

DEVELOPMENT OF AN ACTION MANUAL AND AN EDUCATIONAL PROGRAM FOR COMMERCIAL VEHICLE DRIVERS TO ESTABLISH THE ACTION PATTERNS DURING AN EARTHQUAKE

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Abstract: *APEX Corporation., Ltd., which operates and manages vending machines of paper cup beverage, and University of Hyogo developed “Disaster Management Manual for Drivers” and “Disaster Management Education Program” so that drivers of commercial vehicles can take appropriate actions when an earthquake occurs. In developing the educational program, we adopted the ADDIE model of Instructional Design, which is a theory for enhancing the effectiveness, efficiency, and appeal of educational activities. From interviews with employees, it became clear that there was a need for an educational program to learn appropriate evacuation actions without disorientation in the event of a disaster while driving a commercial vehicle. We set four learning goals: Knowing the dangers of roads immediately after a disaster, Understanding the psychological state of disorientation, understanding appropriate evacuation procedures, and Be able to use disaster prevention items related to evacuation. The disaster management manual was created based on the contents of the learning objectives. It is laminated so that it will not deteriorate even if it is left in the car, and it is easy to browse and add or remove pages by punching holes and putting it together with a card ring. In the disaster management education program, rather than simply reading textbooks, such as watching videos, doing drama-style group work, and using disaster prevention items, students can imagine a disaster situation and work proactively. When we developed teaching guidance plans and teaching materials and implemented the educational program for drivers of APEX, we were able to confirm the effectiveness of this program, with statistically significant improvement in ability for all eight learning objectives. The learning effect was maintained three months after the implementation of the educational program, and we concluded that the educational program establishes behaviour patterns.*

1. Introduction

In this study, we developed an educational program to enable people to respond appropriately even if they are driving a car during an earthquake. The researchers worked with Apex Corporation to develop and validate an “Apex Disaster Management Manual” for drivers and an “educational program” to learn it, according to the ADDIE model of instructional design.

When a person encounters a major earthquake while driving a car, it is important to immediately stop the car to avoid dangerous driving, leave the car in consideration of aftershocks, and not interfere with emergency

vehicle operations when evacuating from the car. In Japan, the appropriate evacuation action in the event of an earthquake is to stop the car as soon as possible and leave the car in neutral or with the engine key still in the ignition in a condition such that the car can be started.

However, based on a survey of the driving behaviour of drivers who were on the road during the 2016 Kumamoto earthquake (April 14: Mw 6.2; April 16: Mw 7.0) conducted with a Japan Meteorological Agency seismic intensity scale of 6 (the third highest intensity level in Japan) or higher, only 25 out of 270 people (i.e., approximately 9.3%) responded appropriately when the earthquake occurred (Center for Automotive Safety and Driving, 2017). This may be because of a lack of knowledge regarding earthquake response procedures and the state of disorientation in which they could not make appropriate judgments due to the massive impact of the earthquake. Hence, an educational program was developed to provide the knowledge and skills to respond when driving a car during an earthquake. In developing the educational program, “Disaster Management Manual for Drivers” aiming to enable commercial vehicle drivers to respond appropriately in the event of an earthquake and “Disaster Management Education Program” to establish the behavioural patterns described in the manual, were developed in cooperation with Apex Corporation, which operates and manages vending machines of paper cup beverage (Figure 1).

Route sales representatives

Cleaning and sterilization of machines during daily patrols

- Parts cleaning and water replacement in the machine
- Alcohol and hot water sterilization
- This work is verified by the base director/manager



Figure 1. Apex Corporation's vending and commercial vehicles and the role of route sales representatives

2. Method

The disaster education program was developed based on the ADDIE Model of Instructional Design (ID) theory. ID is a learning theory in pedagogy, psychology, and educational engineering that is defined as a “model or field of study that compiles methods to increase the effectiveness, efficiency, and attractiveness of educational activities, or the process of applying these methods to realize learning environments such as teaching materials and classes” (Suzuki, 2006). The ADDIE model is the core model of ID. The model enables the design and development of effective educational programs through five steps: analysis, design, development, implementation, and evaluation (Figure 2) (Inagaki and Suzuki, 2015). The ADDIE model has been used in the development of educational programs in interdisciplinary fields from social sciences to engineering, and has been also used in development of disaster educational programs for earthquakes, tsunamis, storms, and floods. (Nagata and Kimura, 2017, 2020; Ikeda et al., 2021; Nagata et al., 2022).

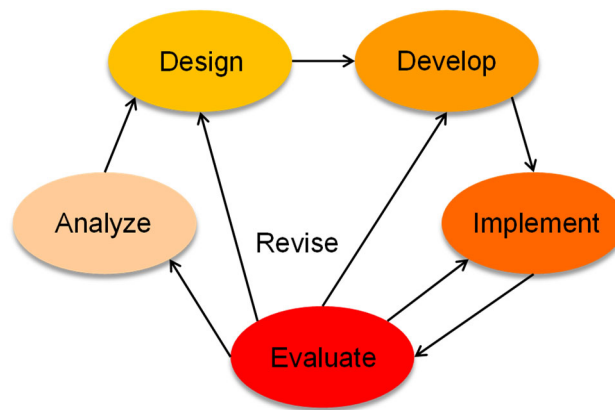


Figure 2. Program development by ADDIE model

3. Implementation according to the ADDIE model

3.1. Analysis

To investigate the level of disaster preparedness awareness among Apex Corporation employees, interviews were conducted with several employees online and in person in September and October 2022. The interviews revealed diverse statements: “I know that disasters are scary, but I struggle to identify specific dangers,” “I cannot imagine how I would respond if an earthquake occurred while I am driving,” “I do not know the appropriate response procedures in case of an earthquake,” “I do not keep emergency supplies in my car,” and “I believe I would remain unaffected by a disaster.” These statements indicated that it is necessary to have a concrete image of what would happen in the event of a disaster and to know the appropriate response procedures. It was also found that it is necessary to learn how to use disaster management goods to protect lives in the event of an emergency.

3.2. Design

From the interviews, it became clear that there was a need for an educational program to “learn how to take appropriate evacuation actions without panicking when a disaster strikes while driving a commercial vehicle”. Thus, four learning objectives were set: “to understand the dangers on the road immediately after a disaster,” “to learn about disorientation,” “to understand the appropriate evacuation procedures,” and “to be able to use emergency items related to evacuation.”

The educational program was conducted for approximately 1 h, with the employees of the APEX Nishi-Nihon Corporation Kakogawa Sales Office in Hyogo Prefecture, Japan, as the study subjects. The number of prospective participants ranged from 20 to 30 and their ages ranged from their 20s to 60s. Because of the wide age range, the content needed to be designed so that all ages could understand and become interested in disaster management. In particular, the Disaster Management Education Program involved watching videos, engaging in drama-style group work, and actually using disaster management items to enable participants to imagine what they would do in the event of an actual disaster and to work according to their own initiative, rather than simply reading a textbook.

3.3. Development

In developing the program, after discussions with Apex Corporation, it was decided to develop an “Apex Disaster Management Manual” to be kept in commercial vehicles and a “Disaster Management Education Program” to help employees understand the manual.

3.3.1. Apex Disaster Management Manual

Figure 3 is an excerpt from the Apex Disaster Management Manual. The content of the manual comprises four points corresponding to the learning objectives: 1) appropriate evacuation procedures immediately after an earthquake disaster, 2) road hazards caused by disasters, 3) how to use emergency disaster management items, and 4) disorientation, which is the psychological state immediately after a disaster. A video was created to facilitate the understanding of the proper evacuation procedures immediately following an earthquake

disaster, and a QR code was included in the manual so that the video could be viewed. In addition, the procedures were also included with pictures in the manual. Road hazards due to disasters were described based on the situation, such as in residential areas, on highways, and with possible tsunamis. Emergency preparedness items included an emergency escape hammer and a foldable helmet with instructions for use. The content of disorientation included an explanation of the state of disorientation and a three-step mindset for overcoming disorientation.

The manual was designed to be: 1) complete on a single A4-size sheet so that it could be taken out of the door pocket of the car for quick reference; 2) laminated to enhance its durability in the car, making it waterproof and stain-resistant; and 3) bound in a card ring with a hole in the upper left corner for easy reordering and updating of the manual contents.



Contents

- Appropriate evacuation actions immediately following an earthquake
- Road hazards caused by disasters
- How to use emergency preparedness items during emergencies
- Disorientation, a state of mind immediately after a disaster

Format

- One complete A4 sheet
It can be taken out of the car door pocket and checked immediately.
- Laminated
→ Waterproof, stain resistant, and durable
- Bundled with a ring
→ Can change the order and add/remove information

Figure 3. Apex Disaster Management Manual (excerpt)

3.3.2. Disaster Management Education Program

The Disaster Management Education Program was not simply a classroom lecture based on a textbook but was devised to enable students to imagine what they would be like in the event of a disaster and to work according to their own initiative by watching videos, engaging in drama-style group work, and actually using disaster management items. After developing a one-hour program, a study instructional plan, a PowerPoint presentation for teaching materials, and worksheets were created (Figure 4).



Figure 4. Excerpts from the “Disaster Management Education Program” (left: instructional plan; middle: worksheets; and right: PowerPoint slides)

The main flow of the study instruction plan is presented below. In “Introduction,” the participants introduce themselves. In “Deployment 1,” the participants imagine what would happen if they were to be struck by a disaster while driving a car, and the types of dangers to which they might be exposed. In “Deployment 2,” an explanation of what happens to the human psyche in the event of an earthquake will be presented to deepen the understanding of disorientation. In “Deployment 3,” the participants learn to take appropriate evacuation actions when they feel an earthquake while driving a commercial vehicle through individual and group work in the form of a role-play based on the assumption that an earthquake has occurred. In “Deployment 4,” the participants also learned about heavy rain damage as a disaster other than earthquakes. In “Deployment 5,” the participants learn about items to be prepared in the car while actually using them. In “Summary,” the learning objectives of the lecture are reviewed and a question-and-answer session is held.

As materials for the class, PowerPoint slides, handouts with important parts of the slides left blank, and an “Evacuation Procedures Worksheet (in case an earthquake occurs while driving)” were created to consider the appropriate steps to take in response to an evacuation. The “Evacuation Procedures Worksheet” states the following: “You are on duty and traveling at a speed of 40 km/h around a residential area. Other vehicles are traveling in front and behind. At that time, an earthquake occurs. The ground rumbles and the car body shakes violently. The surrounding block walls have collapsed, and if the building is hit by an aftershock, it is likely to collapse at any moment. Feeling as if you are in danger, you decide to evacuate. At this time, what steps would you take to evacuate? If “An earthquake occurred” is the first event (1) and “Notify the head of your department of your safety” is the last action (11), write down the second to tenth responses that fall between the first and the last according to the procedure.” Under this instruction, the worksheet was designed to allow participants to think independently about the necessary response and the procedures to be followed.

In addition, video materials showing the actual procedures for response were created. In addition to viewing the video in disaster management education programs, a QR code for the video was presented in the Disaster Management Manual so that it could be viewed at any time, including during emergencies (Figure 5).



Figure 5. Created video materials (left) and captured images (right)

3.4. Implementation

The developed disaster management education program was implemented on December 7, 2022 from 5:45 p.m. to 6:45 p.m. for 28 employees of the APEX Nishi-Nihon Corporation Kakogawa Sales Office. The implementers were university students who developed the program. The lecture time was set at 60 min in the study plan, and actually lasted 60 min as planned (Figure 6).



Figure 6. Disaster management education program in action

3.5. Evaluation

3.5.1. Achievement of learning objectives

Before and after implementation of the program, an evaluation sheet was handed out with eight items that were further divided into the four learning objectives, and participants completed a self-evaluation. This is based on the definition of Gagné, a leading researcher of ID, that “evaluation is expressed solely in the assessment of the learner’s performance” (Gagne et.al., 2007).

There are eight essential tasks: 1) provide a comprehensive explanation of the condition called “disorientation” and its immediate post-disaster risks; 2) explain the three steps for self protection against disorientation; 3) elaborate on the dangers associated with roads immediately after an earthquake; 4) specify the road hazards resulting from heavy rainfall; 5) explain the proper evacuation procedures when encountering a major earthquake while driving a car for business purposes; 6) thoroughly explain the adverse effects of neglecting proper evacuation procedures during a major earthquake while driving a car for business purposes; 7) assemble a folding helmet; and 8) use an emergency escape hammer. The participants were asked to rate each on a five-point scale: 1: No, 2: Not very much, 3: Neither yes nor no, 4: Somewhat yes, and 5: Yes. These evaluations were conducted before and after the program implementation to assess whether the program was appropriate. They also completed a further self-evaluation three months after the educational program to determine whether the lessons learned in the learning objectives were retained.

Analysis of the responses showed a statistically significant increase in all items, indicating that the program was effective in achieving the learning objectives and that the content learned was retained even after three months (Figure 7). It can be thought of as having fostered an “awareness of their own affairs” (i.e., thinking about disasters as something that is close to them, and drawing on themselves), in which people think of disasters as a problem that is close to their own community and one that needs to be responded to properly, not as something that happens in other areas and is other people’s problem.

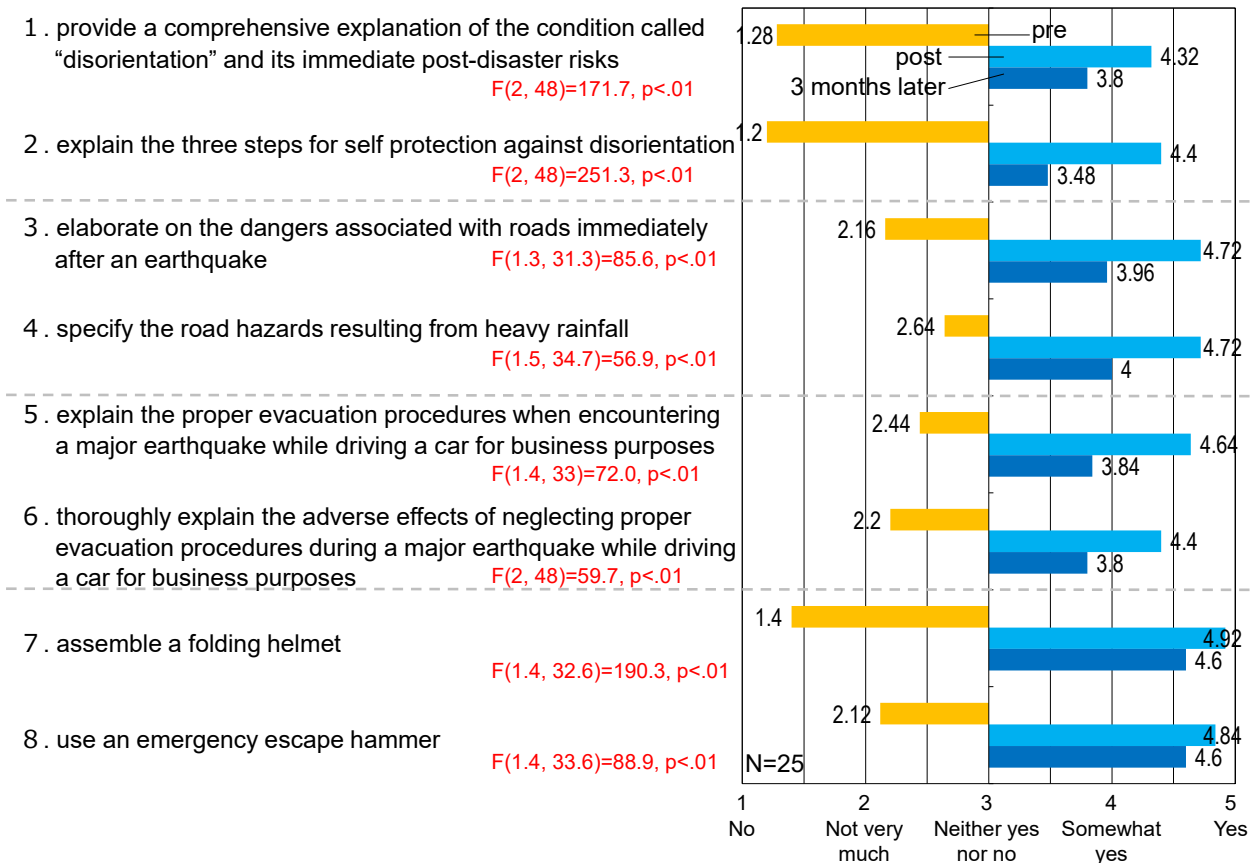
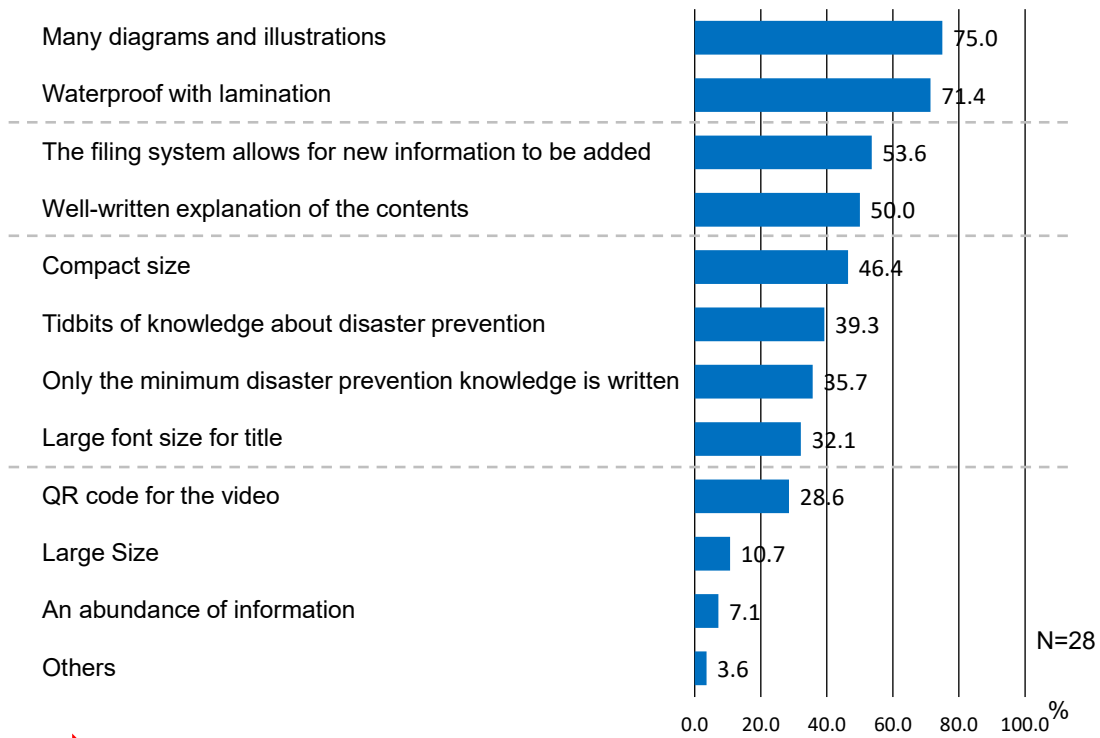


Figure 7. Achievement of learning objectives

3.5.2. Achievement of learning objectives

After the completion of this program, the participants were asked to evaluate the “Apex Disaster Management Manual,” and their evaluations are shown in Figure 8. Evaluations included the following statements: “There are many diagrams and illustrations” (75.0%), “It is laminated to be waterproof” (71.4%), “It can be filed to add new information” (53.6%), and “The explanations of the contents are well-written” (50.0%).



➔ The manual should be “well-written with lots of diagrams and illustrations,” “with a filing system that enables addition and deletion, and laminated.”

Figure 8. Elements needed to get more people to use the manual

The results of the evaluation of the disaster management manual three months after the program (Table 1) showed that “the main points are easy to understand and can be handled calmly,” “having the manual provides a sense of security,” and “checking the contents from time to time reminds you of things that you have forgotten.” However, there was also a request for the size to be small enough to fit in a passenger-side glove compartment or a door pocket. In the future, it will be necessary to improve the manual’s availability and responsiveness by reducing its size and by creating regular opportunities to check its contents.

Table 1. Evaluation of the disaster management manual (free opinion after 3 months of use)

Easy to get to the point and handle calmly.

- I think the manual is very easy to read, concise, and well proofread.
- I think it is very easy to understand, and I think I will be able to respond calmly, even in an emergency.

Having it provides a sense of security.

- The manuals are loaded with information on what to do in the event of an emergency, so I can perform my daily duties with peace of mind.
- I think it can be used in an emergency, so having it provides a sense of security.

Checking the contents from time to time reminds me of what I have forgotten.

- Once in a while, I check the contents to remind myself of what I have forgotten.

I would like it to be of an adequate size to fit in the passenger-side glove compartment or door pocket.

- It is easy to read because it is clearly organized. A smaller size would make it more manageable.
- Easy to understand but a little large
- I would like to have it on the passenger seat where I keep the vehicle inspection certificate; however, I would appreciate a smaller size because the A4 size does not fit in there.
- I would like the size to be adequate enough to fit in the glove compartment.



It is necessary to improve the manual's availability and responsiveness by reducing its size and by creating regular opportunities to check its contents.

4. Conclusion

In this study, we developed an educational program to enable people to respond appropriately even if they are driving a car during an earthquake. The researchers worked with Apex Corporation to develop and validate an "Apex Disaster Management Manual" for drivers and an "educational program" to learn it, according to the ADDIE model of instructional design. The developed disaster management education program was implemented for 28 employees of the APEX Nishi-Nihon Corporation Kakogawa Sales Office as examines. Analysis of the responses showed a statistically significant increase in all items, indicating that the program was effective in achieving the learning objectives and that the content learned was retained even after three months. The results confirmed that the educational program was effective in achieving the learning objectives. In addition, such educational programs to encourage appropriate behavior during earthquakes can also help reduce regional risks.

The study was conducted with the employees of the APEX Nishi-Nihon Corporation Kakogawa Sales Office. It is expected that the developed program will be implemented at all Apex's sales offices in Japan in the future. In addition, efforts will be made to improve the manual by making it compact enough to fit in a car door pocket and adding new information, such as emergency contact numbers and hazard maps of the travel area, to make the manual even more useful for earthquake response actions.

Furthermore, as a future development, consideration will be given to the versatility of the program by implementing the manual/education program developed in this study at other companies that use commercial vehicles. In addition, because the actual response in the program was only evacuation immediately after the earthquake, we would also like to consider making it a comprehensive manual/education program in conjunction with various response drills, such as fire extinguishing, safety confirmation, rescue and extrication, transporting injured people, and first aid.

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