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Empowering Reality: A New Injury Prevention Education System to Promote the Empowerment of Child Caregivers

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Abstract

Although awareness about the importance of injury prevention has been increasing among Japanese people, preventable injuries remain the third leading cause of death in children aged 0–14 years, and prevention of these injuries is critically important in terms of childhood health. To identify dangerous situations for children and provide preventive measures to avoid such situations, this paper proposes an effective method, called "Empowering Reality (ER)", that integrates knowledge graphs with object detection to enable lecturers to educate caregivers on preventing unintentional childhood injuries while communicating with caregivers using augmented reality technology. The proposed ER system consists of knowledge graphs for explaining dangerous situations, an online video capture part, and a situation recognition part. This paper describes the major advantages of knowledge graphs that consider not only the relationship between objects and injuries, but also dangerous layouts with the help of "inclusion" and "collocation" features. The feasibility and effectiveness of the system were evaluated through tests among caregivers, including 11 parents and six teachers from three nursery schools. This system allows lecturers to conduct in-situ suggestions about specific preventive measures adapted to the home or nursery school environment via online learning.

Keywords: *Empowerment, Injury Prevention, Online Education, Augmented Reality, Knowledge Graphs, Situation Recognition*

1. Introduction

In the past decades, various technologies have been developed to improve not only people's health, but also health education. The use of technology in health education enhances the ability of learners to absorb information that improves their quality of life. Augmented reality (AR) and virtual reality (VR) are some of the newer technologies used in healthcare and health education [1]. Gamification with the aid of AR has become a common method. Lin et al. [2,3] indicated that board games incorporating AR positively influenced learning outcomes, motivation, and negative emotions. Schwebel et al. [4] reported on the effectiveness of using smartphone-based VR to teach children about how to cross streets safely. Piech and Czernicki [5] conducted a literature review on VR and exergames for fall prevention in the aged and concluded that VR training is a promising approach to improve cognitive and physical functions. Safe Kids Worldwide, a leading global organization working on childhood injury prevention, also developed a new system using VR technology to educate parents [6].

In the present study, we focus on childhood injury prevention. Although awareness of the importance of injury prevention has been increasing among Japanese people, preventable injuries are still the third leading cause of death in children aged 0–14 years [7]. In Japan, the Ministry of Economy, Trade and Industry has promoted an engineering approach toward injury prevention, and now, many manufacturers are attempting to develop children's products that contribute to child safety, such as steamless rice cookers, flexible toothbrushes, pen lids with a hole, and edible crayons.

In the field of injury prevention, the modification of these products is referred to as a passive approach, meaning that people are required to take only minimal or no actions to prevent injury [8]. While a passive approach is practiced among many manufacturers, an active approach, which is education-based, is still accomplished using a traditional, top-down strategy. For example, people obtain injury-related information published in magazines, newspapers, and maternal and child health handbooks, parents attend parenting classes, and pediatricians give parents some advice for prevention. Although health education is fundamental for changing behavior, the existing methods have made little progress toward the betterment of injury prevention education.

Moving away from a top-down approach, our research employs health education empowerment models [9]. Empowerment has become central to public health, and a main characteristic of empowerment models is that their process is more valued than their outcomes. Empowerment occurs when

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people gain more power over the decisions they can make, which enhances their lives and health [9,10]. When empowerment models are applied to childhood injury, people solve their queries and become more familiar with possible preventive measures and empowered through gaining a deeper understanding of injury risk.

We previously proposed a new education system for injury prevention called “Empowering Reality (ER)”. We developed this ER system aiming to create a dual pathway through which caregivers and educators could work together to overcome unique challenges. For instance, even if they know the associated risks, many parents do not take preventive actions, such as installing safety gates at the top and bottom of the stairs, making their child wear a bike helmet, and keeping medicine out of sight and reach of children. People tend to think that negative events such as serious injury are less likely to happen to them; this is called “optimistic bias” [11,12]. In modern society, most parents face numerous competing priorities, such as going to work, doing housework, taking their children to lessons, and responding to e-mails. These competing priorities often cause parents to postpone taking necessary actions for injury prevention. In addition, in some cases, parents cannot install safety devices because of the layout of their home or rules in a rental agreement. These optimistic biases and hectic daily routines easily interfere with people’s motivation to take actions at the right time. People need to be empowered to overcome these challenges, and this cannot be achieved by one-way education.

In the present study, empowerment is defined as a process by which people expand their choices and gain more power over the decisions they can make to prevent childhood injury. Our proposed system enables lecturers to educate caregivers through real-time communication utilizing AR technology. In short, this study aimed to achieve the following:

1. Expand caregivers’ options while also discussing challenges or other reasons for not being able to take actions. This process creates an opportunity for both lecturers and caregivers to revisit issues around injury prevention on the individual level.
2. Help caregivers to become more empowered using the proposed system.

In this paper, we provide an overview of the ER system and discuss the results of a feasibility study conducted to evaluate its implementation.

2. Development of Empowering Reality (ER)

2.1. Overview of the proposed in-situ support system

Figure 1 shows an outline of the system proposed in this study. Online information presentation means using face-to-face communication apps such as Zoom or Skype to assess the living environment in real time and present necessary information about injury prevention. First, we asked the learner to obtain a picture of the indoor environment (e.g., living room, bedrooms, classrooms, corridors) using the device’s camera or a webcam (Caregiver’s PC, tablet, or cell phone) while taking part in the online learning. The live data are then received on the instructor’s end (Instructor’s PC). The captured image is subsequently processed to identify potentially dangerous objects that can lead to injuries. The recognition results and information on measures to prevent potential accidents or injuries are displayed by virtue of screen sharing with the caregivers.

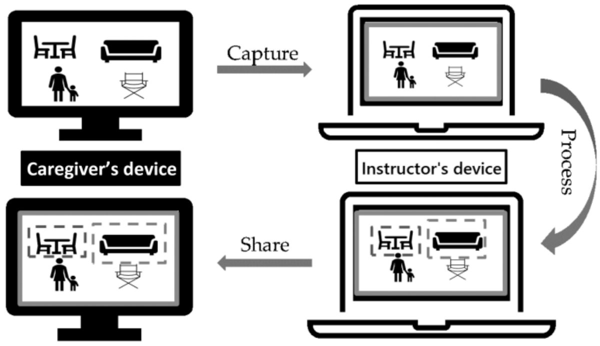

Fig. 1. The process of the proposed presentation system

2.2. Basic functions of the proposed in-situ support system

There are two main underlying technologies used in the proposed system. First, “knowledge graphs” help organize big data in the form of attributes and relationships, which makes it easier to visualize the information flow and extract required data effectively [13]. Second, “object detection” is an important technique used in the field of computer vision to detect multiple objects in an image or video, especially for real-time surveillance [14].

Figure 2 shows a detailed configuration of the presentation system proposed in this study. First, the image of the home or classroom obtained from the camera is retrieved via an online communication tool such as Skype or Zoom on the Instructor’s PC, and dangerous objects are detected. Then, the system refers to the knowledge graph database, which helps recognize not only dangerous objects, but also dangerous situations that can arise because of their relative position. Data on the detected dangerous situations and preventive measures are then presented to the parents. The developed system also provides support for creating and registering knowledge graphs on dangerous situations. It can be obtained from a database composed of various details on the relationship between objects and injuries (e.g., number of past accidents, age group prone to such injuries). Kivy, a Python-based graphical user interface tool, is used for the application development and information presentation.

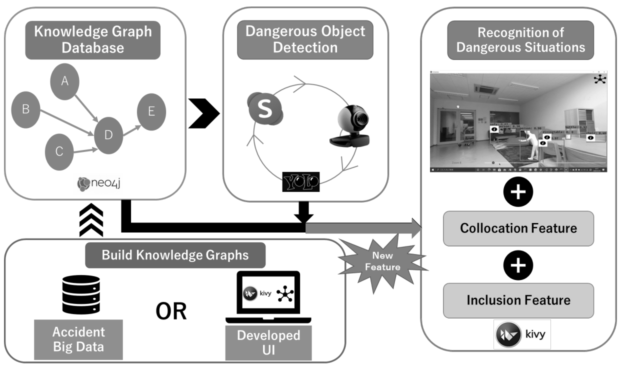

Fig. 2. System configuration for the detection of dangerous situations (Instructor’s PC)

2.2.1. Knowledge representation technology related to dangerous situations

Regarding injury situations, as shown in Figure 3, we created an ontology regarding the relative arrangement of dangerous objects and the relationship between objects and injuries using Neo4j [15]. Figure 3 shows how knowledge graphs were used in this study. A "node" represents a dangerous object (circle) or accident (ellipse) that occurs in a general household. Connecting these nodes represents the "relationship" between objects and injuries. Here, the "relationship" is the relative position between objects, the causal relationship with the object or injury, and so on. As shown in Figure 3, if a window is found above the sofa, it could lead to a fall injury, or blind shades that may have a cord could lead to accidental strangulation; therefore, the positional relationship is considered dangerous. In this way, using knowledge graphs helps not only to identify the danger from a single object, but also to define the potentially dangerous situations arising as a result of the positional relationships among multiple objects. These situations can then be deduced from the larger main object, such as the possible involvement of smaller parts such as cords, which are difficult to identify, even with the help of image processing techniques.

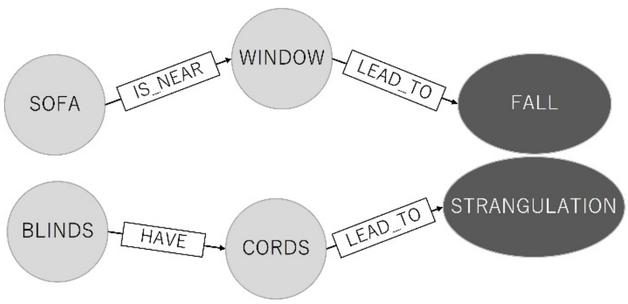

Fig. 3. Specific examples of dangerous situations implemented using knowledge graphs

Although accident situations vary widely, the accident information databank system of the National Consumer Affairs Center of Japan [16] and the Kids Design Circle, Japan [17], provide a possible way to define actual indoor accident situations by referring to their open datasets. For this reason, as shown in Figure 4, we also implemented an interface to define dangerous positional relationships using an image. Given an input image, objects are recognized, and by selecting the suitable objects and drop-down menus available, one can easily create a knowledge graph. The knowledge graphs can then be accumulated in a database and used for recognizing dangerous situations.

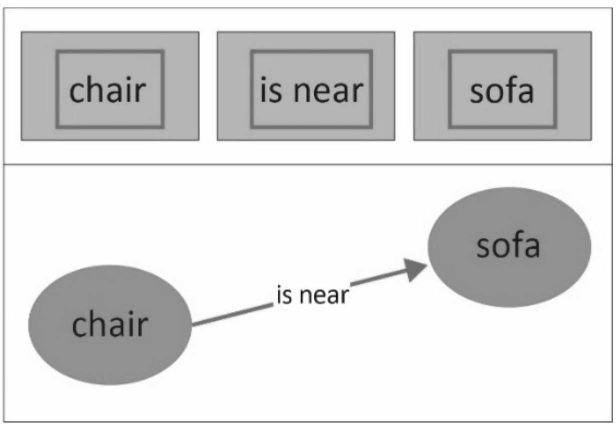

Fig. 4. Example of an interface to create knowledge graphs using object recognition

2.2.2. Dangerous situation recognition technology using image processing

For object detection based on images of the indoor environment, we used a popular pretrained neural network called YOLOv3 [18]. Dangerous situations are recognized by combining object detection with the use of the knowledge graphs proposed in this study. Figure 5 shows how the system achieves situation recognition in a simulated living space constructed within our laboratory. For validation, we considered 15 types of common dangerous objects that are present in general households, including a sofa, TV monitor, bed, backpack, cup, chair, dining table, bench, bottle, vase, refrigerator, fork, knife, wine glass, and potted plant.

Our system detects these predefined dangerous objects along with dangerous arrangements, and the details of the situation are presented when the lecturer clicks the "i-button". The system also presents the severity of an injury with the help of pink dots on the top right of each dangerous object detected (Fig. 5 shows the dots in gray scale). On a scale of 1–5, "1 dot" indicates the "lowest priority" and "5 dots" indicates the "highest priority". The prioritization of these risks is based on multiple factors, such as the child's age, number of past accidents, and relative position of the objects. This helps parents understand which risk more dangerous and which actions need to be taken as soon as possible. Upon clicking the "i-button", detailed information about dangerous objects is displayed, as shown in Figure 6. These details include: 1) an illustration showing exactly why the situation is dangerous (e.g., the TV/monitor may fall if placed on a desk), 2) preventive measures that can help avoid such situations (e.g., a wall mount for the TV), and 3) details regarding what and how safety goods can be acquired (e.g., a QR code link to an e-commerce site).

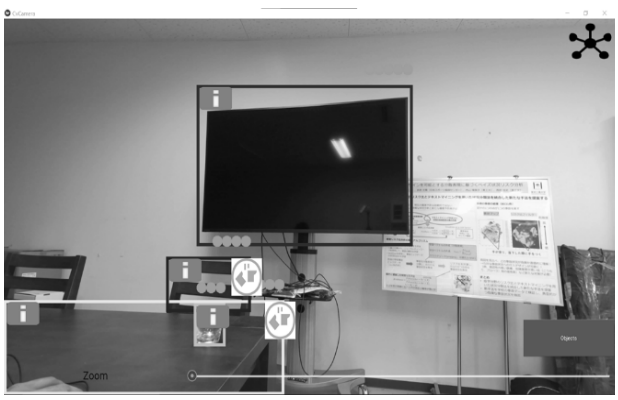

Fig. 5. Example image showing how the system provides information related to a dangerous situation

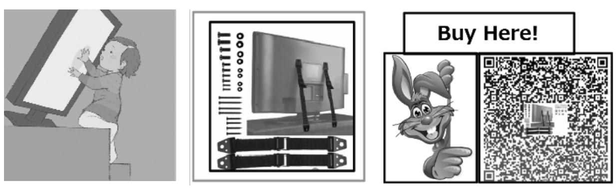

Fig. 6. Example of detailed information, including the type of danger, preventive measures, and how safety goods can be acquired (e.g., a QR code is displayed upon clicking the "i-button")

Our proposed ER system is similarly extended toward its use in a nursery school environment. In contrast to the home-based ER system, additional factors need to be considered in terms of possible dangerous objects in classrooms and the types of classroom layouts that pose more challenges to caregivers.

Fig. 7. Illustration showing dangerous situations associated with sharing a common space at a nursery school

In nursery schools, many children share a common space, such as a table for group activities, and this can cause a dangerous situation leading to a number of typical injuries. For example, as shown in Figure 7, children can get hit in the eye by a piece of paper swung quickly around by a friend, have beads lodged in their ears, or be bitten by a classmate. These risks are quite different from those that occur at home.

For the nursery school-based ER system, we considered the dangerous objects and associated types of injuries prevalent in nursery schools in Japan based on data provided by the Japan Sport Council. As a result, we were able to provide a similar experience to the teachers at the nursery school, as well as illustrations such as those shown in Figure 7.

2.3. Verification of dangerous situation recognition (inclusion and collocation features) using knowledge graphs

In this research, we created knowledge graphs containing the recognition of dangerous objects and their inclusion relationships with dangerous parts (inclusion graphs). The use of inclusion graphs makes it possible to assume that certain dangerous parts may be present in a relatively larger part of the identified object in an image, because such small parts are not actually visible in the image itself. Figure 8 shows the recognition results of a window blind, which is an object that may contain dangerous parts. Blinds that are commonly found in ordinary households may contain cords (within the circle on the bottom left), which can lead to strangulation and suffocation in infants. In this case, the presence of cords is assumed when blinds are detected. Existing image recognition technology depends on the resolution of the image, and low resolution often makes it difficult to recognize small parts. By creating a knowledge graph that can consider the possibility of the existence of small parts that are difficult to recognize using images alone, much more useful information regarding dangerous situations can be provided.

Fig. 8. Example of inclusion knowledge graph, where window blinds are considered a dangerous object that may contain small parts such as cords

We also created knowledge graphs that can help detect dangerous layouts resulting from not only a single object, but also the positional relationships of multiple objects (collocation graph), which is not possible with mere object recognition and detection. Collocation graphs are implemented by defining the positional relationships of the objects, such as “Is-Above”, “Is-Below”, and “Is-Near”. The steps for the estimation of dangerous situations are as follows. First, the system detects the dangerous objects in the input two-dimensional image based on the knowledge graph database. Once recognized, the center point of each object is calculated, after which, the positional relationships of the objects are estimated. Further details are given in the following sections. If the obtained relationship matches the relationship information in the knowledge graph database, it is recognized as a collocation-based dangerous situation. As shown in Figure 9, first, “Sofa” and “Window” are recognized as dangerous objects. Then, their positional relationship is estimated as “Window” “Is-Above” “Sofa”. As this relation matches the information in the knowledge graph database exactly, it is identified as a dangerous situation.

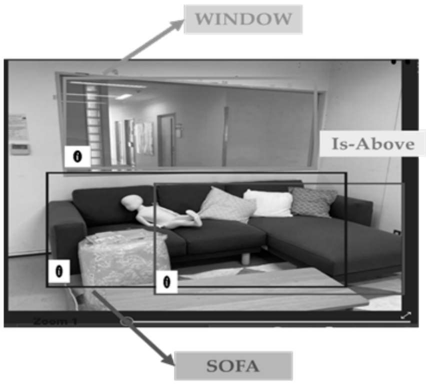

Fig. 9. Example showing how the system can identify a dangerous layout

2.3.1. Calculation of detailed positional relationships

Figure 10 shows a method for calculating the positional relationship between dangerous objects **A** and **B**. When a dangerous object is recognized, the center point **(X1**, **Y1)** and **(X2**, **Y2)** of each object and the height **h** and width **w** of the box surrounding the objects are known. The method for finding the positional relationship of object **B** with respect to object **A** is as follows. First, the position of object **B** is estimated as “above” or “below” object **A** from the Y-component, as shown in Eq. 1.

$$\begin{cases} Y2 < Y1 \;\; \text{Above} \\ Y2 > Y1 \;\; \text{Below} \end{cases} \tag{1}$$

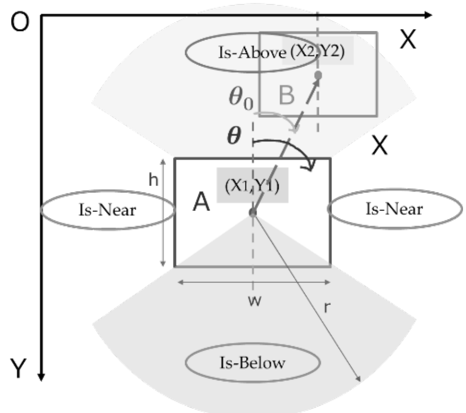

Fig. 10. Specific example of a dangerous situation implemented using knowledge graphs

In Figure 10, the position of object **B** is estimated as being "above" object **A**. Next, we calculate $\boldsymbol{\theta_0}$, which is the angle between the line joining the center of both objects and the vertical line passing through center of object **A** (Eq. 2).

$$\theta_0 = \tan^{-1}\frac{X2-X1}{Y1-Y2} \quad (2)$$

If **Y1=Y2**, the objects are placed side-by-side parallel to the x-axis ($\boldsymbol{\theta_0}$= 90°). In that case, the relation becomes "Is-Near". Otherwise, the range of the "Is-Above" or "Is-Below" region is calculated accordingly, which is determined by $\boldsymbol{\theta}$ (Eq. 3).

$$\theta = \tan^{-1}\frac{w/2}{h/2} \quad (3)$$

Using Eq. 2 and Eq. 3, if $\boldsymbol{\theta_0} \in [-\boldsymbol{\theta}, \boldsymbol{\theta}]$ is satisfied, the relation becomes "Is-Above". If the conditions are not met, the relation becomes "Is-Near". For example, in Figure 9, $\boldsymbol{\theta_0} \in [-\boldsymbol{\theta}, \boldsymbol{\theta}]$ is satisfied, and hence, the positional relationship of dangerous object **B** is considered "Is-Above". Similarly, it is possible to deduce the positional relationship as "Is-Below" if object **B** is placed below object **A**.

2.3.2. Verification of Knowledge Graphs used in the experiment.

We conducted virtual home visits and nursery school visits to verify the working of our ER System. For this experiment, we made knowledge graphs only for those set of dangerous objects which can be detected by the pretrained YOLOv3 image recognition model. As a result, 16 types of individual knowledge graphs were devised before the ER system was tested in the virtual home and nursery school environment. These knowledge graphs are chosen based on the similar situations that have occurred in the past. (We referred to the data provided by Japan Sport Council)

We then manually analyzed the videos recorded during the virtual visits. Out of 16 such situations pre-defined by us, 14 situations have occurred in the virtual visit sessions. Of which, 11 situations have been detected by the ER system. (Please note that here we do not take into consideration of how many times each situation gets detected throughout the recorded session.). This shows that about 88% of the pre-defined situations have occurred when our ER system was experimented for the virtual visits. Out of which, 71% of these situations were identified by the ER system to predict the dangerous situations.

3. Feasibility study of the developed system

We conducted two types of feasibility studies: virtual home visits for parents, and virtual nursery school visits for teachers. The aim of these studies was to evaluate the feasibility and usefulness of the developed ER system. We used snowball sampling to recruit participants for this study. This study was approved by Tokyo Institute of Technology Institutional Review Board (#2020221)

3.1. Methods

The virtual home or nursery school visit proceeded as follows: 1) each participant accessed a provided URL via his or her smartphone, tablet, or PC; 2) the participant listened to a 15-minute lecture on home or nursery school safety; 3) the participant displayed his or her living space, such as the living room or nursery classroom; and 4) the risks detected by the ER system during the virtual visit were discussed. All virtual visits were conducted one-on-one. Both the participant and the lecturer used information provided by the system to discuss what preventive measures could be taken and, in some cases, the reasons for not taking an action. When the participant explained difficulties to the lecturer regarding taking preventive measures, the lecturer suggested possible alternatives that would reduce the risk of injury and help create a safer environment. The online sessions lasted 30–45 minutes depending on each participant's environment. After the virtual visits were completed, the home visit participants were asked to complete an evaluation survey and the nursery school visit participants were asked to remain online to take part in an evaluation interview. The survey questions for parents are listed in Table 1. An open-ended interview was used for the nursery school teachers based on questions 4–7 in Table 1.

3.2. Results

3.2.1. Survey results from parents

In total, 11 parents participated in the virtual home visits. All participants answered "yes" in response to question 1, and examples of specific actions included learning about the most frequent injuries, knowing what to do to prevent injury and change behaviors, using door guards to prevent fingers from being jammed, and rearranging furniture. When asked about the importance of learning about injury prevention for parents and caregivers, all participants responded that it was very important. In response to question 3, four participants indicated a confidence level of 3 or 4, and seven indicated a confidence level of 5 or 6. In relation to question 3, examples of challenges that the participants faced in regard to taking action included the following: the appropriate timing to take action was unclear, they were too busy to locate safety goods, they were unsure which safety standards should be followed, they could not install safety goods because of their home layout, and they did not know which actions should have the highest priority. In response to question 5, 54.5% of the participants said that they had learned about new injury risks. Regarding the usefulness of the proposed ER system, 36.4% indicated level 3 or 4, and 63.7% level 5 or 6 (Fig. 11). When asked about how effective the ER system was in motivating parents to create a safer home environment, all participants indicated level 5 or 6 (Fig. 12).

Table 1. Survey Questions

No.	*Questions with responses given on a six-point scale [1] = Not very important/confident/useful/effective [6] = Highly important/confident/useful/effective
1	Do you think there is anything you can do to prevent serious injury or death? If yes, please specify.
2	How important do parents and caregivers think injury prevention is?*
3	How confident are you in taking preventive actions for injury risks detected by the system?*
4	Please let us know some challenges you face in taking preventive actions (e.g., safety goods are expensive, you do not know which ideas are good, it is bothersome).
5	Were you previously unaware of any of the risks detected by the system?
6	How useful do you think the ER system was for preventing injuries at home?*
7	How effective was the ER system in motivating you to create a safer home environment?*

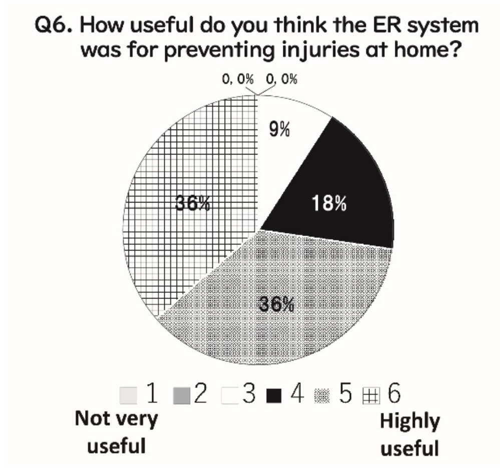

Fig. 11. Responses to question 6

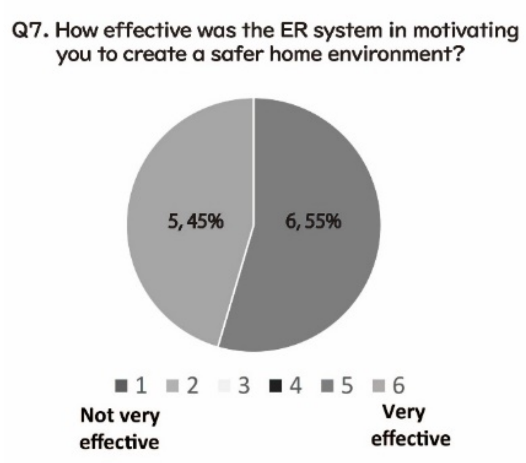

Fig. 12. Responses to question 7

3.2.2. Nursery teachers' interview results

Six teachers from three nursery schools participated in the virtual nursery visits. One person from each school mainly spoke during the interview. We identified the following four themes in terms of the usefulness of the developed ER system:
(1) Share risk information among all school personnel
(2) Reaffirm the responsibility of looking after children
(3) Objectively find possible risks
(4) An adviser is helpful

(1) Share risk information among all school personnel
All participants discussed the importance of sharing information about injury risks. One participant said, "I think that the ER system is useful because it visually tells us the exact location to pay extra attention to in order to protect kids from injury. Showing a tablet screen makes it easy for all staff members to share information. If the online session is recorded, other staff members who did not attend the real-time session can watch it later and learn about the risks".
(2) Reaffirm the responsibility of looking after children
The ER system helped members of the school staff increase their awareness about the importance of injury prevention. Most nursery schools in Japan have prioritized the prevention of severe injuries, and many staff members work on injury prevention on a daily basis. However, one participant mentioned that attending the online session provided a good opportunity to review the safety level of their school environment and inspired her to create a safer school.
(3) Objectively find possible risks
As the ER system indicated injury risks inside the classrooms, teachers from the school could accept the facts easier without any negative feelings. One participant made an interesting comment, saying, "When a government official comes to our school for a safety inspection and points out possible injury risks, I usually feel unpleasant. But when AI (our developed ER system) identifies the risks, I am willing to fix those problems because AI identified risks based on big data, not on subjective judgments." Generally, the more a teacher works on injury prevention, the more he or she tends to become offended or feel uncomfortable when a person directly points out a dangerous place.
(4) An adviser is helpful
The developed system allows dual communication between lecturers and teachers. Therefore, teachers from three nursery schools had an opportunity to ask the lecturer about a highly school-specific question regarding how to improve a particular situation. For instance, one school asked about an interaction between children and a safety gate. Edge guards were placed on the top of the safety gate, but one child chewed on them. Another school asked about finger pinching from a sliding door. They had attempted to use several different safety products, but none worked well. During the online session, the lecturer suggested alternatives by searching for other safety products online. The participants mentioned that they did not know who to ask about such specific concerns and that it was difficult to ask for advice from other schoolteachers verbally because the physical environment at each school is very different. They also pointed out that the discussion with the lecturer was very helpful because she was an expert on injury prevention and examined whether their preventive measures were sufficient, as well as whether there were better ways to prevent injury.

4. Discussion

In this study, we developed an ER system that helps caregivers become empowered in regard to injury prevention. Specifically, this study identified three benefits of applying empowerment models. First, caregivers were able to recognize exact injury risks because the developed system identified dangerous objects and situations based on their own environment. Generalized information is not effective in heightening people's perceptions of injury risks. Second, the developed ER system allows lecturers to discuss injury risks with caregivers and identify possible actions together, which helps caregivers make decisions more easily. Searching for better alternatives that are more suitable for caregivers allows them to engage in research actively. Third, the developed system promoted dialogue about injury risk and prevention between caregivers and lecturers. On one hand, caregivers had the opportunity to reflect on behaviors that put their child at risk of injury, learn about available preventive measures, and reaffirm their responsibility to protect children from injury. On the other hand, lecturers were empowered by understanding the problems faced by the caregivers. Knowing the caregivers' various reasons for not taking preventive actions could help lecturers understand how to improve their education provision.

The developed ER system should not only identify injury risks and instruct caregivers about what to do, but also accept caregivers' beliefs and lifestyles through discussions. It is crucial to devise a process that builds relationships of trust between caregivers and lecturers through sharing information and exploring possible solutions together. The ER system developed in the present study can be more empowering by adding new functions based on comments from caregivers. In fact, we implemented the 1–5 dot scale as a prioritization indicator based on advice from a collaborator who has a child.

The survey results indicated an increase in the level of parents' motivation to take actions after using the ER system. The ER function that provides a QR code to caregivers could have contributed to these results because saving time is an important factor that reduces psychological and physical barriers to taking preventive actions. In addition, the ER system clearly indicated where to pay attention at home or in nursery schools, and the lecturer tailored information specifically for each participant. This type of hybrid support could lead to changes in behavior by promoting perceived susceptibility and injury severity among caregivers. In fact, some parents took the actions recommended by the ER system during the virtual home visits. From the perspective of lecturers, the ER system is a useful tool for remembering how to educate caregivers because it is sometimes difficult to notice injury risks that are very different from home to home or between nursery schools, even for professional educators.

Increasing the number of lecturers for virtual home and nursery school visits is an important key factor in scaling up the usage of our proposed ER System. To achieve this, we provide 4-day training program on injury prevention once a year to nurture the lecturers. In addition, we collaborate with *Shinnosuke Memorial Foundation*, which offers certificate programs to individuals who want to learn childhood injury prevention. We expect that these program participants would be lecturers for the ER system in the future. In terms of application fields, our proposed in-situ support system, including defining dangerous situations by knowledge graphs can be applied for various fields such as school safety, occupational safety, and safety for seniors. Cost to implement new technologies is often a huge barrier, but our proposed system requires end-users to have PCs, tablets, or smart phones and an online communication app, which now many people already have. Although this study is an ongoing project, our ER system has shown great potential for empowering parents, nursery school teachers, and lecturers.

5. Conclusion

In this study, we focused on empowering caregivers to prevent childhood injuries. We proposed and developed a new online education system that takes AR one step further. The results of this study suggest that our developed ER system allows caregivers to participate in injury prevention research, become more involved in decision-making, and gain critical awareness about the importance of injury prevention, all of which are essential aspects of empowerment. In many middle- and high-income countries, including the United States, Western Europe, China, and Japan, digitalization is being rapidly promoted in health education. Our newly developed ER system provides an unprecedented opportunity for researchers, practitioners, educators, and caregivers to become empowered and make headway in the field of injury prevention education. The same system could be applied to various fields of health education, such as safety education for children and people with disabilities. Human–AI hybrids are critical in the present digital era. In fact, sensors and other technological devices have already been introduced for children's safety[19].

In closing, we believe that improving our ER system could help meet the United Nation's Sustainable Development Goals (SDGs) by enabling caregivers to access education (SGD 4), reduce social inequalities (SDG 10), promote healthy lives (SDG 3), and create strong ties between researchers and community members (SDG 17).

Acknowledgments

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