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EARTHQUAKE AND DISASTER MANAGEMENT EDUCATION FOR CHILDREN WITH INTELLECTUAL DISABILITIES

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Abstract

In the Great East Japan Earthquake in 2011, the death rate of people with disabilities (those with a disability certificate) was nearly double that in the entire affected area. Since the earthquake, the Ministry of Education, Culture, Sports, Science and Technology (MEXT) of Japan has stressed the importance of disaster management education at special needs schools. This education is intended to prepare children with disabilities (elementary to high school) to think, judge, and act properly and independently during disasters, and is based on the current status, characteristics, and degree of children's development, as well as the current conditions of the local community. However, at many special needs schools, emergency drills are performed in a non-independent manner; in other words, the date of each drill is specified in advance, and teachers give directions to children (e.g., to wear a safety helmet or protective hood, or to get under tables) and also support children when necessary. Such drills are likely to cause children to develop passive attitudes, such as "teachers (or adults) always protect and help me," or "I can depend on teachers (or adults) when I would like to do something." Such attitudes are undesirable because they result in children with intellectual disabilities having fewer opportunities to develop their abilities to think, judge, and act for themselves.

This study thus developed a disaster management educational program, based on existing studies, that trains children with disabilities to proactively protect themselves when they feel shaking due to an earthquake or see or hear an earthquake early warning issued by the Japan Meteorological Agency, even if there are no teachers or adults around them. This educational program is implemented according to each child's level of learning-related intellectual disability (four levels). Our program is characterized by the following goals: 1) improving preparedness to recognize earthquake early warnings, 2) adopting an attitude of self-sufficiency, and 3) being willing to accept directions and/or support from others. This program has been designed so that disaster management education is implemented on a daily basis by teachers at special needs schools without the need for intervention by disaster management specialists.

The program was developed using the Analysis, Design, Development, Implementation, and Evaluation (ADDIE) processes of instructional design (ID). The program was then implemented by teachers at the Tochigi Prefectural Special Needs School, and children and teachers performed self- and objective assessments of children's attitudes and actions. Then the program efficacy was evaluated statistically. Figure 1 shows a portion of the evaluation results. Positive changes were observed in children with mild disabilities; they started to think and act in an independent manner, and imitate others in their emergency responses in an early stage of the program. Children with severe disabilities also benefited; they became able to silently take actions based on a teacher's directions and to get under a table with some support. Children with profound disabilities (class A1 in the relevant local classification) showed several positive changes; although they could not protect themselves throughout the implementation of the program, they became able to keep silent after hearing an earthquake early warning and tried to get under a table with teachers.

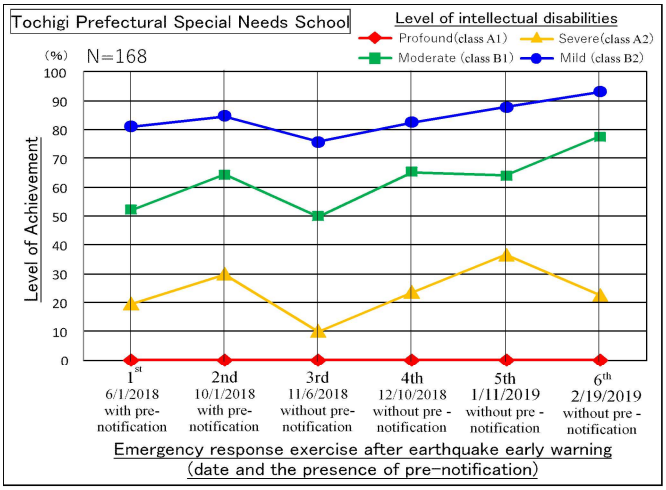

Fig. 1 – Teachers' objective assessment of the item "the child took action to protect him/herself."

These results demonstrate the efficacy of this disaster management education program designed for different levels of intellectual disabilities.

Keywords: special-needs schools, Intellectual Disability, disaster management education/training program

1. Introduction

1.1 Necessity of measures for people with disabilities based on lessons learned from the Great East Japan Earthquake

Japan is an earthquake-prone country. On March 11, 2011, the Great East Japan Earthquake (hereinafter referred to as "the Earthquake") occurred off the coast of the Tohoku Region in Japan. The Earthquake, which had a magnitude of 9.0 and a maximum seismic intensity of 7, is the largest in Japan's history. The Earthquake caused a huge tsunami, resulting in extensive and widespread tsunami damage and 18,434 dead or missing persons (as of March 2019, National Police Agency), mainly in Miyagi, Iwate, and Fukushima Prefectures in the Tohoku Region.

According to the White Paper on Disabilities issued by the Cabinet Office of Japan, the death rate of people with disabilities who need care (those with a disability certificate) was nearly double that of the entire disaster-affected area [1]. To prepare people with disabilities for future major earthquakes, it is important that they acquire knowledge about earthquakes and the ability to protect their lives in case of an earthquake without relying on tangible measures.

1.2 Current status of and challenges in disaster management education for people with disabilities

Following the Earthquake, the Ministry of Education, Culture, Sports, Science and Technology (MEXT) has presented the disaster management education goal at schools as "promote disaster management education to improve the ability to predict and avoid risks" in the "Final Report of the Council on Disaster Education and Disaster Management after the Great East Japan Earthquake" [2]. In addition, according to guidelines such as the "Reference Materials for Disaster Management at School – Development of Disaster Management Education to Foster “Zest for Life”" [3] and “Safety Education in School to Foster “Zest for Life”” [4], disaster management education must be enhanced to foster the ability to survive in accordance with the state of disability, the stage of development, and characteristics of children with disabilities as well as the measures taken in the region.

All schools, including many special needs schools, implement school wide evacuation drills (assuming a fire or an earthquake) systematically every year as opportunities for disaster management education. During these drills, students practice evacuation with instructions and assistance from teachers, including instructions for initial response actions (e.g., wear a safety helmet or disaster prevention hood, get under a desk to protect themselves, etc.). As a result, one challenge in disaster management education is that children gradually lose the abilities to think and make decisions in an independent manner because they develop a passive attitude such as thinking, "the teacher (or an adult) will always protect me" or "I can rely on the teacher (adult) to tell me what to do."

In addition, previous studies on disaster management education for students with disabilities have pointed out the lack of teaching plans and learning materials such as worksheets that can be customized based on the characteristics of disabilities and the necessity to develop educational curricula that practices disaster management education [5]. Furthermore, a different study has found that the research necessary to systematize disaster management education and specific cases of practice is lacking [6].

Considering these facts, it is an urgent challenge to offer practical disaster management curricula in special needs education to address existing issues for students with disabilities.

1.3 Purpose

This study presents a case of implementation and demonstrates the efficacy of an earthquake disaster management education program, which is made by customizing an existing earthquake disaster management education program developed in previous studies [7] [8] by considering the general learning characteristics and other learning-related capabilities for people with intellectual disabilities. The program was implemented at the participating school with the goal of applying the program comprehensively to all students with disabilities.

To this end, we developed a program that is applicable to the four different levels of intellectual disabilities using the learning theory of the ADDIE process, which is an instructional design (ID) framework [9] [10]. During the program development process, the effectiveness of the program was evaluated by analyzing the results of students' self-evaluations statistically and identifying the degrees of achievement against the learning objectives. In addition, an objective evaluation was performed by teachers on the attitudes and behaviors of students (including those who cannot self-evaluate) to verify and improve the educational effects of our program accordingly.

The educational program developed in this study is designed to be freely customizable to enable teachers at special needs schools to implement disaster management education in their daily teaching without intervention from disaster management specialists. Based on the outcomes of the program at the participating school, we also examined an optimum way to systematically advance disaster management education.

2. Application of an earthquake disaster management education program to people with intellectual disabilities

2.1 Customization of an earthquake disaster management education program

An earthquake disaster management education program already exists and is practically implemented for children in regular schools. Similar to this existing program, the objective of this study is to develop students' attitudes and abilities to take actions to protect their lives in an independent manner upon hearing or seeing an earthquake early warning (issued by the Japan Meteorological Agency) even when there are no adults to help them. The learning objectives were set based on the following aspects by levels of disability: preparedness to recognize earthquake early warnings, attitude to act in an independent manner (self-sufficiency), and attitude to accept directions and support from others. The following four levels of intellectual disability were: A1 (profound; IQ is about 20 or less), A2 (severe; IQ is about 21 to 35), B1 (moderate; IQ is about 36 to 50), and B2 (mild; IQ is about 51 to 70).

To develop a program adaptable to each level of intellectual disability, this study employed the ADDIE process and customized the five steps of an existing program: analysis, design, development, implementation, and evaluation (Fig. 2).

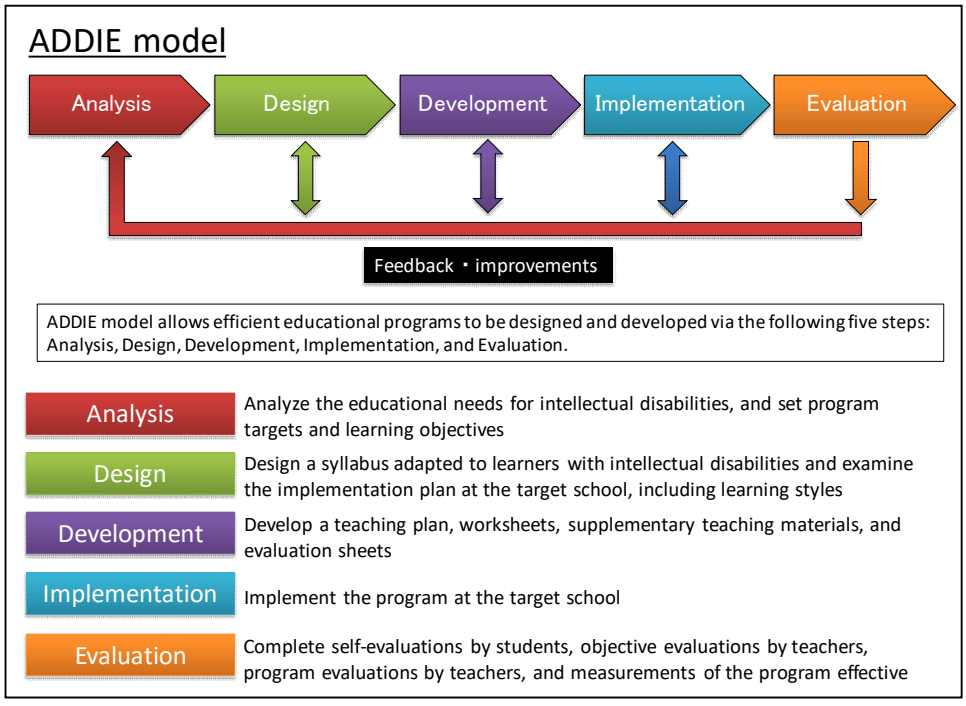

Fig. 2 – Program development using the ADDIE model

2.2 Implementation and evaluation of the program

The participating school was the Tochigi Prefectural Tochigi Special Needs School, which provides education for children with intellectual disabilities (Fig. 3).

Contents (target students/with or without pre-notification)	Objectives	Date
1st Questionnaire on earthquakes	Measurement of effectiveness	May 31, 2018
Preliminary study (all students/by department)	Studying disaster management	June 1, 2018
1st Emergency response exercise after an earthquake early warning (all students with pre-notification)	Emergency response exercise	June 1, 2018
2nd Questionnaire on earthquakes	Measurement of effectiveness	June 1, 2018
1st Response evaluation	Objective evaluation	June 1, 2018
2nd Emergency response exercise after earthquake early warning (all students with pre-notification)	Emergency response exercise	October 1, 2018
3rd Questionnaire on earthquakes	Measurement of effectiveness	October 1, 2018
2nd Response evaluation	Objective evaluation	October 1, 2018
3rd Emergency response exercise after earthquake early warning (all students without pre-notification)	Emergency response exercise	November 6, 2018
4th Questionnaire on earthquakes	Measurement of effectiveness	November 6, 2018
3rd Response evaluation	Objective evaluation	November 6, 2018
4th Emergency response exercise after earthquake early warning (all students without pre-notification)	Emergency response exercise	December 10, 2018
5th Questionnaire on earthquake	Measurement of effectiveness	December 10, 2018
4th Response evaluation	Objective evaluation	December 10, 2018
5th Emergency response exercise after earthquake early warning (all students without pre-notification)	Emergency response exercise	January 11, 2019
6th Questionnaire on earthquakes	Measurement of effectiveness	January 11, 2019
5th Response evaluation	Objective evaluation	January 11, 2019
6th Emergency response exercise after earthquake early warning (all students without pre-notification)	Emergency response exercise	February 19, 2019
7th Questionnaire on earthquakes	Measurement of effectiveness	February 19, 2019
6th Response evaluation	Objective evaluation	February 19, 2019

Fig. 3 – Contents of the educational program implemented at the participating school

To evaluate the effectiveness of the program, a self-evaluation by the students (learners) was used to verify the degrees of achievement for the learning objectives and to measure the effectiveness of the program. An evaluation method for programs is academically defined by Robert M. Gagné, an ID researcher, as "should be expressed solely by evaluation of the learners' performance" [11].

As part of our program's implementation, we distributed a "Questionnaire on Earthquakes," which had eight questions. Each question corresponded to a specific learning objective of our program. The questionnaire was used to measure the effectiveness of the program through a quantitative (three-rating) self-evaluation of learning achievements.

Four questions evaluated the level of knowledge. 1) Do you know what happens when an earthquake occurs? 2) Do you know what you should do when an earthquake occurs? 3) Do you know what happens when you hear the sound of an earthquake early warning? 4) Do you know what you should do when you hear the sound of an earthquake early warning? The learners evaluated themselves using three ratings: 3) Yes, I know; 2) I know a little; 1) No, I do not know.

The remaining four questions assessed the understanding of the appropriate actions. 5) Do you think it is dangerous to stay in a place where things fall, drop, or move when an earthquake occurs? 6) When an earthquake occurs or you hear an earthquake early warning, do you think you should keep a low posture, protect your head and body, and stay still until the shaking stops? 7) Do you think that you should move to a safe place as soon as you hear an earthquake early warning to protect yourself? 8) Do you think you should think and protect yourself in an independent manner when you feel any earthquake shaking or hear an earthquake early warning? The learners answered these questions using three ratings: 3) Yes, I think so; 2) I think so a little; 1) No, I do not think so.

2.3 Evaluation and analysis of the program

The effectiveness of our program was evaluated statistically using the paired t-test on the self-evaluation dataset collected before the program was initiated (May 31, 2018) and after the sixth emergency response exercise was completed (February 19, 2019). The subjects of the analysis were students (n = 71) enrolled in junior high and high schools with B2 and B1 levels of intellectual disability as these students were able to answer the eight research questions.

The score for each question increased from before to after the customized program. Hence, the degrees of achievement of the learning objectives increased. In addition, the paired t-test showed that all items had a statistically significant difference at the 1% significance level, confirming the educational effects and effectiveness of our program (Fig. 4).

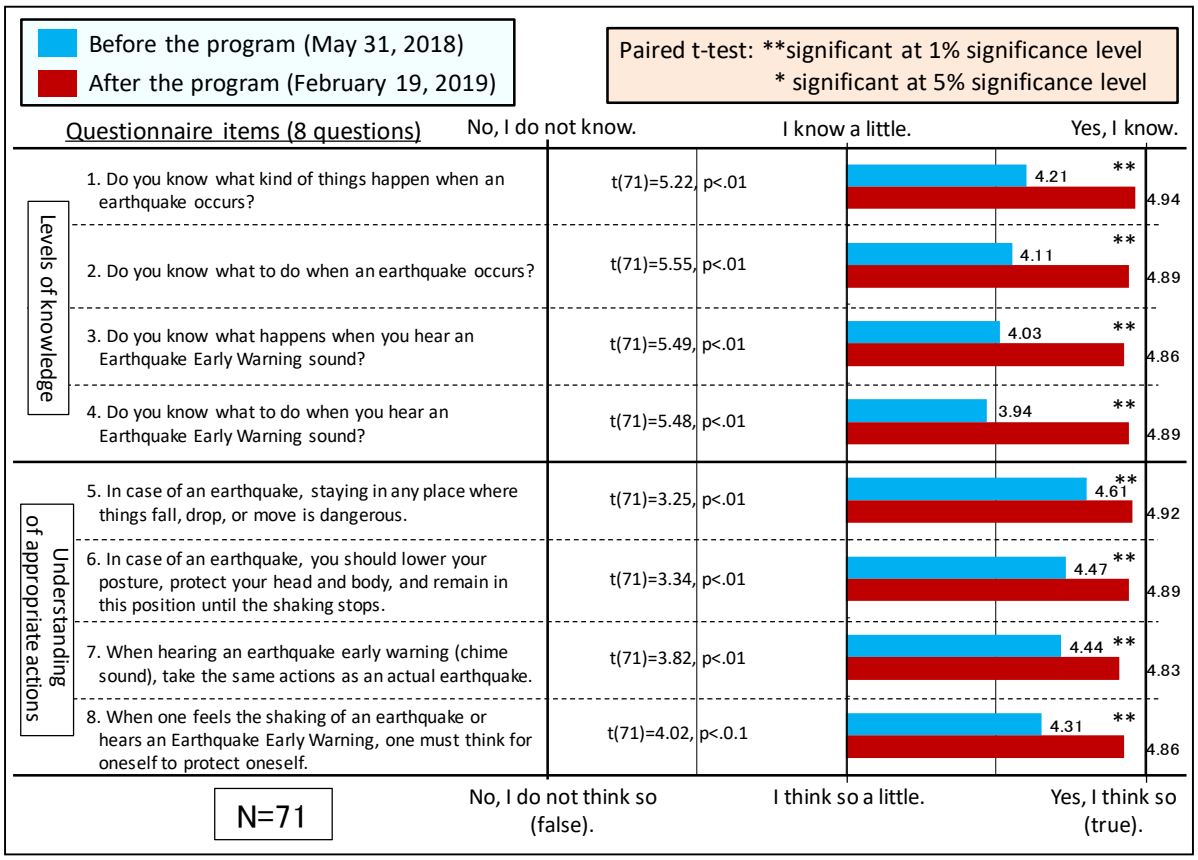

Fig. 4 – Measured effectiveness of the earthquake disaster management education program at the participating school

2.4 Objective evaluation of emergency actions

The program was implemented for all students of the participating school, regardless of the level of disability. To verify the educational effects of our customized program, teachers objectively evaluated the change in the responding actions of the students from the perspectives of attitude and behavior. In this objective evaluation, the learning objective was to "think independently without panicking and get under a table/desk or take other actions to protect yourself." The degree of achievement was rated on a five-point scale: 1) The student could do it independently; 2) The student could take an appropriate action by imitating others; 3) The student tried to do something; 4) The student could not take any action; 5) The student took action with a teacher. Teachers observed students' actions and completed an individual evaluation sheet for each student. The authors tabulated and analyzed the sheets.

The evaluation was conducted on all students enrolled in the participating school (n = 168). The evaluation was performed based on the total points of the individual scores of each objective evaluation for the six response exercises. Figure 5 shows the proportion of answers for "1) the student could do it independently" by level of disability.

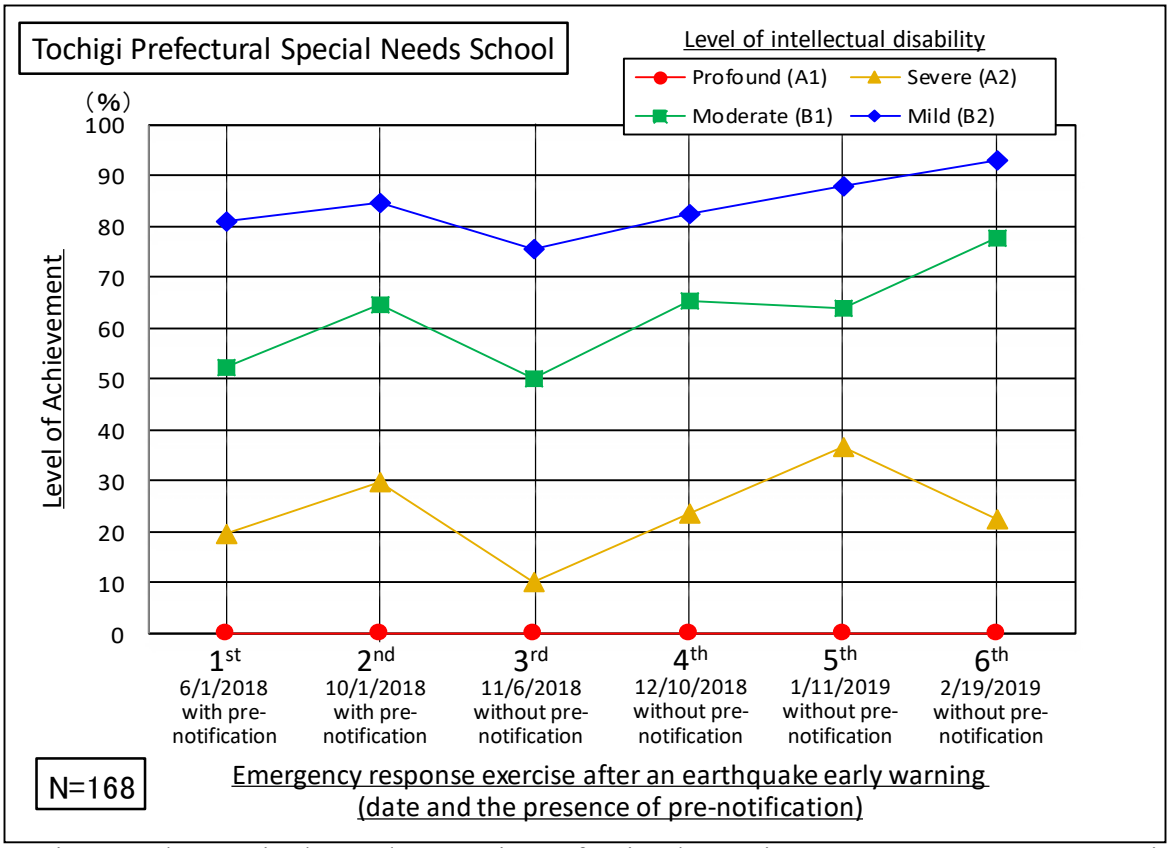

Fig. 5 – Changes in the students' actions after implementing emergency response exercises (all students)

For students with a B2 disability level (n = 49), the score was low in the third exercise because it was the first one conducted without pre-notification, and many students could not take appropriate responding actions. However, as the exercises without pre-notification were repeatedly conducted, the score tended to increase. Accordingly, the degree of achievement of the learning objectives improved. The same tendency was observed for students with B1 (n = 50) and A2 (n = 55) levels of disability. However, the score for students with an A2 disability level decreased in the sixth exercise. This is attributed to the fact that some students were unable to take actions using their own decisions because the exercise was conducted in an unfamiliar place (outside the classroom).

On the other hand, students with an A1 disability level (n = 14) could not act independently even after the exercises were repeated. However, when looking at the details of the evaluation, the score increased for "5) the student took action with a teacher." Hence, students with an A1 disability level showed a slight improvement as they were able to take action with the assistance from teachers without panicking (Fig. 6).

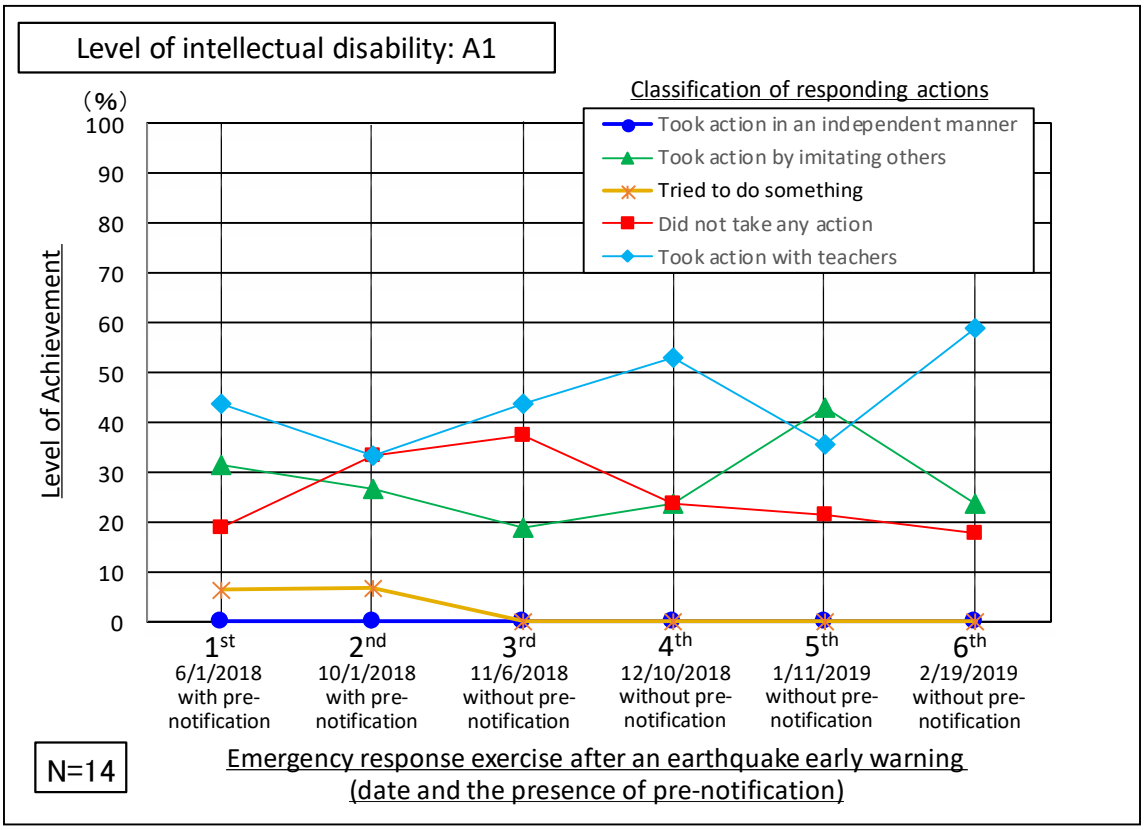

Fig. 6 – Changes in the students' actions due to emergency response exercises (level of intellectual disability: A1)

Based on these evaluation results and interviews with teachers, we summarized the key points for teaching emergency responses to students with intellectual disabilities according to the level of disability (Fig. 7).

Level of intellectual disability	Key points for teaching in the preliminary study	Key points for teaching the proper actions
A1	Ensure students understand: -They should protect their heads upon feeling shaking from an earthquake or hearing an earthquake early warning -The earthquake early warning is a signal of upcoming earthquake shaking -Have students practice listening to the warning sound to reduce fear upon hearing the warning	Ensure students are able to: -Get under a table with teachers' assistance -Imitate "roly-poly" to help themselves with teachers' assistance -Have students practice taking appropriate actions in classrooms
A2	In addition to the teaching points for level A1 students, ensure students understand: -After an earthquake early warning, an earthquake will occur -They can act before receiving any directions from teachers -Have students imagine an earthquake in detail (using pictures and/or videos)	In addition to the teaching points for level A1 students, ensure students are able to: -Take action by imitating others upon earthquake early warning -Take action to protect their lives in an independent manner upon earthquake early warning.
B1	In addition to the teaching points for level A2 students, ensure students understand: -There is only a short time from an earthquake early warning to earthquake shaking -An earthquake early warning may also occur in their daily life -An earthquake may occur without an earthquake early warning	In addition to the teaching points for level A2 students, ensure students are able to: -Take action to protect themselves out of the classroom -Make decisions about the situation and take appropriate actions independently (junior high and high schools) -Review their responding actions (junior high and high schools)
B2	In addition to the teaching points for level B1 students, ensure students: -Gain broad knowledge about earthquakes (junior high and high schools) -Understand the mechanism of an earthquake early warning (junior high and high schools) -Think about damage caused by earthquake off school (junior high and high schools)	In addition to the teaching points for level B1 students, ensure students are able to: -Always make decisions about the situation and take appropriate actions independently (junior high and high schools) -Review and examine their responding actions (junior high and high schools)

Fig. 7 – Key points for teaching the proper actions by level of disability

In the implementation of the program, students with mild intellectual disabilities (B2 and B1) were able to think and act on their own judgement and decisions or take action by imitating others from an early stage of the implementation. Students with severe disabilities (A2) showed changes such as taking actions by following instructions from teachers or silently getting under a desk with support from teachers. Students with profound disabilities (A1) could not take actions to protect themselves but showed change as they were able to remain calm when being surprised by an earthquake early warning, accepted support from a teacher, and tried to get under a desk together with a teacher. These findings indicate that implementing a customized program can develop the attitudes and abilities of students to take actions in an independent manner according to their level of disability.

3. Conclusion

This study developed an earthquake disaster management education program applicable to students with different levels of intellectual disabilities (four levels). The program was designed by customizing a previously developed earthquake disaster management education program according to the levels and states of disabilities. Its effectiveness was subsequently verified by implementing at a participating school.

The customized program enhanced the educational effects, confirming its effectiveness as a disaster prevention education program for different levels of intellectual disabilities. Moreover, if the program was not customized (e.g., the style or format of the overall program was not changed), tailoring the exercise objectives based on developmental age and repeatedly implementing the program improved the educational effects as a systematic disaster management education to foster the "zest for life" needed for self- and mutual- help (Fig. 8).

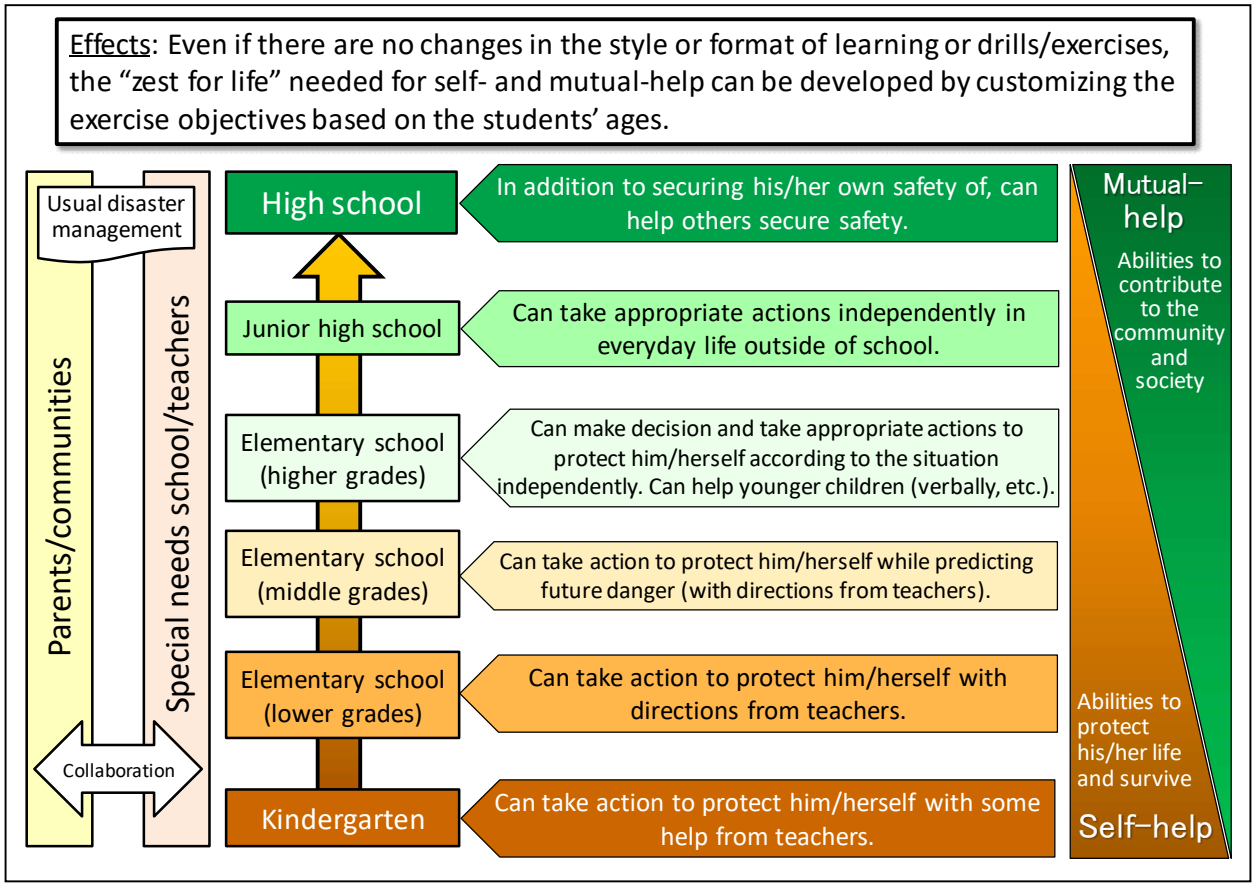

Fig. 8 – Systematic disaster management education according to the stages of development

4. Acknowledgements

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5. References

[1] Cabinet Office of Japanese Government, "White Paper on Disabilities 2012,"2012 (in Japanese).

[2] Ministry of Education, Culture, Sports, Science and Technology, "Final Report of Council on Disaster Education and Disaster Management after the Great East Japan Earthquake,"2012 (in Japanese).

[3] Ministry of Education, Culture, Sports, Science and Technology, "Reference Materials for Disaster Management at School – De-velopment of Disaster Management Education to Foster "Zest for Life","2013 (in Japanese).

[4] Ministry of Education, Culture, Sports, Science and Technology (MEXT), Safety Education in School to Foster 'Zest for Life,' 2010 (in Japanese).

[5] Motoki Fujii and Mitsuo Matsumoto, "An Undertaking of Disaster Management Education for Students with Intellectual Disabilities -- A Case Study of Gifu Prefectural Kamo Special Needs School," Bulletin of Center for Educational Practice, Shizuoka University Vol. 22, pp. 73-81, 2014 (in Japanese).

[6] M. Wada, H. Ikeda, R. Ikezaki, M. Kuribayashi, A Discourse on Directions for Disaster Management Education in Special Support Schools for the Intellectually Disabled -- Based on Results of Interviews on Current Status and Examination of Practice as Set Forth in Curriculum, Bulletin of Department of Human Development Science, University of Toyama, No. 2, Vol. 10, pp. 143-153, 2016 (in Japanese).

[7] T.Nagata and R.Kimura, "Practice of Disaster Management Education to Enhance "Zest for Life" by Using Earthquake Early Warning–Cooperation among Local Meteorological Observatory, Board of Education and Schools, "Papers of Institute of Social Safety Science,No.21,pp.81-88,2013 (in Japanese).

[8] T.Nagata and R.Kimura, "Proposing A Multi-Hazard Approach to Disaster Management Education to Enhance Children's "Zest for Life": Development of Disaster Management Education Programs to Be Practiced by Teachers", Journal of Disaster Research, Vol.12, No.1, pp.17-41, 2017 (in Japanese).

[9] T.Inagaki and K.Suzuki, "Manual for Design of Classes Ver.2 Instructional Design for Teacher,"Kitaooji Shobo Publishing, 2015 (in Japanese).

[10] K.Suzuki, "Instructional Design for Practice of E-learning,"Journal of Japan Society for Educational Technology, Vol.29, No.3, pp.197-205, 2006 (in Japanese).

[11] R. M. Gagne, W. W. Wager, K. C. Golas, and J. M. Keller, "Principles of Instructional Design (5th ed.)," Wadsworth Pub Co, Belmont, CA, 2004, Translation supervised by M. Iwasaki and K.Suzuki, "Principles of Instructional Design, "Kitaooji Shobo Publishing, 2007 (in Japanese).

