


Brief Communication

Development of virtual reality content for learning Japan Prehospital Trauma Evaluation and Care initial assessment procedures

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Aim: The Japan Prehospital Trauma Evaluation and Care (JPTEC) is a standardized educational program for prehospital trauma care in Japan. The initial assessment in the JPTEC course comprises a training segment that includes a 30-min session. Given the limited face-to-face training due to the coronavirus disease 2019, virtual reality (VR) content has become an alternative. However, creating VR content typically requires the assistance of expert technicians. We aimed to create VR content for the initial assessment segment of the JPTEC and verify its educational effectiveness.

Methods: We created VR content for learning the initial assessment of the JPTEC using our easy-to-use VR content creation system. The participants played the VR content for 15 min. The number of times they “cleared” (i.e., made a correct decision and completed the initial assessment) was recorded every 5 min. Then, a JPTEC-certified instructor tested their practical skills through face-to-face simulation.

Results: The authors had no specialized skills and created the VR content in 2 days. Fourteen students used the material. They cleared the scenario 3 (3–4) times in the first 5 min in 15 min, 5 (4–5) times in the second 5 min, and 5 (5–5) times in the third 5 min ($P < 0.05$). All participants passed the practical evaluation.

Conclusion: A shorter VR training developed using our easy-to-use VR content creation system can replace the 30-min JPTEC session on the initial assessment. This system allows for the free and easy creation of VR content.

Key words: Content creation, initial assessment, JPTEC, prehospital trauma care, virtual reality content

INTRODUCTION

THE JAPAN PREHOSPITAL Trauma Evaluation and Care (JPTEC) is a standardized educational program for prehospital trauma care in Japan. The initial assessment, which is the core of JPTEC, includes a 15-s evaluation and care of the airway, breathing, circulation, and consciousness in various situations, including the supine and prone positions.¹ In face-to-face training programs, one or more

instructors are assigned to each of the four trainees, and trainees often take turns leading the initial assessment, usually two to give times in approximately 30 min.² Due to coronavirus disease 2019 (COVID-19), various face-to-face training sessions have been restricted,^{3–5} and the JPTEC courses are no exception.

Virtual reality (VR) is an attractive method for remotely conducting courses.^{6–8} Although acquiring hands-on skills, for example, palpation of patients or use of emergency equipment, solely with VR use is currently difficult,^{9–11} attempts have been made to teach standardized procedures efficiently.^{12,13} Virtual reality can be adapted to provide the initial assessment training of the JPTEC. However, the creation of VR content usually requires the assistance of expert technicians, which can be a hindrance.

This study aimed to create VR content to learn the initial assessment segment of the JPTEC using our easy-to-use VR

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content creation system and verify its educational effectiveness.

METHODS

IN THIS OBSERVATIONAL study, we created VR content to teach the initial assessment segment of the JPTEC using 360-degree video as the source material. The content was played by wearing IDEALENS K4 (Idealens Technology Co., Ltd., Chengdu, Sichuan, China), a head-mounted display type VR device. In scenarios where the patient's body position, level of consciousness, and respiratory status appear randomly, the learner decides by clicking on the choice buttons as in a video game. The scenarios covered variations of the standard situations used in the JPTEC courses. When the users make a mistake or do not make a selection within the allowed time, they are asked to repeat the process. If they proceed without making a mistake, they can “clear” the initial assessment in approximately 30 s (Fig. 1). The content was created in the following order: scenario creation, video recording using GoPro MAX (GoPro Inc., San Mateo, CA, USA), video editing using Adobe Premiere (Adobe Inc., San Jose, CA, USA), creation of images of choice buttons, and VR content creation using our easy-

to-use VR content creation system (a modified CREEK & RIVER scenario branching system; CREEK & RIVER Co., Ltd., Tokyo, Japan). Content creation involved placing cut-out video material and choice images drawn with paint software on a spreadsheet (Fig. 2). With no special skills in VR content creation, the authors arbitrarily created the VR course using the content creation system, demonstrating its ease of use.

We invited paramedical and medical students to participate in the study and excluded those who had already taken the JPTEC course. After a 15-min classroom lecture on the initial assessment based on the JPTEC course content, the participants played the VR content for 15 min. The number of clears (making the correct decision and completing the initial assessment) was recorded every 5 min. After VR learning, a JPTEC-certified instructor evaluated the participants' practical skills in a face-to-face simulation using a practical skills evaluation chart.² The primary end-point was the number of clears.

The differences between groups were tested using the Friedman test and Bonferroni correction. Probability value of less than 0.05 was accepted as significant in the Friedman test, but probability values of less than 0.0167 by the Bonferroni correction regarding a comparison between two of



Fig. 1. Virtual reality content for learning Japan Prehospital Trauma Evaluation and Care initial assessment procedures. (A) A 360-degree video shows an injured person and an emergency medical service team member. The learner makes decisions as a team leader using the buttons. The buttons on the left, from top to bottom, are for calling response, pain stimulus, airway and respiratory assessment, skin and pulse assessment, bleeding assessment, and quitting the session. The buttons on the right, from top to bottom, are for changing position, oxygen administration, bag valve mask ventilation, compression hemostasis, cardiopulmonary resuscitation, and complete initial assessment. (B) Indications when a wrong selection is made. The incorrect selection is displayed in red letters on a yellow background. Two options are displayed in white letters on a blue background: “Try it again” and “Quit session.” (C) Indications when the initial selection is correct. The word “Clear” is displayed in blue letters on a yellow background. Two options are displayed in white letters on a blue background: “Try another scenario” and “Quit session.” If the first option is chosen, another scenario randomly appears.

Line No	movie file name	Type	choice	choice①	image	choice②	image	choice③	image	choice④	image
1	opening.mp4	Random	2	2		41					
2	supine.mp4	FollowE	12	5	response.png	2	pain.png	2	breathing.png		
3	DAMMY.mp4	A	2	1	wrong.PNG	2	UNDO.png	1	quit.png		
4	DAMMY.mp4	A	4	1	timeup.png	2	UNDO.png	1	quit.png		
5	DAMMY.mp4	Random	2	6		9					
6	aleart.mp4	FollowE	12	6	response.png	7	itami.png	14	breathing.png		
7	DAMMY.mp4	A	4	1	wrong.PNG	1	zero.png	6	UNDO.png		
8	DAMMY.mp4	A	4	1	timeup.png	1	zero.png	6	UNDO.png		
9	unconscious.mp4	FollowE	12	9	response.png	40	pain.png	10	breathing.png		
10	weak breathing.mp4	FollowE	12	12	response.png	12	pain.png	10	breathing.png		
11	bvm .mp4	A	4	1	clear.png	1	zero.png	1	another.png		
12	DAMMY.mp4	A	4	1	wrong.PNG	1	zero.png	9	UNDO.png		
13	DAMMY.mp4	A	4	1	timeup.png	1	zero.png	9	UNDO.png		
14	breathing.mp4	FollowE	12	14	response.png	14	pain.png	14	breathing.png		
15	DAMMY.mp4	A	4	1	wrong.PNG	1	zero.png	14	UNDO.png		
16	DAMMY.mp4	A	4	1	timeup.png	1	zero.png	14	UNDO.png		

Fig. 2. Content creation spreadsheet for development of virtual reality content for learning Japan Prehospital Trauma Evaluation and Care initial assessment procedures. Each row is assigned the following: line number (Line No.), video to be played, the choice to be displayed, and the transition destination for each choice. The Line No. is in column A. The name of the video file to be played is shown in column B. Display pattern of choice is set in column C; there are several patterns and “RANDOM,” when the next transition proceeds at random. Column E is the number of choices, with 2 to 12 available. Column G is the Line No. to which the transition to the first choice is selected. Column H is the image corresponding to the first choice. Thereafter, the cells are filled in the same way for the 2nd through 12th choices.

the three groups were accepted as significant. Statistical analyses were undertaken using the statistical software EZR (version 1.55; Saitama Medical Center, Saitama, Japan), based on R and R Commander.¹⁴

RESULTS

TWO INSTRUCTORS CREATED the VR content. It took 1 h to create the scenario, 3 h to shoot the video, 3 h to edit the movies and create the images of choice buttons, and 4 h to create the content.

Five medical and nine paramedical students used the VR content as learners. They “cleared” the scenario 13 times (median) in 15 min. To further assess how rapidly the participants cleared the scenario, we divided the 15 min into three intervals (i.e., first, second, and third intervals) of 5 min each. The median number of times the learners cleared the scenario was 3 (3–4) (1st to 3rd quartiles) in the first 5 min, 5 (4–5) in the second 5 min, and 5 (5–5) in the third 5 min (Fig. 3). The results of the Friedman test in the three groups were $P < 0.001$. The results of multiple comparisons in the Bonferroni correction were: $P = 0.0125$ between the first 5 min and the second 5 min, 0.0915 between the second 5 min and the third 5 min, and $P = 0.0045$ between the first

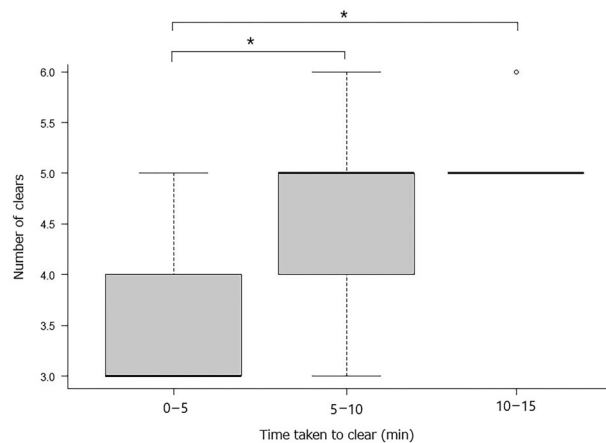


Fig. 3. Number of “clears” (i.e., record a correct decision and complete the initial assessment) per 5-min interval during virtual reality (VR) training for Japan Prehospital Trauma Evaluation and Care initial assessment procedures. The study participants viewed the VR content for 15 min. Shown is the number of “clears” achieved in the first, second, and third 5-min intervals. The black line indicates the median, and the gray box shows the 25th–75th percentile range. The minimum and maximum values are indicated by lines and white circles, respectively. *Significant difference between two groups.

5 min and the third 5 min. The increase in clearance rate with time up to 10 min was statistically significant. All participants passed the practical skills evaluation.

DISCUSSION

WE COULD EASILY create educational material to teach the initial assessment segment of the JPTEC using our VR content creation system. Through repeated learning of our VR content 13 times in 15 min, the learners gradually completed the scenarios without making mistakes, and the individual differences observed in the first semester were reduced in the second semester, with all learners acquiring JPTEC-passing level skills. Training with VR content allowed for a greater number of scenario exercises in a shorter amount of time than the face-to-face JPTEC course and facilitated the acquisition of competency in initial assessment procedures.

Consistent with previous studies,^{15–17} our study found that the immersive experience with the VR content increases independence and concentration, enhancing the effectiveness of experiential learning. However, creating VR content is time-consuming and usually requires the assistance of specialized technicians. To provide adequate education, new or modified learning materials should be constantly created for different situations and target students, and reliance on specialists hinders this process. Especially during the COVID-19 pandemic, when remote training is often required, it is important to establish a system that allows the free and easy creation of VR teaching materials. We believe that our system is one way to address this challenge, as it enables the creation of VR educational materials without special knowledge of image processing or programming, but with enough knowledge to use a computer to cut videos and use spreadsheets and the Paint application.

STUDY LIMITATION

VOLUNTEERS WERE A convenience sample consisting of students who agreed to participate and did not reflect the entire JPTEC attendance population. The instructor who evaluated the participant's practical skills knew that the participant was a learner using VR materials, which might have influenced the evaluation. The statistical tests in this study cannot rule out the possibility of type 2 errors due to the small sample size.

CONCLUSIONS

THIS STUDY SUGGESTS that training for the initial assessment, which takes approximately 30 min with

the usual JPTEC course, could be replaced by a shorter training using the VR content created by our easy-to-use VR content creation system. We have determined the effectiveness of this system that allows users to freely and easily create the desired VR content.

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DISCLOSURE

APPROVAL OF THE research protocol with approval no. and committee name: The study protocol was approved by the Institutional Ethics Committee of the National Defense Medical College (approval no. 4488) and conforms to the provisions of the Declaration of Helsinki.

Informed consent: Informed consent was obtained from all the study participants.

Registry and registration no. of the study/trial: N/A.

Animal studies: N/A.

Conflict of interest: None.

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