevention

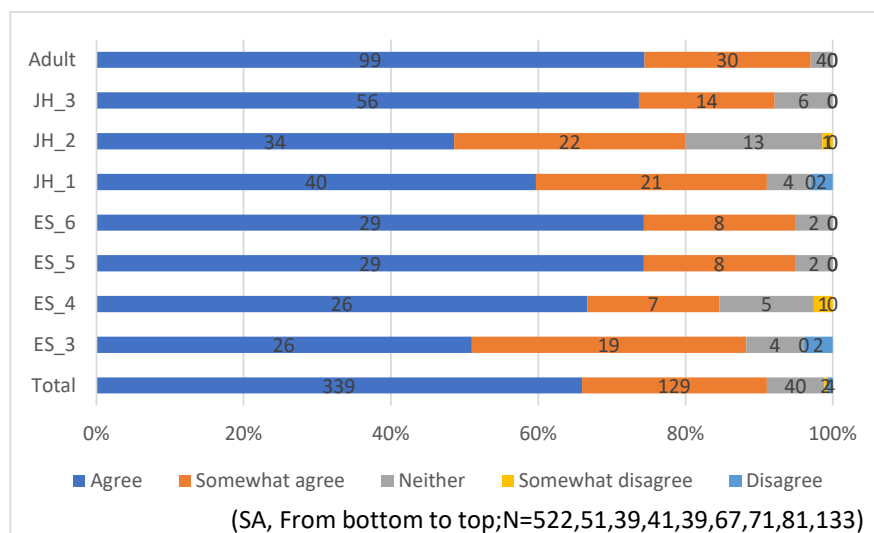
Regarding respondents' future views on disaster risk reduction in Question 4 (Figure 7), 77% had a positive response (a total of +2 and +1) about "interest in future disaster education". However, differences were observed among the grades. Although the reasons could not be determined, Grade 4 in elementary school and Grades 1 and 2 in junior high school were slightly less positive than the other grades. Nevertheless, parents responded more positively (92%) than the students. Regarding "caution against disasters in the future," 91% of the respondents had affirmative responses, indicating a high awareness of the need for

caution against future disasters, given the increased risk of flooding due to climate change. However, among the students, a smaller percentage of students strongly agreed (+2) (Grades 3 and 4 in elementary school and Grades 1 and 2 in junior high school). However, this number increased with increasing grade levels in both elementary and junior high school. Almost all the respondents (95%) were in favor of “future disaster preparedness” and the rate of agree(+2) increased with grade in both elementary and junior high school.

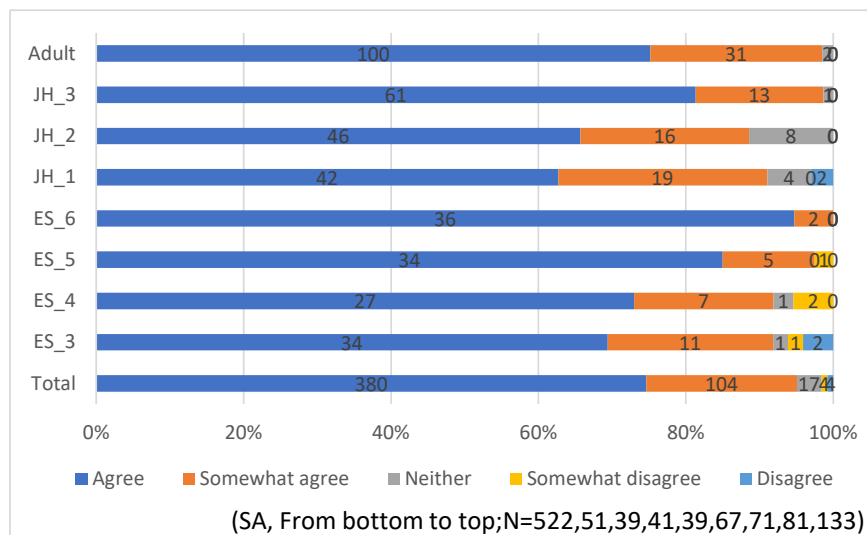
Thus, parents expressed the most positive views on future disaster prevention, which was confirmed by the students, regardless of grade level.



(i) Interest in future disaster education



(ii) Attention to future disasters



(iii) Behavior in response to future disasters

Figure 7. Views on future disaster prevention

(ES_xx: elementary school students in Grade xx, JH_xx: Junior high school students in Grade xx)

5. DISCUSSION

5.1 Disaster Education Evaluation

The disaster education evaluation was mainly based on Question 1 about the impressions of disaster education and its effectiveness. Characteristically, elementary and junior high school students and their parents had different impressions of disaster education; however, most students evaluated disaster education positively. On the contrary, less than half of the parents were positive about disaster education. Parents' impressions may have been based on their past experiences, memories, and other factors. Since the relative impressions of the current disaster education provided to their children were taken into account, it can be concluded that recent disaster education in the research site has been more extensive than in the past. In fact, 56% of the parents reported that they did not have much access to disaster education as children (-1 and -2). The results of the χ -square test on the results of Question 1 were divided into two groups – positive [(1) several times, (2) a few times] and negative [(3) not many, (4) never] – and a significant difference was confirmed for all the questions ($p < 0.0001$). Hence, a tendency to give negative answers due to insufficient disaster education in childhood was noted. Furthermore, to evaluate the impact of disaster education due to recent enhancements, the authors conducted a χ -square test on participation in disaster education (Q.1(0)), dividing parents based on whether they were elementary school students at the time of 1995 Great Hanshin-Awaji Earthquake, and confirmed a significant difference ($p < 0.005$). This may confirm that recent changes in disaster education had significant impacts.

Thus, concerning current disaster education, elementary and junior high schools evaluate it positively, although the trend of the results differs. On the other hand, as indicated by the results for parents, it was also confirmed that the loss of opportunities for disaster education naturally led to negative impressions of past disaster education. This result is consistent with the fact that “positive results in short-term evaluation” are often noted in many other studies of disaster education.

5.2 Long-Term Effects of Disaster Education

The long-term effects of disaster education, particularly in Questions 2 and 3, were confirmed as changes in daily preparedness for disasters, the content recalled during disasters, and changes in disaster awareness. Although these results did not have a follow-up survey of individual students, the trends and the changes in the school year were considered long-term effects of disaster education.

The results of Questions 2(i) and 2(ii) indicated that, in terms of daily disaster preparedness, there were no clear trends among the participants, except for the fact that information collection was more prominent among parents. Disaster preparedness was low among Grade 5 in elementary school and Grades 1, 2, and 3 in junior high school; however, it was higher among the lower grades in elementary school. It may be inferred from these results that the long-term effect was not sufficiently long-lasting. The reason for the low response rate among 5th graders was not clear. However, since it is possible that the different locations that elementary school students come from can be a factor in the low response rate among junior high school students, an independent samples t-test was conducted on the number of choices for each part of Question 2, excluding “nothing in particular”, depending on whether the students came from Nakajima or other elementary schools. In all the questions, there was no significant difference ($p > 0.005$) between the respondents from Nakajima Elementary School and other elementary schools. In fact, a survey on the status of disaster education was separately conducted for each elementary school, and it was confirmed that various types of disaster education, including evacuation drills, were provided in schools other than Nakajima Elementary School. Therefore, it is appropriate to assume that the low level of behavioral choices occurs among junior high school students as they grow older. Option 6 of each question was related to cooperation with the local community. Although Nakajima Elementary School conducts disaster education in cooperation with the local community, it is not completely linked to daily disaster response. It had been assumed that through the implementation of classes by the residents, awareness of the need to work with the community would increase; however, the survey confirmed that this point was not fully conveyed. Therefore, it may be necessary to reconsider the class content such as clarification of cooperation in the community in the events of disasters to improve this weak link.

Regarding Questions 2(iii) and 2(iv), the proportion of respondents who recalled disaster education and evacuation drills at school (options 5 and 6) decreased with increasing age, while the proportion of those who relied on external information (option 1) increased. As

people grow older, they have more opportunities to come into contact with various types of information about disasters; however, there is information dependence and a wait for disaster information, suggesting that the current disaster education would replace external influence in the long run. Hence, it is necessary to discuss that the current disaster education may not have a sufficient long-term impact.

As shown in the previous section, the current disaster education contributes to the basic awareness and understanding of disasters; however, it may not be contributing enough for promoting daily life preparedness and effective use in case of disasters. It is necessary to adjust the content to the changing environment with age. As Johnson *et al.* (2014) pointed out, “while there is significant evidence of valuable knowledge change, there is still very limited empirical evidence of how disaster education programs facilitate children's roles in household preparedness, their self-protective capacities, or their likelihood of preparing for disasters as adults.” This study confirms the challenges of current disaster education and the need to reconsider its content from a long-term perspective. We believe it is also necessary to continuously conduct the same survey across age groups, precisely designed to evaluate long-term impacts to facilitate such discussions.

The results of Question 2 also showed almost similar results for heavy rain and earthquake. This is another important point. Current disaster education often deals with natural phenomena separately, such as heavy rainfall and earthquake, since the impact and response to natural disasters may differ depending on the type of disaster. However, the results of this survey suggest that there may not be much difference in the effects of disaster education on these types of disasters. Therefore, it is important to discuss and to develop disaster education programs that transcend the boundaries of various natural disasters.

5.3 Disaster Education Evaluation

Long-term evaluation is required in disaster education because disasters are relevant for all generations, regardless of age; therefore, the emphasis is on its future impact. Similar perspectives exist in other educational evaluations; however, they are especially important in disaster education. In fact, disaster prevention lectures for adults are held across Japan, and the extent to which disaster education is considered and implemented as a lifelong education is a very important perspective.

Question 4 asked about respondents' thoughts on future disaster education. Parents were more interested in future disaster education than students, which may be due to lost opportunities and low evaluation of disaster education as a child, as mentioned in Section 5.1. When the χ -square test was conducted on the results of Question 4 after dividing the results into two parts – positive responses [(1) several times, (2) a few times] and negative responses [(3) not many, (4) never] – regarding the status of attending disaster education as a child, no significant differences were found for any of the questions, indicating a high awareness about future disaster education, regardless of past participation in disaster education. This result

indicated that disaster education must target students and be discussed and positioned for adults, including parents. Disaster education is basically targeted to children in most cases; however, Musacchio *et al.* (2014) discusses disaster education for the elderly as well, it is necessary to consider the prospects for long-term disaster education programs in a cross-generational manner and educational programs that allow for intergenerational collaboration.

Regarding future disaster awareness and willingness to act during disasters, positive opinions increased with increasing grades in both elementary and junior high schools. In addition, future interest in disaster education increased with grade. Although it is unclear whether this is an effect of disaster education, it is clear that interest in disaster education is not decreasing, even though the position of disaster education in daily life tends to decline with grade level. The same holds for the parents.

Thus, in addition to the long-term evaluation of disaster education, it is important to position disaster education as lifelong education, and discuss better ways to link interest in disaster education with actual preparedness and action. Disaster education in schools in cooperation with local communities has been discussed in recent years. One method would be for local residents to conduct disaster education, rather than teachers outside the community who are transferable in their positions, as is the case at the research site of this study. The importance of disaster education in free-choice learning environments such as museums has also been pointed out (Sumy *et al.*, 2022). It is also possible to relate disaster education to the understanding and enjoyment of nature. Thus, it is very effective to utilize opportunities for cross-generational exchange in disaster education, or conversely, to use disaster education as a means of creating cross-generational exchange.

In Japan, the use of smartphones by the elderly has been increasing. MIC (2021) reported utilization rates of 73.4% for those in their 60s and 40.8% for those in their 70s and older. In some countries, mobile devices have penetrated all generations. Mobile devices can be an important common means of receiving alerts in disasters. Therefore, disaster education through mobile devices would also provide a good opportunity for all generations to experience some drills of disasters (e.g., Budimir *et al.* (2021), Yamori and Sugiyama (2020)). The results of this study also show that external influences increase with age, and it is also important to take advantage of such information-based opportunities with mobile devices. However, since the use of such mobile devices for disaster education often targets individuals, it is also important to consider the perspective of cross-generational exchange in their use.

6. CONCLUSION

To ascertain the long-term effects of the current disaster education, students and their parents at Nakajima Elementary School and Ise-Miyagawa Junior High School in Ise City, Mie Prefecture, were surveyed through a questionnaire from four perspectives—disaster

education evaluation, disaster preparedness and recall during disasters, change in disaster awareness, and views on future disaster prevention.

The results demonstrated that the parents' generation, which had few opportunities for disaster education, gave a low evaluation, while elementary and junior high school students gave a very high evaluation. As for the long-term effects of disaster education, both elementary and junior high school students' attention to disasters, and their willingness to take action, increased with their grades, indicating that the current disaster education is highly evaluated from a long-term perspective. Regarding the content of daily disaster preparedness and recall during the disasters, the recall of disaster education and evacuation drills at school declined significantly with age, and the accumulation of external information through TV and the Internet significantly increased, especially during flooding. However, regarding future disaster education, all the respondents had positive opinions, especially the parents. Hence, it is evident that disaster education must be positioned as a lifelong education and successfully linked from foundation building to practice. In addition, it must be targeted at both the students and the parents by spilling over from the students to the parents.

A long-term evaluation of disaster education was conducted as a comparison between grades and between students and parents, rather than changes for the same individuals. This evaluation is only one of various methods on long-term evaluation, and it is not a perfect one. The relationship between individuals would also need to be discussed. Based on the results of this study, the evaluation method itself must be further explored over the long term. Hence, it will be necessary to discuss long-term research support, including long-term research periods and a system of regular surveys at school institutions. This study suggested that the effectiveness of conventional disaster education content in elementary and junior high schools is limited and may be superseded by external factors. In addition, a more disaster-conscious cooperative system would be needed in collaboration of disaster education with the local community. We believe that more careful discussions would be needed for lifelong education, per the grade level and across ages, along with future research. Points that require further discussion and for which no clear reason has been identified in this study will be the subject of future research since we plan to continue conducting disaster education with the target schools.

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