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Online clinical skills education using a wearable action camera for medical students

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The purpose of this study is to analyze medical students' satisfaction and educational effectiveness after real-time online clinical skills education using a wearable action camera. One hundred eighteen third-year medical students participated in this study. The education program consisted of clinical skills (wound management and vascular access procedures) and a medical interview with a simulated patient. The author wore the head-mounted action camera throughout the class. A systematic questionnaire survey was issued to the students after the education program to analyze the educational satisfaction and effectiveness. This education program showed their high educational satisfaction. The online environment was also mostly positive except for some negative comments about video quality. In the educational satisfaction, though the comparative satisfaction with the face-to-face skill class was slightly lower, the rest of the questionnaire items also showed high relative satisfaction. Online video education using a wearable camera could be a good modality that can replace a face-to-face class when it is impossible to open the class.

Keywords: Online education, Clinical skill, Medical student, Satisfaction, Effectiveness

INTRODUCTION

The coronavirus disease 2019 (COVID-19) pandemic has led to dramatic changes in the means or methods of education. An educational paradigm shift from traditional lectures to an online class has occurred worldwide. Most medical schools also have been fostering alternative education strategies (Bellini et al., 2021). Although the situation of the COVID-19 pandemic has improved worldwide, non-face-to-face e-learning systems are still being used. Fortunately, because e-learning content such as MOOC or YouTube clips had been applied to clinical education before the pandemic, medical teachers tried to utilize them instead of adhering to their traditional lectures (Curran et al., 2020; Lunde et al., 2018). Video-based e-learning has been as effective as typical learning in teaching practical clinical skills (Buch et al., 2014). Nevertheless, the clinical education that requires experiments, clinical practices or clinical skills could not be completely replaced by online e-learning, and this is because of its weaknesses that learners cannot directly perform the skills and receive feedback on them.

The author has already implemented online clinical skills education using a smartphone for medical students as an alternative educational method (Bang and Kwon, 2022). The teacher filmed a video of specific clinical skills with the smartphone and broadcast in real time through Zoom (Zoom Video Communications, Inc., San Jose, CA, USA). This smartphone-based education has some benefits. There was no need to purchase additional equipment and no difficulty of video filming and broadcasting. Students also responded positively to the questionnaire about the effectiveness on the clinical skills training in this study. However, this education also had some operational difficulties. Because of this, the author tried a new method using a wearable filming device instead of a smartphone and finally decided to apply a head-mounted action camera among various devices (Wintraub et al., 2020). Filming with a head-mounted action camera has the advantage of being able to obtain images in high definition and of point-of-view (POV). Because the learners observed the video of POV, they

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were able to feel a greater sense of vividness when the teacher was performing skill techniques. This has already been used not only in clinical education but also in various fields, such as interviews (Bräutigam et al., 2021; Lee et al., 2017; Maamari et al., 2015; Matsumoto et al., 2013; Muensterer et al., 2014; Ortensi et al., 2017; Skinner and Gormley, 2016).

There have been studies on POV filming using an action camera so far, but few studies have explored the educational effectiveness of the clinical skills and medical interview education for medical students. The purpose of this study is to analyze medical students' satisfaction and educational effectiveness after real-time online skills clinical education using a wearable action camera.

MATERIALS AND METHODS

Education program

Before the class, flipped learning was conducted by announcing prelearning materials (video clips) about the clinical skills and medical interview to the students. The clinical skills consisted of wound management procedures (wound dressing, local anesthesia, and suture technique) and vascular access procedures (arterial blood gas analysis, venipuncture, and blood transfusion technique). The medical interview consisted of history taking from a simulated patient and physical examination. The education runtime was 4 hr totally (2 hr of clinical skills education and medical interview, respectively). One hundred eighteen third-year medical students participated in this program. The teacher who has the experience of many years of clinical skills training and an assistant involved in this program. The action camera used in this program was GoPro 10 (GoPro, San Jose, CA, USA), and the teacher wore the action camera on his head throughout the class. The action camera was connected to a laptop computer by cable. POV skills and medical interview scenes were transmitted in real time through the Zoom online platform.

Table 1. The items of the systematic questionnaire survey

Online educational environment	Network access
	Smoothness of listening to a lecture (disconnection or buffering)
	Video quality (sharpness)
	Action camera working
Satisfaction with education program	Satisfaction of prelearning materials
	Adequacy of education running time
	Difficulty level of education program
	Adequacy of teacher's attitude
	Comparative satisfaction with self-directed learning with video clips
	Comparative satisfaction with face-to-face procedural learning during clerkship
Educational effectiveness	Usefulness of acquiring clinical skills
	Comparative effectiveness of self-directed learning with video clips
	Usefulness of preparing for National Medical Licensing Examination
	Comparative effectiveness of face-to-face procedural learning
	Predictive educational effectiveness compared to face-to-face procedural learning after coronavirus disease 2019

Data analysis

To analyze the online educational environment, satisfaction, and educational effectiveness, a systematic questionnaire survey was issued to the students after the education program. The survey was developed from the questionnaire used in the previous study (Bang and Kwon, 2022). The survey was completed between July 2022 and August 2022, and all participants were voluntarily surveyed. The answers were recorded on the 5-point Likert scale (from 1 = very unsatisfied to 5 = very satisfied) and the questions were open-ended. The four categories are shown in Table 1.

Seventy nine students (response rate of 66.9%, male:female = 51:28) completed the questionnaire. The Cronbach alpha of the questionnaire was measured as 0.872. The score differences between the grades were analyzed using Student *t*-test. The analysis was conducted with IBM SPSS ver. 26.0 (IBM Corp., Armonk, USA) software, and its statistical significance was set at $P < 0.05$.

RESULTS

Online educational environment

Students answered that they accessed the network very easily (4.84 ± 0.436), had little problems while listening to this program (4.52 ± 0.714), and satisfied with the working action camera (4.59 ± 0.543). The answers about video quality (4.28 ± 0.800) showed relatively lower satisfaction than others. There was no statistical significance between gender groups (Table 2).

Table 2. Analysis of survey about online educational environment by gender

Variable	Male (N = 51)	Female (N = 28)	Total (N = 79)	*P*-value†
Network access	4.84 ± 0.42	4.82 ± 0.48	4.84 ± 0.44	0.651
Smoothness of listening to a lecture	4.45 ± 0.76	4.64 ± 0.62	4.52 ± 0.71	0.220
Video quality (sharpness)	4.19 ± 0.85	4.42 ± 0.69	4.28 ± 0.80	0.220
Action camera working	4.56 ± 0.57	4.64 ± 0.49	4.59 ± 0.54	0.164

Values are presented as mean ± standard deviation.
†Student *t*-test.

Table 3. Analysis of survey about satisfaction with education program by gender

Variable	Male (N=51)	Female (N=28)	Total (N=79)	*P*-value†
Satisfaction of prelearning materials	4.12±0.91	4.57±0.57	4.28±0.83	0.136
Adequacy of education running time	4.47±0.64	4.68±0.67	4.54±0.66	0.223
Difficulty level of education program	4.73±0.49	4.86±0.35	4.77±0.45	0.110
Adequacy of teacher's attitude	4.92±0.27	4.89±0.32	4.91±0.29	0.401
Comparative satisfaction with self-directed learning with video clips	4.76±0.59	4.86±0.36	4.80±0.52	0.116
Comparative satisfaction with face-to-face procedural learning during clerkship	4.00±1.06	4.18±0.98	4.06±0.10	0.988

Values are presented as mean±standard deviation.
†Student *t*-test.

Table 4. Analysis of survey about educational effectiveness by gender

Variable	Male (N=51)	Female (N=28)	Total (N=79)	*P*-value†
Usefulness of acquiring clinical skills	4.59±0.67	4.68±0.55	4.62±0.63	0.272
Comparative effectiveness of self-directed learning with video clips	4.61±0.60	4.64±0.56	4.62±0.58	0.746
Usefulness of preparing for Korean Medical Licensing Examination	4.69±0.55	4.68±0.55	4.68±0.54	0.954
Comparative effectiveness of face-to-face procedural learning	4.14±0.10	4.32±0.86	4.20±0.95	0.498
Predictive educational effectiveness compared to face-to-face procedural learning after COVID-19	3.76±1.19	3.86±1.11	3.80±1.16	0.954

Values are presented as mean±standard deviation.
COVID-19, coronavirus disease 2019.
†Student *t*-test.

Satisfaction with the education program

Most students answered positively to satisfaction of the prelearning materials (4.28±0.831), adequacy of the education running time (4.54±0.656), difficulty level of the education program (4.77±0.451), adequacy of the teacher's attitude (4.91±0.286), and comparative satisfaction with self-directed learning with the videoclips (4.80±0.516). However, the scale of the answer about the comparative satisfaction with face-to-face procedural learning during clerkship (4.06±0.103) was relatively lower than the other questions. There was no statistical significance between the gender groups (Table 3).

Educational effectiveness

Responses to the educational effectiveness regarding as usefulness of acquiring the clinical skills (4.62±0.626), comparative effectiveness of the self-directed learning the with video clips (4.62±0.584), usefulness for preparing for the National Medical Licensing Examination (4.68±0.544), and comparative effectiveness of the face-to-face procedural learning (4.20±0.952) were also positive. However, responses to predictive educational effectiveness (3.80±1.159) were not relatively positive compared to those to the face-to-face procedural learning after the COVID-19. There was also no statistical significance between the gender groups (Table 4).

Students' comments for the education program

Many students commented on several advantages of this education program. Not a few of students mentioned that he was able to feel vividness and interactivity during the medical interview because of the POV filming. Some of students were satisfied that they could follow the teacher's hand movements in real time while watching the clinical skills demonstration. However, there were some negative comments. Some of the students still demanded video quality improvement of the action camera, and some students felt dizzy when the teacher moved his head quickly.

DISCUSSION

The current COVID-19 situation has improved gradually compared to the beginning of its outbreak. The ways of teaching and learning have been switching to the typical face-to-face learning in many educational institutions. However, it will be necessary to prepare alternative educational strategies against the possibility of another outbreak. The continuation of the non-face-to-face situation can easily lead to lack of clinical skills education, which results in deterioration of healthcare providers' performance skills. Online e-learning maybe a great method for clinical skills training (Jang and Kim, 2014). To overcome the shortcomings of the non-face-to-face clinical skills education, medical educators made efforts through classes using a variety of video clips.

Compared to the class using video clips, the real time online class that provides skill demonstration by a teacher will be more helpful to students. The author has already conducted alternative education using a smartphone. However, smartphone-based education required someone who understood clinical skills well and had to take charge of filming. When the person filming a video

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did not have a good understanding of the skills, satisfaction with the class and its degree of completion might be considerably lowered. The teacher had difficulty demonstrating the skills because he was already using his one hand for filming with a smartphone. The students also pointed out the defect that it was difficult to observe detailed techniques with smartphone-based video.

The author decided to apply a wearable action camera. If the teacher performs the skills while wearing a camera, there is no hindrance in his performing them and medical interview because both hands are free (Bizzotto et al., 2014). In addition, vivid POV video filming by the teacher can be more helpful in improving the learners' clinical performance (Thomson et al., 2018). This education program showed high educational satisfaction of the medical students. Online environment was also mostly positive except for some negative comments about the video quality. In educational satisfaction, though the comparative satisfaction with the face-to-face skill class was slightly lower, the rest of the items also showed high relative satisfaction. Students answered that it was also helpful in acquiring the clinical skills in terms of the educational effectiveness.

However, this method also had some limitations. Satisfaction with the method, which is an alternative to the face-to-face skills education, was relatively low. The students pointed out a distinct disadvantage of not being able to practice on their own. There were also some technical difficulties. Smartphones have their own wireless communication devices, and there is, therefore, no need of direct connection to a computer. However, the action camera had to be connected to a computer by cable because it did not have a connecting device. This cable limited the teacher's movement during his skills demonstration.

In summary, online video education using a wearable camera could be a good modality that can replace a face-to-face class when it is impossible to open the class. Although online education cannot completely replace face-to-face education because students cannot perform the skills directly, it can be expected that it plays a significant role in education in a situation where the face-to-face education is impossible, pretraining before practice, and wrap-up in education after practice. A comparative analysis of education where various wearable devices are used will be needed in the future.

CONFLICT OF INTEREST

No potential conflict of interest relevant to this article was reported.

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